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GUIDE FOR SAFE SPEEDS

Managing Traffic Speeds to Save Lives and Improve Livability

GRSF Global Road Safety Facility

Bloomberg Philanthropies | Initiative for Global Road Safety

UKaid from the British people

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Preface

Around 1.19 million people die each year on the world's roads, and another 20 million to 50 million are seriously injured. Half of these deaths and many of the injuries involve pedestrians, bicyclists and motorcyclists – the most vulnerable road users. Those who are in motorized vehicles are also at risk, especially on the fastest of our roads. In this context, speed is one of the main risk factors and is universally recognized as the leading contributor to road fatalities and serious injuries.

But there is good news. The speed problem is solvable. Interventions that are proven to be effective exist and it is well understood where and how to apply these solutions. This guide presents solid evidence to make informed decisions and shows how barriers to changing traffic speeds, which are often based on lack of knowledge or misunderstandings, can be overcome.

Effective speed management has many road safety benefits. But lower speeds also help to reduce air and noise pollution as well as fuel consumption, and in many cases, alleviate congestion in urban areas. They improve the quality of the environment for pedestrians and cyclists, contributing to the creation of livable communities and help to reduce noncommunicable diseases because of increased physical activity and pollution reduction.

While our transport and traffic systems have unfortunately been designed to prioritize vehicle movement, this guide presents the tools to shift towards systems that protect all road users. It provides information on the impact of speed reduction and how to set and support safe speed limits. It considers varying global contexts and nuances, especially in low- and middle-income countries. The information presented is consistent and easy to implement, while offering alternatives where there are gaps in resources, such as data collection, or legal and organizational frameworks. Real-life examples help build the case for safe speeds and gain political and community support.

We recommend this guide to all practitioners and decision makers who want to make substantial improvements in road safety and the general well-being of their communities.

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Executive summary

Speed is the most critical risk factor in road crashes. It can determine both whether they happen and how severe they are, since speed affects energy levels and impact forces. Even small increases in speed can significantly heighten road crash risk. Current speed limits used around the world are often higher than the recommended safe speeds. In addition, compliance with these limits is often low, which heightens risks. Many decision makers tasked with setting speed limits feel the need to balance priorities like safety and travel times. In reality, the benefits of faster traffic speeds have been overstated. They barely reduce travel times and come at a high cost. They damage public health and wellbeing, increase emissions and noise, and make communities less livable.

Public policy and popular perceptions are often out of step with this reality. People tend to blame crashes on poor driving rather than excessive speed, underestimating the role speed plays in the risk and severity of crashes. They erroneously assume that lower speed limits will add to congestion. In general, the opposite is true. Recurring congestion, during rush hour, for instance, occurs when vehicles are likely already traveling well below the posted speed limit. Lower speed limits can even thin congestion by preventing crashes. Research has shown that driving at a speed appropriate for the road and surrounding conditions will likely only minimally increase travel time.

There is some lack of understanding about what works and what does not in terms of managing speed. For example, many mistakenly assume that a speed limit sign alone will convince people to drive at or below the posted speed. Most of the time it will not. People are often unaware of the significant benefits that supporting measures provide when managing speeds. These include road design and engineering interventions, such as raised pedestrian platforms, speed humps or rumble strips, and enforcement such as the use of speed cameras.

The benefits that could flow from reducing speed-related crashes are enormous. Preventing serious injuries and fatalities from speed-related crashes can boost national income over the long term. Countries can increase productivity, enhance the well-being of their population, and build human capital by reducing road traffic injuries and maximizing healthy years of life. Lower speeds can lower costs incurred from transport system disruptions, emergency responses, and caring for people who are injured.

Some policymakers believe their hands are tied because the public wants faster speeds. In fact, the benefits of safer speeds have garnered growing attention in communities worldwide; many now promote lower speeds. This guide provides a series of examples and supporting research to dispel the myths that surround speed management.

Effectively managing traffic speeds is one of the most complex road safety challenges. To meet it, countries need to have key institutional and organizational arrangements in place, and to adopt and fund a systematic, evidence-based approach to speed management. To sustain speed management efforts and interventions, countries should develop a speed management strategy that aligns management activities across key institutions and organizations. A strategy also helps ensure robust and consistent speed limit setting and prioritizes changes with the greatest road safety impact. This guide can help governments at all levels develop speed management strategies that work.

Based on the latest research in this field, and international good practice, this guide presents a new, practical, evidence-based approach for selecting safe speed limits on all types of urban and rural roads: the Roads-for-Life framework. It can be used not only to determine safe speeds for existing roads, but also to assess the safety impact of design speeds for new road projects. It can ensure speed limits are safe for all road users, and that the necessary infrastructure is in place to support these safe speed limits.

The Roads-for-Life framework complements traditional hierarchic road classification systems by addressing their major flaws. Most functional road classification systems focus on motorized traffic flow without considering other road users, or the land or communities roads pass through. Often, roads traditionally classified as arterial roads, or highways, with corresponding speed limits of 80 to 100 kph, cut through villages full of pedestrians, cyclists and children going to school or playing by the roadside. In such cases, the function of the road and the corresponding speed limit should be adjusted to match the actual road use and context.

In addition, in many countries, speed limit setting is still based on the "85th percentile" method. It determines the "desired" speeds of motorized traffic and sets a speed limit that 85 percent of drivers are expected to comply with. This method neglects the fact that the travel speeds most drivers select are not safe in any absolute sense – and even less safe for vulnerable road users (VRUs). Drivers do not consider all the relevant costs and benefits of the speeds they choose to travel. This method should be abandoned in the face of strong evidence that setting and enforcing speed limits below the 85th percentile speed is feasible, sustainable, and safer.

The Roads-for-Life framework determines speed limits and road classifications according to actual needs and vulnerabilities of all road users, including pedestrians and cyclists. It views roads as places for human presence and activity. It also reflects the growing expert consensus that roads should prioritize not just motorized transport, but the safety and mobility of pedestrians and cyclists and especially the most vulnerable people like children, the elderly, and persons with disabilities. This framework is based on the principle that speed management needs to reflect how roads are actually being used, not in theory, but in practice. It acknowledges that roads can be destinations in their own right, places where people gather and shop in markets and where children play, and that a road can morph from deserted highway to busy suburban thoroughfare, and back again, several times along its length.

Rather than accepting speed-related crashes as inevitable, and responding incrementally, it proactively and systemically targets and treats speed-related risks. It builds on the Safe System approach, a human-centric approach to road transport which acknowledges that, while human error is unavoidable, road deaths and serious injuries are both avoidable and unacceptable. It stresses that this imperative should dictate the design, use, and operation of the road network to provide safe transport for all road users.

Building on this framework, the guide proposes key tools such as speed management strategies and action plans. It provides a step-by-step approach to developing, implementing, and monitoring speed management at a national, regional, local or city level. It also offers solutions for specific locations, such as busy arterial roads with mixed traffic that includes VRUs. Tailored to meet local needs, it describes effective policies, interventions, processes, and enabling conditions for supporting safe speed limits. These include sustainable land use planning, well-designed road infrastructure, policing and deterrence, education and communication as well as vehicle technology. Speed limit changes show better results if supported by these interventions.

This guide considers varying global contexts and nuances, especially in low- and middle-income countries (LMICs) where speed-related road safety problems are most prevalent. It aims to provide clear guidance that is consistent and easy to implement, while offering alternatives where there are gaps in resources such as data collection or legal and organizational arrangements. It presents evidence-based interventions and real-life examples to help build the case for safe speeds and gain political buy-in as well as community support.

It can also help countries meet the Paris Climate Agreement's objective of limiting global warming. Well-implemented speed management can reduce emissions from fossil fuel burning vehicles and encourage emission-free alternatives such as walking and cycling.

This guide targets:

- Decision makers and practitioners working in the fields of road safety, road infrastructure management, mobility and urban design
- Government agencies, road authorities, and non-governmental organizations supporting speed management initiatives, especially in LMICs

It can aid them and others striving to:

- Develop successful speed management strategies
- Build support by providing solid evidence to rebut common myths about speed
- Change general speed limits at national, regional, or city levels
- Assess a road network or corridor, define different areas along it, and assign safe speed limits for each section
- Review new developments, zoning, or other changes to identify the safe speed limits
- Evaluate speeds at "hot spots" with the highest risk of crashes, injuries, and fatalities
- Select effective interventions or changes in road infrastructure, policing and deterrence, education and communication, as well as vehicle technology, that can lower speeds
- Assess infrastructure provisions to make higher speed travel safer

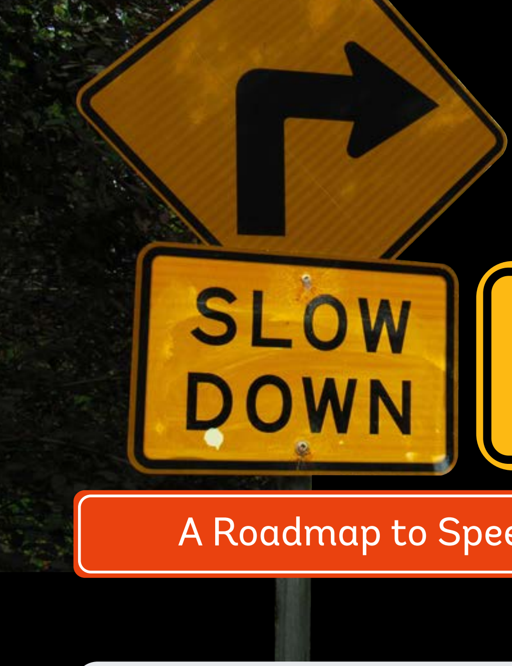
It introduces innovations and insights on:

- Setting speed limits based on actual road use rather than on stereotypes about road function or hierarchy
- Evaluating broader benefits of speed management for reducing carbon emissions as well as air and noise pollution, enhancing social inclusion, and facilitating active transport
- Providing an equitable approach to setting speed limits that recognizes the needs of the most vulnerable groups such as elderly, children, and people with disabilities

It covers:

- All types of roads, from cities to inter-urban roads and motorways, existing or new
- All types of speed limit changes – from national general speed limits, to localized changes based on risk
- Ways to set speed limits in challenging environments (for example, where resources, guidance or data on existing conditions are limited)

Roads need to provide mobility and safety for VRUs as well as moving other traffic, and finding the right balance between competing demands is important. The approach this guide takes makes it possible to set safe speed limits, not just for motorized traffic flow, but for all road users.



SAVE LIVES

A Roadmap to Speed Management

The Issue

1.19 million people die in road traffic crashes each year

90% of global crash deaths occur in LMICs

Road traffic injury: The leading cause of death for **ages 5-29 years**

Speed has a ripple effect

1% increase in average speed can lead to »»»»

- **2%** Increase in injury crash frequency
- **3%** Increase in severe crash frequency
- **4%** Increase in fatal crash frequency

Higher speed › Narrower field of vision › Longer time to halt › Higher fatality rate

The Benefits

Environment · Travel · Health · Economy · Gender · Livability · Access · Equity

The Solution

The Roads-for-Life Framework (R4L)

A new, practical and innovative tool, developed to help select safe speed limits for all types of roads and road networks.

4 Principles

Safety for all
Proactively set speed limits

Community wellbeing
Work with road users to prioritize their needs

Network availability
Mobility planning to benefit all road users

Predictability
Clear & consistent speed limits

The Implementation

Speed Management Strategy

A range of measures aimed at regulating and controlling vehicular speeds to enhance safety, efficiency, and livability.

- Assess the existing speed management status and identify speed-related problems
- Classify the roads based on the R4L framework and select safe speed limits for different types of roads
- Engage high-level key stakeholders and establish a working group
- Gain political support
- Develop, implement and promote the strategy
- Monitor and evaluate the strategy

The Outcomes

- Positive guidance to safely navigate the mobility system
- Clear direction for appropriate contextual speed
- Space to recover from human errors
- Protection from fatal and serious injuries

Abbreviations

BIGRS	Bloomberg Philanthropies Initiative for Global Road Safety
ESF	Environmental and Social Framework
ESRA	European Survey Research Association
EU	European Union
GDP	Gross Domestic Product
GIS	Geographic Information System
HIC	High–Income Country
GRSF	Global Road Safety Facility
GRSP	Global Road Safety Partnership
iRAP	International Road Assessment Program
ITF	International Transport Forum
ISA	Intelligent Speed Adaptation
ITS	Intelligent Transport System
km	Kilometer
kph	Kilometer Per Hour
KPI	Key Performance Indicator
LMIC	Low- and Middle-Income Country
MDB	Multilateral Development Banks
NCAP	New Car Assessment Program
OECD	Organization for Economic Cooperation and Development
PIARC	Permanent International Association of Road Congresses
RAP	Road Assessment Program
R&D	Research and Development
R4L	Roads-for-Life
RS	Road Safety
RSA	Road Safety Audit
RSE	Road Safety Engineering
RSI	Road Safety Inspection
SDG	Sustainable Development Goal
SPI	Safety Performance Indicator
TfL	Transport for London
UN	United Nations
VRU	Vulnerable Road User
WB	World Bank
WHO	World Health Organization
WRI	World Resources Institute

Glossary

This glossary contains definitions for terms newly introduced in this guide as well as definitions for terms that might be used in different contexts in various countries around the globe.

City center road: Road or road section with very high-density mixed use (high-rise residential/office buildings) as well as downtown commercial use (shopping boulevards) and civic spaces.

Commercial road: Road or road section which provides access to shops and services by all modes.

Functional road classification: The classification of a road into groups according to their function.

Highway: A road, often connecting towns or cities, often with two or more lanes in each direction. In contrast to a motorway, a highway may also have intersections and traffic lights.

Mobility hub: Road or road section with dense activity that has a high demand for all modes of transport, especially public transport.

Motorway: A major road with at least two lanes in each direction, limited access points, median separation, no intersections and no traffic lights, that has been built for fast travel of motorized vehicles over longer distances; also called expressway or freeway.

Residential road: Road or road section which provides residential access for people of all ages and abilities, fosters neighborhood spirit and facilitates local community access.

Road: Route or way on land between two places that has been paved or otherwise improved to allow travel by foot or some other form of conveyance, including by motor vehicle, cart, bicycle, or animal traction. "Road" also encompasses streets, i.e., roads usually found in a city or town with houses or buildings on the sides.

Road user: Any person making use of any part of a road, including pedestrians, cyclists, drivers of vehicles and public transport.

Roads-for-Life (R4L) framework: A framework for setting safe speed limits based on Safe System principles, the scientific consensus on crash risk, severity and survivability, and international good practice for planning, designing, and managing roads and road networks safely for all road users.

Rural human activity road/ rural hub: Road or road section in a rural area where people gather, live, play and/or work on/next to the road or cross it to reach adjacent land-uses (e.g., linear settlements, hamlets, schools, industry, public transport hop-ons/hop-offs).

Rural access-controlled road: Road or road section in a rural area with access control where vulnerable road users are prohibited.

Rural access road: Road or road section in a rural area which provides access to residential or industrial activity and supports these activities.

Rural link road: Road or road section in a rural area which provides the link between rural access roads and rural access-controlled roads.

School road: Road or road section close to schools or similar infrastructure.

Shared road: Road or road section where pedestrians and other vulnerable road users use the same road space as motorized vehicles, including road or road section within schools, hospitals, nursing homes or similar social infrastructure.

Urban human activity road/ city hub: Road or road section where people gather, live, play and/or work on/next to the road, and where people are likely to cross.

Urban link road: Road or road section which provides mobility for people and goods between city districts/strategic centers and mitigates the impact on adjacent communities and where vulnerable road users are protected from motorized traffic (e.g., by adequate sidewalks, bicycle lanes, safe and signalized pedestrian crossings) or even prohibited (i.e., access-controlled urban motorways).

Urban main road: Road or road section which provides mobility and connects with the wider transport network, while accommodating for a high presence of vulnerable road users, on-road activity and public life.

Vulnerable road user: Any road user not in a car, bus, or truck, i.e., pedestrian, cyclist, rider of powered two-wheeler, child, elderly person or user of mobility devices.

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Introduction

Purpose of this guide

The effective management of traffic speeds is one of the most complex road safety issues. Based on the latest research in the field, this guide offers practical information and recommendations for managing speeds on all types of urban and rural roads. It introduces a newly developed process for setting safe speed limits: the Roads-for-Life (R4L) framework. This framework is based on the Safe System approach, a human-centric approach to road transport that focuses on safety of all road users (see Section 1.1), on the scientific consensus on crash risk, severity, and survivability, and on international good practice for planning, designing, and managing safe roads and road networks.

The Roads-for-Life framework reflects the growing expert consensus that roads should prioritize not just motorized transport, but the safety and mobility of pedestrians and cyclists and especially vulnerable people including children, the elderly, and persons with disabilities. This framework enables planners and practitioners to better understand and respond to the needs of all road users, including those who are often overlooked. This inclusive, user-centered approach can generate more equitable outcomes than traditional approaches and aligns with community wellbeing objectives as well as optimal road use and infrastructure.

It can also play an important role in meeting the Paris Climate Agreement's objective of limiting global warming. Well-implemented speed management can cut emissions from the transportation sector including through reduced trips in motorized vehicles by making it safer to walk and cycle.

This framework will contribute to the much-needed paradigm shift on speed management: a shift from prioritizing vehicular traffic towards valuing socio-economic benefits of safe and accessible mobility for all road users, climate considerations, and quality of life. Globally, this is important and needed, because many major road infrastructure projects are currently designed and justified primarily on the basis of higher speeds and a perceived reduction in travel time.

This guide provides tools, not just for setting safe speed limits, but also for developing speed management strategies, action plans, and interventions to support and enforce them. It reveals how these tools are linked and can be used on different types of roads and in a variety of contexts. It lays out a step-by-step approach for developing, implementing, and monitoring speed management, at the national, regional, local or city level, and for specific locations, such as school zones or arterial roads with mixed traffic. It describes the various processes, policy solutions and enabling conditions for impactful speed management. It outlines strategies that target existing roads where speed contributes to fatalities and serious injuries and can also be used early in the planning process to set safe speed limits for new roads, to match road design to intended use, and to select appropriate infrastructure solutions.

Practical guidance to address the greatest risks

Because road traffic fatalities are not evenly distributed around the world, and risks are greatest in low- and middle-income countries (LMICs), this guide can be especially beneficial to them. LMICs face unique speed management challenges. These result from uncontrolled land use, and rapid, often poorly planned urbanization, in a context of widespread poverty. The design of road infrastructure is often poor, vehicle fleets are typically old and rarely inspected, resources for enforcement are limited, and underinvestment in road maintenance is endemic.[1] LMICs face significantly greater crash risks and more severe outcomes than high-income countries (HICs). This is true even though operating speeds in HICs, on similar types of roads, are typically faster. According to the World Health Organization (WHO), 92% of global road fatalities occur in LMICs, even though these countries have approximately 70% of the world's powered vehicles.[2]

This guide considers varying global contexts and nuances, especially in LMICs. It provides clear guidance that is consistent and easy to implement, while offering alternatives where there are gaps in resources such as data collection, or legal and organizational arrangements. In addition, this guide presents evidence-based interventions and real-life examples to help build the case for safe speeds and gain political buy-in and community support.

Targeted at LMICs, this guide is a **companion document of "Speed Management - A Road Safety Manual for Decision-Makers and Practitioners"[3]** which provides more theoretical background on why speed management is important and summarizes state-of-research on which interventions work in various contexts.

Who should use this guide?

The target audience includes decision makers and practitioners working in the fields of road safety, mobility and urban design, public health, government agencies, road authorities, or non-governmental organizations supporting speed management initiatives in LMICs. While this is the primary audience, the content could also be of interest to HICs, because the lack of safe speed limits is a major concern worldwide.

Multilateral Development Banks (MDBs) and their development partners can also use this guide to provide implementation support to their clients, especially in light of road transport investments.

The methodology for developing this guide

The guide draws upon international knowledge, evidence from existing published material, and experience from projects delivered around the world. Evidence is based on peer-reviewed, published literature, referenced throughout its different sections. The authors undertook targeted literature reviews on each topic in the guide. There is extensive research available on the topic of speed, and much of the literature is consistent in findings. For this reason, the guide provides examples drawn from the most recognized sources (for example, higher numbers of citations).

The most relevant references on various speed management topics are summarized in Appendix B. Further supporting evidence comes from project activity by the World Bank, WRI, and national and local agencies around the world, some of which is presented in case studies. The authors interviewed the practitioners who developed and led these case study projects to learn more about the challenges, lessons learned and impact of each project.

1 Job, R. and Wambulwa, W. 2020. *"Features of low-income and middle-income countries making road safety more challenging."* Journal of Road Safety 31 (3).

2 WHO (World Health Organization). *2023. Global Status Report on Road Safety 2023,* Geneva.

3 Global Road Safety Partnership, International Federation of Red Cross, Red Crescent Societies. 2023. *Speed management: A Road Safety Manual for Decision-makers and Practitioners*. Geneva.

How to find your way through this guide

The major contents of this guide are summarized in Figure 1. To make the guide more user-friendly for road safety practitioners, a set of important "Quick Tips for Practitioners" has been added throughout the document. These contain the most important practical information at a glance. In addition, the most common myths that are used as arguments against striving for safe speeds are addressed and dispelled by evidence in highlighted "myth boxes" that can also be found throughout the guide.

Figure 1. Major contents of this guide

Introduction — Provides an overview of the **purpose and audience** for the guide

Chapter 1 — Discusses **why implementing speed management is important for improving road safety and provides a summary of the wider benefits of lower speeds.** It provides evidence-based explanations and information that can be used to counter common misperceptions about speed, speeding and speed management

Chapter 2 — Describes **the main principles for setting safe speed limits** and presents **key information on the newly developed Roads-for-Life framework**

Chapter 3 — Presents **how to implement speed management** through speed management strategies **and select and implement safe speed limits** from a Safe System perspective based on the Roads-for-Life framework

Chapter 4 — Examines **the effective interventions that can be used to achieve safe speed,** including through land use planning, road infrastructure, policing, deterrence and penalties, vehicle technology as well as education and communication and taking into account specific risks within different road environments

Key takeaways — Contains **all important key messages from this guide** in a **short and easy-to-understand format**

Appendix A — Comprises **tables with the most relevant interventions** in road infrastructure, policing, deterrence and penalties, vehicle technology as well as education and communication

Appendix B — Describes the most **useful key resources** for managing speed

1 Why implementing speed management is important

1.1. Background

Approximately 1.19 million people die in road traffic crashes each year and a large share of these fatalities are related to speed. This is true in both HICs and LMICs. For example, speeding is involved in around 60% of fatal crashes in New Zealand[4] and almost 70% in India.[5] Around a third of road fatalities in HICs are attributed to speed.[6] The percentage is higher in LMICs, due to a larger number of VRUs[7] falling victim to such incidents. Road traffic injuries are the leading cause of death for children and young adults aged 5-29 years,[8] and speed is universally recognized as contributing to road fatalities and serious injuries worldwide. Many decision makers and stakeholders believe there are benefits to higher speeds, and often lack awareness of the negative consequences and risks associated with higher speeds. They end up making decisions based on various myths about speed.

Successful speed management applies not just one tool or technique, but a wide range of approaches. These include sustainable land use planning, well-designed road infrastructure, appropriately resourced and sustained policing and deterrence, education and communication as well as vehicle technologies and incentives such as insurance bonus–malus schemes, which adjust premiums based on individual claim and/or crash history. Successful speed management is not a stand-alone, one-off intervention but a holistic mixture of these approaches. It should occur as part of structured and consistent road safety, sustainability, public health, economic development, equity, and/or climate change policies.

Traditional road design is structured to support vehicle flow at high speeds. Accordingly, it provides wide roads with multiple lanes and overpasses (flyovers), and highways that traverse built-up or rural settings often crowded with VRUs. Designing roads with an emphasis on speed hinders safe road travel, even where safe speed limits are in place. This is especially true where policing and deterrence are not adequate to enforce these speed limits, and the road allows for higher speeds to be adopted.

Speed is strongly connected to road use and road design. Thus, speed management is not only or even primarily about lowering speeds, but about directly aligning them with road design, infrastructure and road users. In general, 30 kph or lower are needed on roads where VRUs are present, and adequate infrastructure (such as safe sidewalks and pedestrian crossings) is missing. High(er) speeds are possible on roads that have adequate design and infrastructure to accommodate all types of road users, not only motorized vehicles. Thus, road use should govern road design and speed.

4 Job, S. and Brodie, C. 2022. *"Understanding the role of speeding and speed in serious crash trauma: a case study of New Zealand."* Journal of Road Safety. 33 (1): 5-25.

5 Ministry of Road Transport and Highways, Government of India. 2021. *Road accidents in India 2020*. New Delhi, India.

6 WHO (World Health Organization). 2017. *Managing Speed*, Geneva.

7 WHO (World Health Organization). 2018. *Protecting Vuknerable Road Users*, Geneva.

8 WHO (World Health Organization). 2023. *Global Status Report on Road Safety 2023*, Geneva.

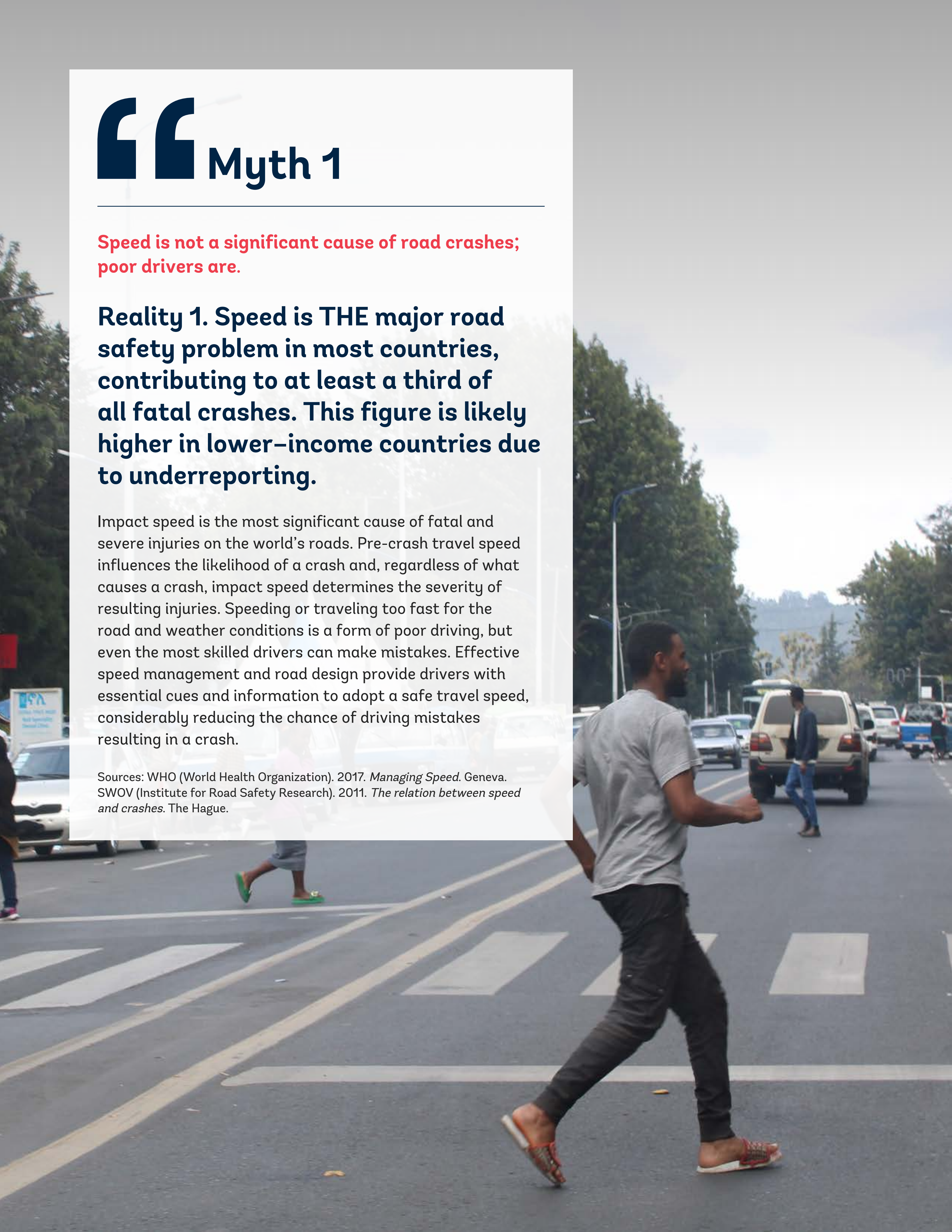
Myth 1

Speed is not a significant cause of road crashes; poor drivers are.

Reality 1. Speed is THE major road safety problem in most countries, contributing to at least a third of all fatal crashes. This figure is likely higher in lower-income countries due to underreporting.

Impact speed is the most significant cause of fatal and severe injuries on the world's roads. Pre-crash travel speed influences the likelihood of a crash and, regardless of what causes a crash, impact speed determines the severity of resulting injuries. Speeding or traveling too fast for the road and weather conditions is a form of poor driving, but even the most skilled drivers can make mistakes. Effective speed management and road design provide drivers with essential cues and information to adopt a safe travel speed, considerably reducing the chance of driving mistakes resulting in a crash.

Sources: WHO (World Health Organization). 2017. *Managing Speed*. Geneva. SWOV (Institute for Road Safety Research). 2011. *The relation between speed and crashes*. The Hague.



Speed management is central to the Safe Systems approach, which has proven to be more effective in reducing road deaths and serious injuries than more traditional approaches.[9] Safe speeds are critical in areas where VRUs and motor vehicles interact. The interventions for effective speed management presented in this guide were informed by the Safe System approach, which has proven that reducing traffic fatalities and severe injuries to zero is possible and feasible. The Safe System approach has been successfully adopted by organizations worldwide (including the World Bank, WHO, United Nations, PIARC, OECD, and others) and countries that are pioneers in road safety and mobility.

The Safe System approach is a human-centric approach in road transport which acknowledges that human error is unavoidable while road deaths and serious injuries are unacceptable and avoidable. It asserts that these facts should dictate the design, use and operation of the road network to provide safe transport for all road users. It is based on a verified set of principles, core elements, and action areas that experts and policymakers globally can use as a guiding tool to improve road safety and mobility (Figure 2). The approach underscores a shift in awareness away from seeing road safety as personal responsibility (victim blaming) to viewing it as a public health issue that governments, decision makers, and stakeholders have the responsibility and power to address together.

Figure 2. The principles, core elements, and action areas of the Safe System approach

PRINCIPLES

- Humans Make Errors
- Humans are Vulnerable to Injury
- Responsibility is Shared
- No Death or Serious Injury is Acceptable
- Proactive vs. Reactive

CORE ELEMENTS

- Economic Analysis
- Priorities and Planning
- Monitoring and Evaluation
- Comprehensive Governance and Management
- Strong Targets and Data

ACTION AREAS

- Land Use Planning
- Improved Mobility Options
- Enforcement, Laws and Regulation
- Vehicle Design and Technology
- Road Design and Engineering
- Speed Management
- Education and Capacity Building
- Post-crash Emergency Response and Care

Source: Sustainable & Safe. WRI, 2018.

[9] Johansson, R. 2009. *"Vision Zero – Implementing a policy for traffic safety."* Safety Science. 47. 826-831.

Mooren, L., Grzebieta, R. and Job, S. 2011. *Safe System – Comparison of this Approach in Australia*. In Proceedings of the Australasian College of Road Safety Conference. Melbourne.

Weijermars, W. and Wegman, F. 2011. *Ten Years of Sustainable Safety in the Netherlands: An Assessment.* Transportation Research Record. 2213 (1), 1-8.

Myth 2

With modern vehicle technologies, people can safely drive faster.

Reality 2. Modern vehicle technologies help people drive safer, not faster.

Modern car technologies can make drivers feel safer and more in control, leading them to drive faster. However, it is important to note, as speed increases, the driver's brain gets flooded with information and their field of vision shrinks. This makes crashes more likely and potentially more severe, reducing the safety benefits of the technology. Importantly, even if drivers feel safer, the risk to pedestrians and others outside the vehicle remains high. So, faster driving can lead to serious crashes, putting those outside and inside the vehicle in danger.

The Safe System approach is based on the following key principles:[10,11]

- ✓ People make mistakes that can lead to crashes. The transport system needs to accommodate human error and unpredictability.
- ✓ The human body has a known, limited physical ability to tolerate crash forces before harm occurs. The impact forces resulting from a collision must therefore be limited to prevent fatal or serious injury.
- ✓ Individual road users are obligated to act with care and obey traffic laws. Those who design, build, and manage roads and vehicles, share responsibility for preventing crashes that cause serious injury or death and providing effective post-crash care.
- ✓ All parts of the system must be strengthened and work together to multiply their effects, and to ensure protection of road users if one part of the system fails.
- ✓ Road safety should be managed proactively to prevent crashes by identifying and resolving potential hazards. This contrasts with traditional reactive approaches where we need to wait for crashes to occur before acting.

Reaching safe speeds through safe design and/or enforcement to eliminate road deaths and serious injuries is the ultimate objective for a Safe System. This guide defines unsafe speeds as driving above the set speed limit or driving too fast for the conditions, regardless of what the posted speed is.

1.2. The road safety benefits of managing speed

Speed is the most critical risk factor in road crashes because it influences the risk of being involved in a crash as well as the severity of the crash outcome. Research shows that even small increases in speed can significantly heighten risk, while reducing speeds can lower risk in several ways, including by reducing impact forces, providing additional time for drivers to react and slow down, and giving VRUs additional time to react as well.

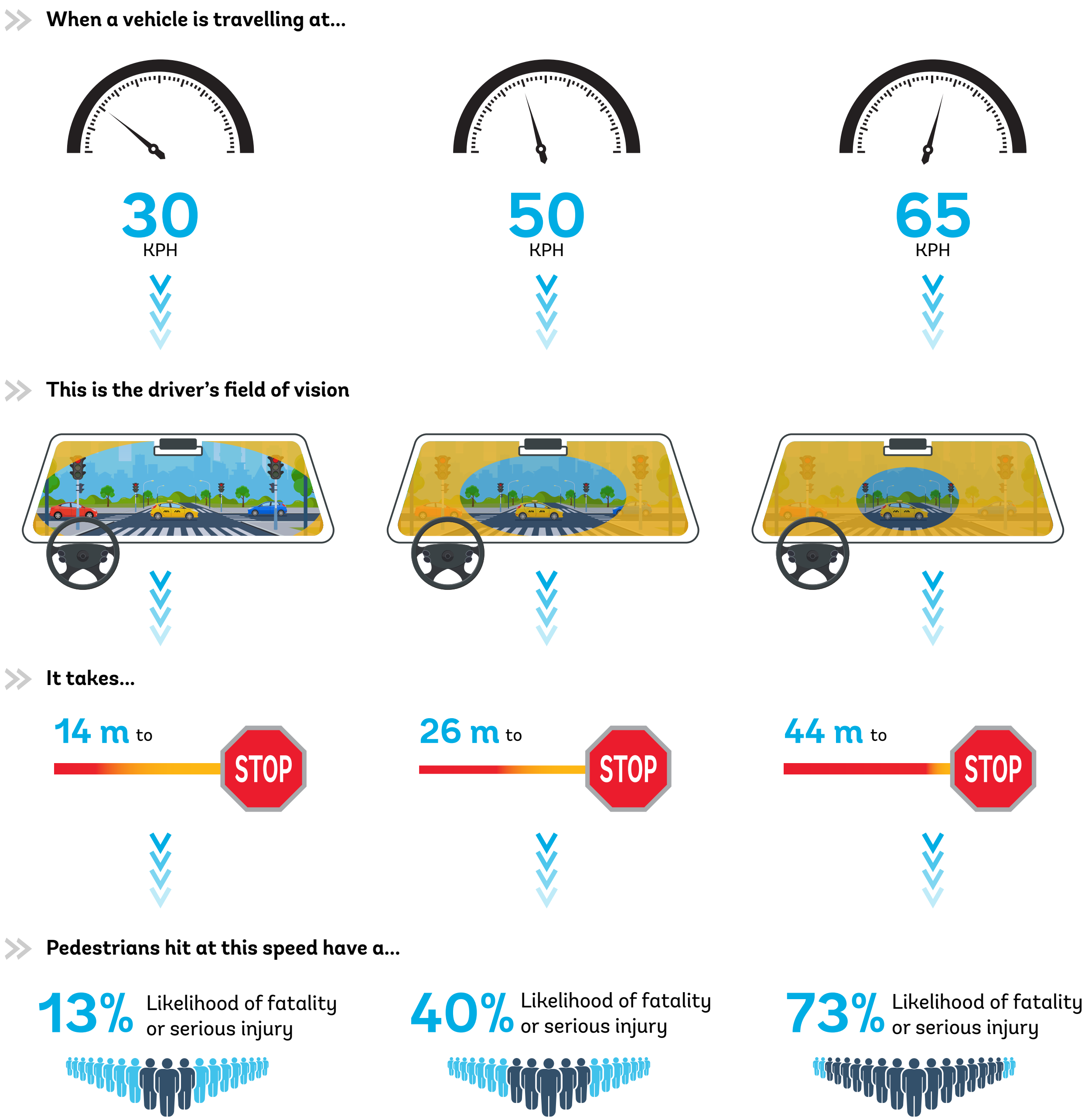
The relationship between vehicle speeds and crash impacts depends on multiple factors. In addition to speed,[12] injury severity is determined by the mass difference between the vehicles, and the vulnerability of the road users involved.[13,14]

Higher speeds minimize the time drivers have to process information, make informed decisions and react. They increase the time it takes for a vehicle to stop upon braking, and worsen the impact of a collision, especially on the receiver's end.[15] Driving at very high speeds can result in tunnel vision and

[10] ITF (International Transport Forum). 2016. *Zero Road Deaths and Serious Injuries: Leading a Paradigm Shift to a Safe System*. OECD Publishing. Paris.
[11] WRI (World Resources Institute). 2018. *Sustainable & Safe: A Vision and Guidance for Zero Road Deaths*. Washington, DC.
[12] SWOV (Institute for Road Safety Research). 2011. *The relation between speed and crashes fact sheet*. The Hague.
[13] SWOV (Institute for Road Safety Research). 2005. *Advancing Sustainable Safety National Road Safety Outlook for 2005-2020*. The Hague.
[14] SWOV (Institute for Road Safety Research). 2011. *The relation between speed and crashes*. The Hague.
[15] Australian Academy of Science. 2015. The physics of speeding cars.

decreased depth perception for the driver.[16] At lower speeds, drivers have a wider field of vision and are more likely to notice other road users (Figure 3).

Figure 3. Influence of speed on the driver's field of vision, stopping distance, and road safety. As speeds increase, the field of vision narrows, which increases the likelihood of fatalities or serious injuries



Source: Low-Speed Zone Guide. WRI & GRSF, 2021.

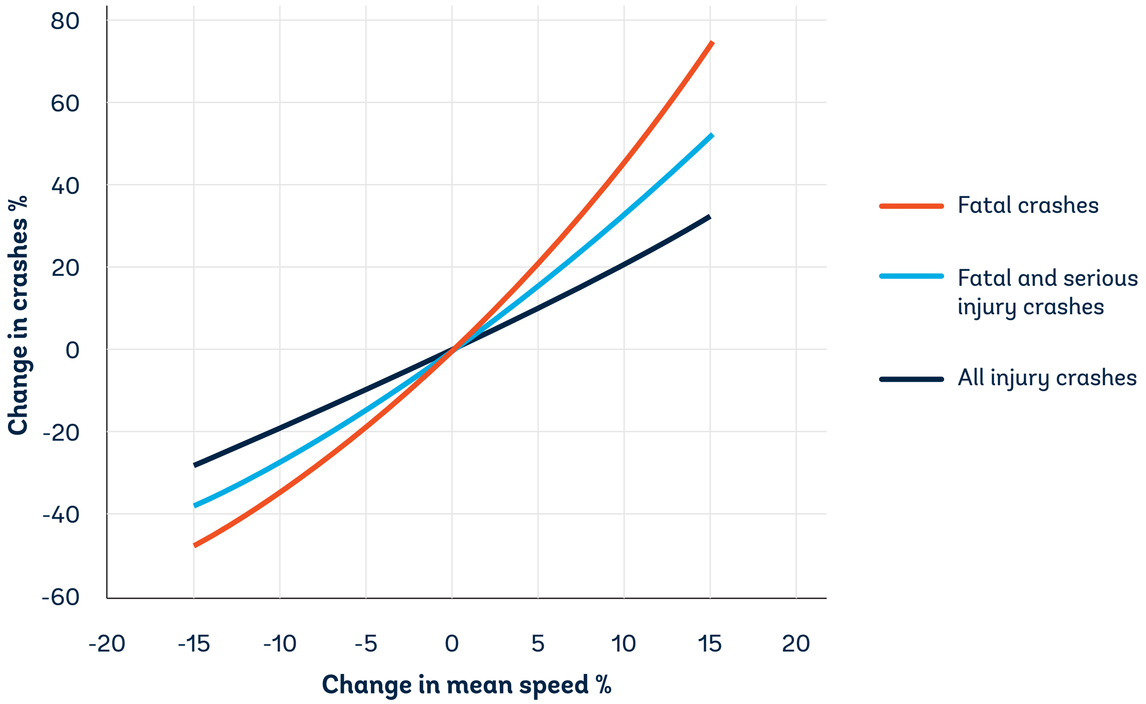
Note: Other sources indicate that the effects on pedestrian fatality and serious injury are even higher.

[16] Qin, L., Dong, L.L., Xu, W.H., Zhang, L.D. and Leon, A.S. 2018. *Influence of Vehicle Speed on the Characteristics of Driver's Eye Movement at a Highway Tunnel Entrance during Day and Night Conditions: A Pilot Study*. International Journal of Environmental Research and Public Health. 15 (4).

Speed and crash outcome

As speed increases, risks rise more steeply. Research has established the relationship between speed and crash outcomes by comparing safety outcomes before and after speed interventions. These evaluations correct for other factors that could affect safety by using "control" locations where no intervention has occurred. Reliable research has been used to develop the "Power Model" of speed (Figure 4).[17] This shows that a 1 percent increase in average speed results in approximately a 2 percent increase in injury crash frequency, a 3 percent increase in severe crash frequency, and a 4 percent increase in fatal crash frequency.

Figure 4. Relationship between speed and crash outcome



Source: Nilsson, G. 2004

These findings show how even very small changes in speed can have a substantial impact on safety outcomes. Reducing speeds has a positive impact, increasing them has a negative one, and for severe crash outcomes, fatal and serious injury crashes, this relationship is especially stark. Research done since Nilsson's study[18,19] suggests that the relationship between speed and crash risk is exponential. The influence of initial vehicle speed in this revised model shows that the effect of speed is more pronounced for high-speed roads than for lower–speed roads. Detailed information on the relationship between speed and safety outcomes can be found on the online GRSF Speed Management Hub, including a new Speed Impact Tool that helps calculate the change in crash risk from a change in speed.

[17] Nilsson, G. 2004. *Traffic safety dimensions and the power model to describe the effect of speed on safety*. Lund Institute of Technology. Bulletin 221.

[18] Elvik, R. 2013. *A re-parameterisation of the Power Model of the relationship between the speed of traffic and the number of accidents and accident victims*. Accident Analysis & Prevention. 50. 854-860.

[19] Elvik, R., Vadeby, A., Hels, T. and Schagen, I. 2019. *Updated estimates of the relationship between speed and road safety at the aggregate and individual levels*. Accident Analysis & Prevention. 123. 114-122.

Speed and fatality risk

The risk of a fatal outcome varies dramatically for different crash types.[20] Table 1 below describes different types of crashes and the impact speeds classified as survivable. These Safe System survivable impact speeds are used in this guide as maximum speed limits acceptable to avoid the risk of fatality or serious injury. They are based on a wide range of studies[21,22] and assume sufficient infrastructure and optimal visibility conditions. These speeds are considered "indicative" because research on this topic continues, and the results vary. Emerging research extends evidence and provides more detailed analyses and nuances on survivable impact speeds for different types of road users and crash scenarios.[23] However, for policy purposes, the impact speeds shown in Table 1 provide a very useful benchmark for avoiding death and serious injury.

Table 1. Safe System survivable impact speeds for different crash scenarios[24,25]

Type of road/road section	Safe System survivable impact speed
Roads/road sections with possible crashes between cars and vulnerable road users including 2- and 3-wheelers	Max. 30 kph
Roads/road sections with intersections with possible side-on crashes between cars	Max. 50 kph
Roads/road sections with possible frontal (head-on) crashes between cars	Max. 70 kph
Roads/road sections with no likelihood of side-on or frontal crashes between cars and limited access (usually motorways)	Max. 100 kph*

* In many countries, motorways still have higher speed limits of up to 120 kph or even 130 kph. But setting speed limits on motorways should be about balancing three core priorities: safety, mobility, and the environment. Introducing lower speed limits on motorways cuts both fuel consumption and pollutant emissions. Thus, speed limits over 100 kph should generally be avoided.

Speeds need to be at or below the Safe System survivable impact speeds presented in Table 1 to reduce the risk of road death or serious injury. If higher speeds are required, then better-quality road infrastructure is necessary to protect road users.[26] This can include separation and crossing facilities for pedestrians, or barrier protection systems to prevent head-on crashes.

[20] GRSP (Global Road Safety Partnership). 2008. *Speed management: a road safety manual for decision-makers and practitioners*. Geneva.

[21] ITF (International Transport Forum). 2016. *Zero Road Deaths and Serious Injuries: Leading a Paradigm Shift to a Safe System*. OECD Publishing. Paris.

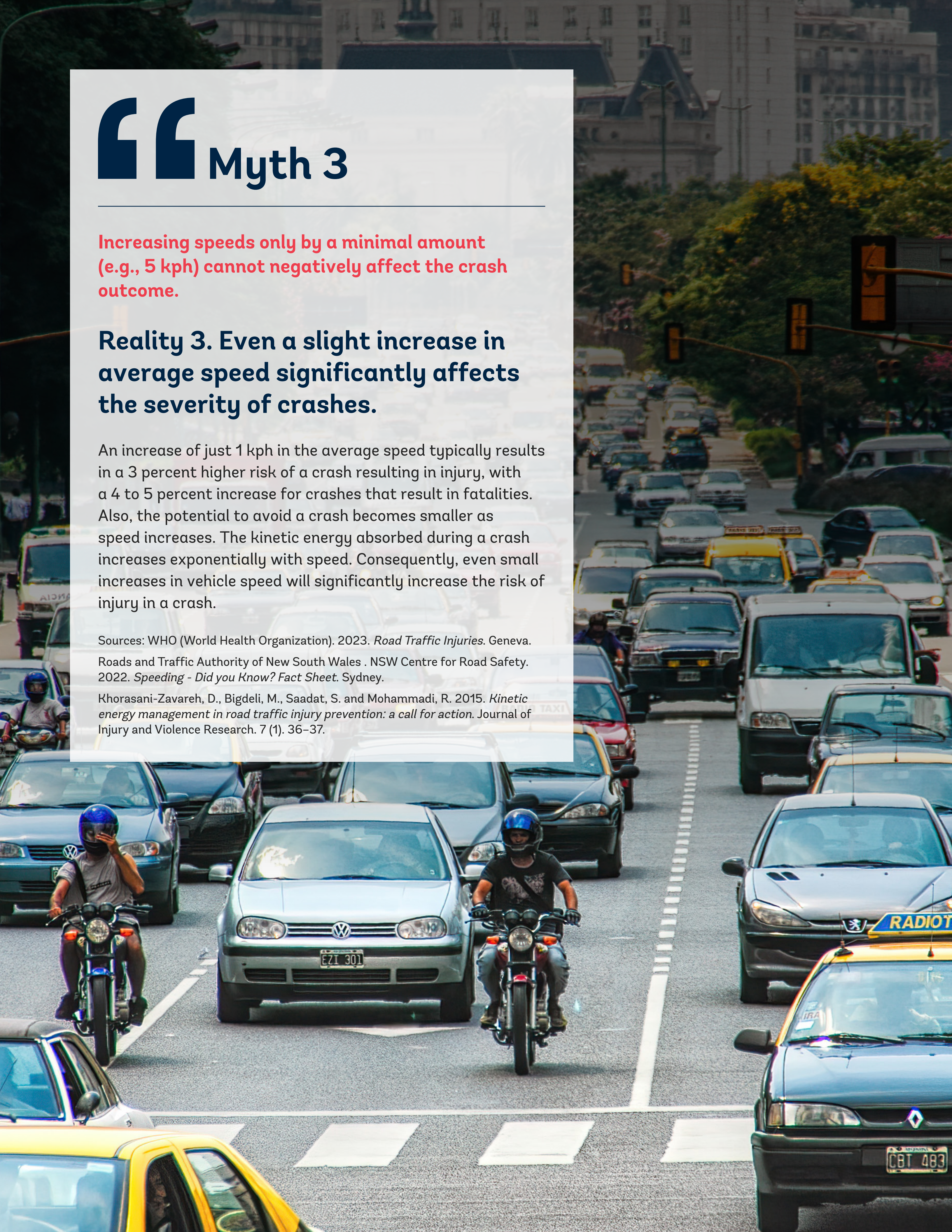
[22] Tingvall, C. and Haworth, N. 1999. *Vision Zero: An ethical approach to safety and mobility*. 6th ITE International Conference Road Safety & Traffic Enforcement: Beyond 2000. Melbourne.

[23] Rizzi, M., Boström, O., Fredriksson, R., Kullgren, A., Lubbe, N., Strandroth, J. and Tingvall, C. 2023. *Proposed Speed Limits for the 2030 Motor Vehicle*. The 27th International Technical Conference on the Enhanced Safety of Vehicles (ESV). Yokohama.

[24] ITF (International Transport Forum). 2016. *Zero Road Deaths and Serious Injuries: Leading a Paradigm Shift to a Safe System*. OECD Publishing. Paris.

[25] Tingvall, C. and Haworth, N. 1999. *Vision Zero: An ethical approach to safety and mobility*. 6th ITE International Conference Road Safety & Traffic Enforcement: Beyond 2000. Melbourne.

[26] WRI (World Resources Institute). 2018. *Sustainable & Safe: A Vision and Guidance for Zero Road Deaths*, Washington.



Myth 3

Increasing speeds only by a minimal amount (e.g., 5 kph) cannot negatively affect the crash outcome.

Reality 3. Even a slight increase in average speed significantly affects the severity of crashes.

An increase of just 1 kph in the average speed typically results in a 3 percent higher risk of a crash resulting in injury, with a 4 to 5 percent increase for crashes that result in fatalities. Also, the potential to avoid a crash becomes smaller as speed increases. The kinetic energy absorbed during a crash increases exponentially with speed. Consequently, even small increases in vehicle speed will significantly increase the risk of injury in a crash.

Sources: WHO (World Health Organization). 2023. *Road Traffic Injuries*. Geneva.

Roads and Traffic Authority of New South Wales . NSW Centre for Road Safety. 2022. *Speeding - Did you Know? Fact Sheet.* Sydney.

Khorasani-Zavareh, D., Bigdeli, M., Saadat, S. and Mohammadi, R. 2015. *Kinetic energy management in road traffic injury prevention: a call for action*. Journal of Injury and Violence Research. 7 (1). 36–37.

However, these limits may still be too high. In LMICs traffic is typically more mixed than in HICs. Vehicles travelling at very different speeds pose risks on urban and rural roads, including highways. Modern cars may be flying along at 80 - 100 kph in rural environments, while older trucks, buses, or autorickshaws are crawling along at speeds of 20 - 40 kph. These differential speeds can lead to severe rear-end crashes as well as crashes that result from swerving to pass and other maneuvers. Having pedestrians on the road creates additional hazards.[27] Where these conditions exist, speeds need to be adjusted to accommodate the most vulnerable road users and eliminate risks imposed by differential speeds.

1.3. The broader benefits of lowering speed limits

Lowering speed limits brings an array of direct and indirect benefits, not only for safety, but for public health, environmental protection, transport efficiency, equity, economic growth and well-being, as well as community livability. The 2020 Stockholm Declaration[28] highlights the link between road safety and more comprehensive societal benefits and connects it to the UN Sustainable Development Goals.

Environmental and health benefits

Globally, the transport sector contributes almost one-fourth of total carbon dioxide emissions (CO_2).[29] Countries have agreed to reduce CO_2 emissions from transport by a minimum of 50% by 2050.[30] Meeting the Paris Climate Agreement's objective of limiting global warming to 1.5 degrees Celsius will require coordinated and collective action on many levels.[31] One key action is promoting safe speeds to foster active travel such as walking and cycling, thus cutting down on vehicle use, particularly in urban areas. The Transformative Urban Mobility Initiative (TUMI) Transport Outlook report concluded that to meet the 1.5 degrees Celsius goal, public transport capacity needs to double, and 50 percent of trips should be made by walking or cycling. TUMI further estimates that governments should build roughly 2 kilometers of segregated cycling lanes per 1,000 inhabitants.[32] A study found that if people switched just one trip per day from driving to cycling, they would reduce their individual carbon footprint by 67 percent—about 0.5 tons of CO_2 per year.[33] More walking and cycling also improves public health by helping to prevent noncommunicable diseases (Figure 5). Research shows that the prevalence of cycling in the Netherlands prevents 6,500 deaths annually, and has improved Dutch life expectancy.[34]

[27] Jurewicz, C., Sobhani, A., Woolley, J., Dutschke, J. and Corben, B. 2016. *Exploration of vehicle impact speed–injury severity relationships for application in safer road design*. Transportation Research Procedia 14. 4247-4256.

[28] The Stockholm Declaration is the outcome of the 3rd Global Ministerial Conference on Road Safety, February 2020. This ambitious and forward-looking statement connects road safety to the implementation of the 2030 Agenda for Sustainable Development.

[29] World Bank. 2021. *Motorization Management and the Trade of Used Vehicles: How Collective Action and Investment Can Help Decarbonize the Global Transport Sector*. Washington, DC.

[30] UNECE (United Nations Economic Commission for Europe). *Climate Change and Sustainable Transport*. Geneva.

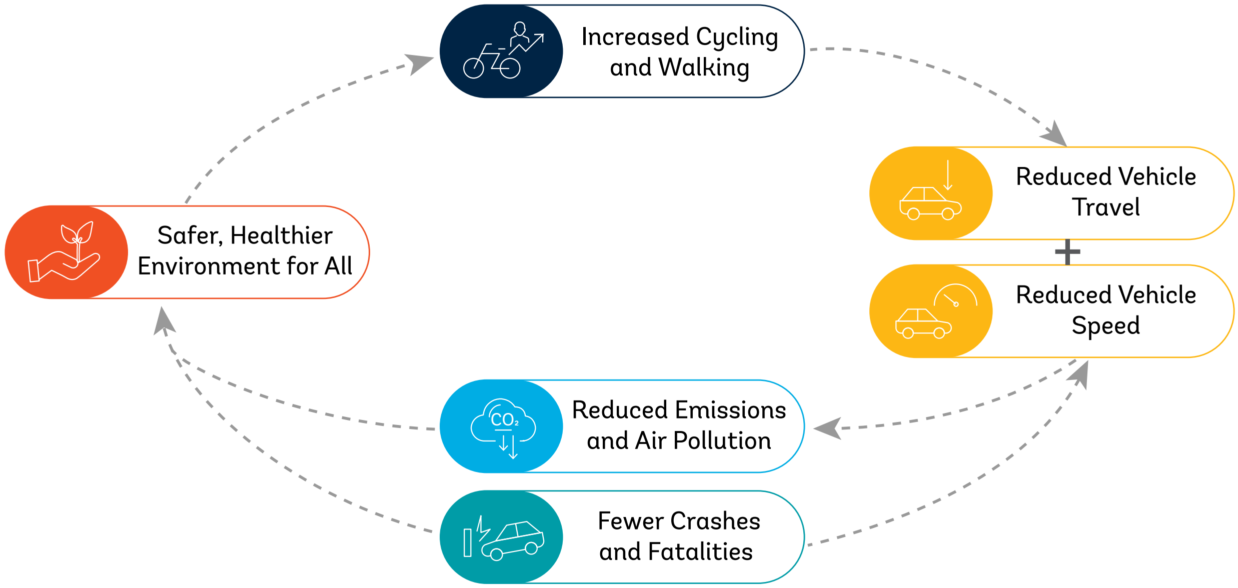
[31] United Nations Framework Convention on Climate Change (UNFCCC). 2016. *The Paris Agreement*. Geneva.

[32] Teske, S., Niklas, S. and Langdon, R. 2021. *TUMI Transport Outlook 1.5°C - A global scenario to decarbonise transport*. University of Technology Sydney for the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. Sydney.

[33] Brand, C., et al. 2021. *The climate change mitigation impacts of active travel: Evidence from a longitudinal panel study in seven European cities*. Global Environmental Change. 67.

[34] Fishman, E., Schepers, P. and Kamphuis, C. 2015. *Dutch Cycling: Quantifying the Health and Related Economic Benefits*. American Journal of Public Health. 105 (8). 13-5.

Figure 5. Environmental and health benefits of lowering speeds. As roads become safer as a result of better design, reduced vehicle numbers and speed, and improved air quality, more people will feel comfortable walking, cycling, and taking public transport, leading to ongoing health benefits



Source: Adapted from Sustainable & Safe. WRI, 2018.

There is clear evidence that high speeds (above 80 kph) increase both fuel consumption and CO_2 emissions.[35] Speed reduction can be a highly effective solution for cutting CO_2 emissions on high-speed urban arterials as well as inter-urban roads. Like speed, intense acceleration and deceleration can increase emissions. Higher speed limits in urban areas are associated with rapid and aggressive acceleration and deceleration. Where maximum speeds are 30-40 kph, drivers accelerate for 77 meters to reach them, whereas going from zero to 40-50 kph takes 162 meters. Drivers accelerate rapidly, and sometimes aggressively, to reach higher target speeds.[36]

Reducing noise, particularly vehicle noise due to acceleration, has a positive effect on physical and mental health.[37] In urban areas with speeds between 30 and 60 kph, reducing speeds by 10 kph would cut noise levels by up to 40 percent.[38]

Livability, placemaking, social inclusion and access benefits

Low-speed zones can enhance an area's amenity and economic activity by improving road environments and making a community or neighborhood more livable. Lower speed zones enhance community vibrancy, economic activity, and boost the quality of life. They promote safer, more inclusive neighborhoods that benefit all residents, irrespective of income, including

[35] Transport Research Centre. OECD (Organization for Economic Co-operation and Development). 2006. *Speed Management.* Paris.
[36] Omar, N., Prasetijo, J., Daniel, B., Abdullah, M. and Imail, I. 2018. *Study of Car Acceleration and Deceleration Characteristics at Dangerous Route FT050.* IOP Conference Series: Earth and Environmental Science.
[37] WHO (World Health Organization). 2011. *Burden of disease from environmental noise: Quantification of healthy life years lost in Europe*. Geneva
[38] Mitchell, P. 2009. *Speed and Road Traffic Noise: The role that lower speeds could play in cutting noise from traffic.* UK Noise. UK Noise Association. London.

Myth 4

Lowering the speed limits will increase congestion.

Reality 4. Lower speed limits can actually reduce congestion.

About half of traffic congestion is non-recurring and caused by “temporary disruptions” in travel, e.g., bad weather, road closures, vehicle crashes or breakdowns. Higher speeds lead to more crashes, and thus increase non-recurring congestion. When recurring congestion does occur (during rush hours) in urban environments, low speed limits do not exacerbate it. Vehicles are likely already traveling well below the posted speed limit. Lower speed limits may even ease congestion in some cases by reducing the likelihood of bottlenecks. In Sao Paulo, lowering the speed limit on major arterials reduced congestion by 10 percent during the first month of implementation, as well as lowering fatalities.

Source: Ang, A., Christensen, P. and Vieira, R. (2020). *Should congested cities reduce their speed limits? Evidence from São Paulo, Brazil*. Journal of Public Economics. 184.

children, the elderly, and those with mobility issues. High speeds can become a barrier that leads to community severance. There can be separation of people from goods, services, and each other by transport infrastructure that makes crossing unsafe and unpleasant.[39]

Reduced speed limits in school zones and other busy areas encourage active mobility such as walking and cycling, fostering healthier lifestyles and community interactions. Lowering speeds also transforms roads into hubs for community activities and strengthens social bonds. The positive impact extends to gender equity as well, offering safer environments for women, easing their daily tasks and enhancing their quality of life. For example, the transformation of Times Square in New York City into a pedestrian-friendly zone revitalized the local community and businesses while enhancing safety and social engagement.[40] Since the transformation, revenues from businesses in Times Square have risen 71 percent.[41] Attractive, vibrant, and healthy neighborhoods support local real estate and businesses, drawing people to shop, socialize, work and commute sustainably and safely.

Travel benefits

From an economic perspective, optimal speeds are defined as those with the lowest costs associated with safety, emissions, journey time and other related factors. These optimal speeds are often lower than current actual speed limits. Research has shown that driving at a speed appropriate for the road will likely only minimally increase travel time.[42] This occurs for several reasons, including because congestion, intersections, lower quality roads and other constraints mean that travel speeds are often already less than the existing speed limit. Traffic disruption may also be reduced because of fewer crashes.

Lowering the speed limits on access-controlled roads, such as motorways, can increase the volume of traffic that can pass through and reduce journey times. This is because vehicles can follow closer together at lower, more stable speeds, with less stopping, starting, and "shock waves" where congestion starts.[43] Signal timings, weather conditions and the number and type of intersections also impact travel time. Improving intersection safety and function, and coordinating signal timing, are better ways to improve flow than increasing speed limits.

Economic benefits

Reducing the number of road traffic injuries by reducing speeds can boost national income over the long term. It can increase productivity, enhance the well-being of the population and build human capital by maximizing healthy years of life.[44] It can also lower costs for transport system disruptions, emergency responses and healthcare. Crashes heap the heaviest financial burdens on

[39] Higgsmith, M., Stockton, Paulo Anciaes, P., Scholes, S. and Mindell, J. 2022. *Community severance and health – A novel approach to measuring community severance and examining its impact on the health of adults in Great Britain*. Journal of Transport & Health. 25.

[40] Welcome to Times Square. Times Square Transformation. https://www.welcome-to-times-square.com/times-square-transformation/

[41] Cruz, J. (2014). *Snohetta Makes Times Square Permanently Pedestrian*. ArchDaily.

[42] Archer, J., Fotheringham, N., Symmons, M. and Corben, B. 2008. *The impact of lowered speed limits in urban and metropolitan areas*. Report No. 276, Monash University Accident Research Centre, Victoria, Australia.

[43] Vicroads. 2019. *Managed Motorway Design Guide*. Melbourne.

[44] World Bank. 2017. *The High Toll of Traffic Injuries: Unacceptable and Preventable*. Washington, DC.

Myth 5

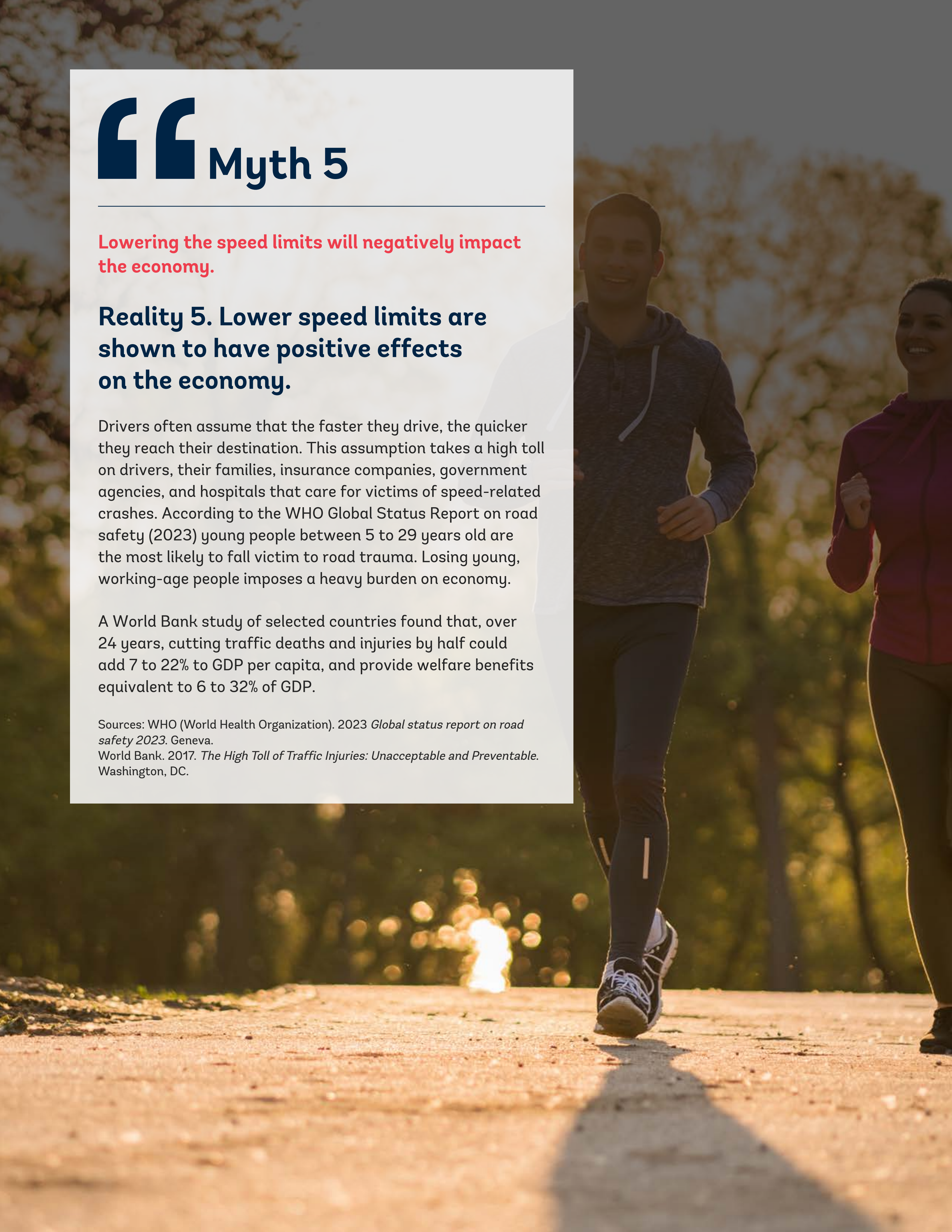
Lowering the speed limits will negatively impact the economy.

Reality 5. Lower speed limits are shown to have positive effects on the economy.

Drivers often assume that the faster they drive, the quicker they reach their destination. This assumption takes a high toll on drivers, their families, insurance companies, government agencies, and hospitals that care for victims of speed-related crashes. According to the WHO Global Status Report on road safety (2023) young people between 5 to 29 years old are the most likely to fall victim to road trauma. Losing young, working-age people imposes a heavy burden on economy.

A World Bank study of selected countries found that, over 24 years, cutting traffic deaths and injuries by half could add 7 to 22% to GDP per capita, and provide welfare benefits equivalent to 6 to 32% of GDP.

Sources: WHO (World Health Organization). 2023 *Global status report on road safety 2023.* Geneva.
World Bank. 2017. *The High Toll of Traffic Injuries: Unacceptable and Preventable.* Washington, DC.



the poor. A study from Bangladesh found that 75 percent of poor households and 59 percent of non-poor households experienced a decrease in their standard of living after suffering a road crash injury, which also impacted employment and education.[45]

Gender and equity benefits

Transportation is a health equity issue. Minority groups and low-income communities disproportionately suffer the consequences of poor road safety and high speeds.[46] Poor communities, especially women in these communities, are more likely to travel by foot, bicycle, motorcycle or public transport and therefore, are more likely to be the victims of speed-related crashes particularly as pedestrians.[47] These groups often live beside poorly designed roads that expose pedestrians and cyclists to fast-moving vehicles. At the same time, many communities, especially in low-income countries, use their roads as extended front yards, increasing the risk posed by speeding vehicles.

In case of a crash, women, children, elderly and people with disabilities are more likely to be badly injured than the "average adult male" when they are all exposed to the same forces.[48] Yet the usual models and standards used to design vehicles and roads (such as crossing times at intersections) are based on the "average adult male". When vehicles and roads are designed for all road users, including the most vulnerable, safety and accessibility are boosted. This inclusive approach considers different tolerance levels to crash forces among women, children, the elderly, and those with disabilities, reducing injury severity. Road agencies should review road design and intersection crossing times with all these users in mind to aid those who need more time, preventing crashes and serious injuries. This shift to inclusivity fosters a safer, more equitable transport system, enhancing safety and comfort for all, regardless of age, gender, or physical abilities.

[45] Aeron-Thomas, A., Jacobs, G., Sexton, B., Gururaj, G. and Rahman, F. 2004. *The involvement and impact of road crashes on the poor: Bangladesh and India case studies*. Department for International Development. London.

[46] WHO (World Health Organization). 2023. *Road Traffic Injuries*. Geneva.

[47] US Department of Transportation. Federal Highway Administration. 2016. *Pursuing Equity in Pedestrian and Bicycle Planning*. Washington, DC.

[48] Kahane, C. J. 2013. *Injury vulnerability and effectiveness of occupant protection technologies for older occupants and women.* National Highway Traffic Safety Administration. Washington, DC.

2

Principles for setting safe speed limits under the Roads-for-Life (R4L) framework

The Roads-for-Life (R4L) framework is a new, practical and innovative tool, developed to help select safe speed limits for all types of roads and road networks. It reflects the evidence-based state of knowledge in speed limit selection, drawing from a review of approaches used across different countries, recent literature (as documented throughout this Guide, including Appendix B), and refinement based on trials of earlier versions of the framework in several countries.

The R4L framework is based on the Safe System approach and draws upon key elements of the *Movement and Place* philosophy.[49] It recognizes that roads move both people and goods and serve as destinations in their own right. It points out that these two demands are often in conflict. To optimize the movement of people and goods, roads should minimize travel time and allow people and goods to keep moving. In contrast, as places where people congregate for other activities, roads should be safe and attractive.

Unlike traditional functional road classification approaches (discussed below), the R4L framework takes into account the movement and activity needs of VRUs such as pedestrians and cyclists using the road, children playing or people shopping in markets on the roadside. The R4L framework makes this possible by translating these concepts into a practical structure for classifying roads and setting safe speed limits. It identifies the purpose of a road in a way that allows safety for all types of road users and balances their needs across the road network. Accordingly, the speed setting process considers the priorities of different travel modes, roads and contexts, and the best outcomes for walking, cycling, and place-making as well as driving. It supports productivity and efficiency by facilitating movement of goods and people as well.

The R4L framework stipulates that all speed limit setting activities should be guided by four basic principles to ensure that speed limits at national and local levels are safe and credible. This means that they are accepted by most drivers without enforcement due to the alignment between road infrastructure and the speed limit[50] (Figure 6).

[49] Vicroads. 2019. *Movement and Place in Victoria*. Melbourne.

[50] Yao, Y., Carsten, O. and Hibberd. D.O. *A close examination of speed limit credibility and compliance on UK roads*. IATSS Research. 44 (1).

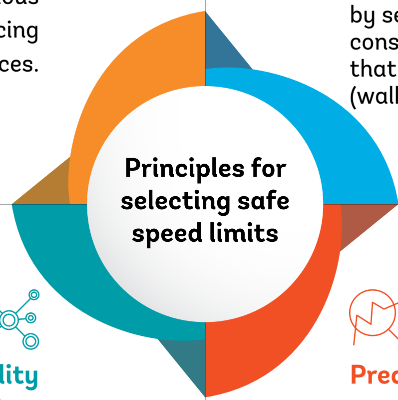
Figure 6. Principles for selecting safe speed limits. All speed limit setting activities should be guided by all of these principles to ensure safety and credibility

Safety for all

Proactively set speed limits that eliminate the risk of fatal and serious injury to all road users by reducing impact speeds and crash forces.

Community wellbeing

Prioritize the equity, health and environmental wellbeing of the community, by setting speed limits through active consultation with communities at a level that supports active transport modes (walking, cycling).



Network availability

Take a network-wide approach to mobility planning by setting speed limits that provide safety, efficiency and functionality benefits across the network for all road users.

Predictability

Set speed limits so they are clear and easily understood and consistent with speed limits on roads with similar characteristics and road user needs.

Safety for all (guiding principle)

- Eliminate fatal and serious injuries for all road users by keeping speeds to tolerable levels for the human body as per the Safe System approach
- Prioritize safety for all road users by ensuring that speed limits reflect the infrastructure available, the road environment, and the actual use of the road rather than just road classifications
- Don't wait for crashes to happen to take action, but employ a proactive approach that anticipates risk, adapts to changes, and aligns with surrounding context and needs
- Use a shared approach to speed management that invites diverse perspectives from policy makers and road safety stakeholders as well as technical experts and road users
- Use an evidence-based approach that integrates different planning tools in processes and decisions including political and community engagement, enforcement, communications, road infrastructure, and vehicle technology

Community wellbeing

- Prioritize the equity, health, and environmental wellbeing of the community by considering the co-benefits of safe speeds
- Set speed limits, especially on local roads, at a level that supports active transport modes (walking, cycling) and minimizes adverse impacts on amenities
- Set speed limits by consulting and informing affected communities and road users so that expectations are managed, and the impacts of speed changes are understood by the public

Predictability

- Set speed limits to be consistent with speed limits on roads in similar environments with similar characteristics and road user needs
- Set speed limits so they are clear and easily understood. When choosing infrastructure interventions remember that the ultimate self-explaining road is designed in such a way that speed limits are clear and reflected in the physical characteristics of the road infrastructure
- Keep speed limit changes to a minimum and ensure they are gradual. If conditions vary within a small area or short distance that does not allow for gradual transition, then select the lower speed

Network availability

- Set speed limits that provide safety, efficiency, and functionality benefits across the network for all road users
- After safety, consider accessibility and mobility, aiming for speeds that optimize safe and easy access for all road users across the road network under consideration
- Plan the road network to provide needed infrastructure for all road users present and provide safe alternative routes if needed. This may include encouraging certain road users onto specific routes and banning them from others, for instance, limiting vehicular access in low-speed zones, or banning pedestrians or cyclists from high-speed motorways while providing parallel routes
- Assess risk factors for road injury or death throughout the network and not just at certain high-risk locations, to prioritize improvements, interventions, or speed limit changes

The R4L Framework, based on these principles, is a core element of this guide.

The main differences between many of the traditional functional road classification approaches and this new framework are summarized in Table 2. This comparison highlights some of the faults with previous approaches and the benefits from using this new framework.

Table 2. Setting speed limits based on traditional functional road classification (left) versus setting speed limits based on the Roads-for-Life framework (right)

Traditional functional road classification approaches…	The Roads-for-Life framework…
…define the function of a road based on its hierarchy and set limits based on motorized traffic flow with limited consideration for vulnerable road users and land use context.	…classifies the road or road section based on the vulnerability of all road users, sets speed limits based on Safe System survivable impact speeds and considers that roads must both move people and goods and be attractive places for vulnerable road users.
…classify roads and determine speed limits and road design for the whole road segment regardless of changing road user needs and context ("A highway is always a highway").	…varies the road classification and speed limit for each section of any road depending on the context, or how the road is being used there. It recognizes that, because conditions and road user needs can change along a single road, its classification and speed limit should too.
…design roads for the typical or predominant motorized road users.	…designs roads and road sections for the most vulnerable road users, usually pedestrians and/or cyclists.
…react to speed-related crashes and take an incremental approach to reduce the problem.	…proactively targets and treats speed-related risks using a systematic approach to build a safe road system.

Traditional approaches for setting speed limits often prioritize vehicular traffic flow and efficiency. They define the functional road classification mainly based on motorized traffic flow without considering other road users and surrounding context and land use. This is not good practice and can undermine safety. In many situations roads classified as an arterial road (i.e., a "highway"), with corresponding speed limits of 100 kph, cut through cities or villages where pedestrians, cyclists, including school children walk, pedal, or play by the roadside. The classification of these road sections and the corresponding speeds should be adjusted to match the actual use and context.

Box 2.1. Why speed limits should not be set based on the 85th percentile

A traditional approach to speed limit setting has been the use of the "85th percentile" method. This has also led to poor road safety outcomes. This approach measures the "desired" speeds of motorized traffic and assumes that the appropriate speed is one whereby 85 percent of traffic complies with the speed limit. The rationale for this approach is that drivers are capable of making decisions about a safe speed; that the approach will reduce the speed variance (speed dispersion) of traffic; and that this approach makes enforcement of speed limits more reasonable.

However, each of these arguments is flawed. Speeds selected by most drivers are actually not safe in any absolute sense as drivers do not consider all the relevant costs and benefits. Also, drivers' subjective assessments of risk, and the relationship between speed and risk, are likely to be inaccurate. As far as speed variance (speed dispersion) is concerned, most fatal crashes stem, not from speed variance, but from the actual traveling speed of the vehicle. This includes single vehicle crashes, intersection crashes, and pedestrian crashes.

There is now strong evidence that setting and enforcing speed limits lower than the 85th percentile speed is feasible, sustainable, and safer. Still, knowing vehicle speed, including 85th percentile speed, is useful when identifying whether speed limits need to be supported by other measures such as enforcement or infrastructure. But this approach should no longer be used to set speed limits.

Source: US Department of Transportation. 2023. *Intersection safety*. Washington, DC.

Traditional approaches also:

- Set speed limits based on the "85th percentile" method (see BOX 2.1) and without involving the local stakeholders and the communities concerned
- Implement uncoordinated isolated speed management interventions
- Fail to provide policymakers with evidence-based information and facts that correct common misconceptions around speed
- Rely only on speed limit signs, even though drivers often disregard posted speeds unless these are coupled with adequate infrastructure and enforcement
- Expect that public campaigns in newspapers and on TV will influence road user's speed choice, although such campaigns often don't work

The ultimate goal of road safety management (and speed management) should be to create clear classes of roads that provide protection for all types of road users through adequate design. Good progress is being made on this in several European countries like the Netherlands (see BOX 2.2). However, this is a complex and long-term endeavor. In the meantime, the R4L framework can fill gaps and enhance safety.

Box 2.2. How the Netherlands led the way to a safe and sustainable road network

Based on its vision of Sustainable Safety, the Netherlands has defined three main road categories, each with its own design principles and features:

- Through-roads allow traffic to travel from origin to destination as quickly and safely as possible ("flow"). Car traffic has the highest priority. Through-roads may only be situated outside urban areas.
- Distributor roads connect through-roads with access roads. Traffic flows along road sections and exchanges occur at intersections. Distributor roads are found in both urban and rural areas. Speed limits range from 50 to 70 kph in urban areas to 80 kph in rural areas. Recently, a new type of distributor road has been proposed: a distributor road with a 30 kph limit, where distributor roads cannot be safely designed as 50 kph roads while meeting the needs of all road users.
- Access roads offer direct access to residential areas at the locations of origin and destination. The residential function is prioritized and car traffic needs to adapt (in particular by travelling at low speeds). Access roads can be found in urban areas and in rural areas and include 30 kph roads and slow zones (15 kph) in urban areas, as well as 60 kph roads in rural areas.

Design guidelines for these types of roads were developed to reflect their essential characteristics (i.e., elements that are always present or never present in the design of a type of road) with the following aims:

- Recognizable road types
- No conflicts with oncoming traffic
- No conflicts with crossing traffic
- Separation of types of traffic
- No obstacles on the roadside
- Roads should fit into the surroundings

Source: Sustainable Safety. https://sustainablesafety.nl/

2.1. Basic concept of the Roads-for-Life framework and methodology

Setting context specific speed limits to cover a variety of conditions and the needs of all road users can be a complex process. The Roads-for-Life framework integrates Safe System survivable impact speeds into this process. It also goes beyond traditional road classification approaches by considering the following factors:

- Road characteristics and conditions, such as land use and surrounding activities
- Specific spatial functions (e.g., schools, hospitals, transit stations, markets)
- Type of road users and traffic
- Infrastructure quality and design

The framework offers a practical tool for setting speed limits based on these concepts that reflects the diverse needs and prioritize safety of road users, including VRUs.

The **presence of VRUs** on a road describes the extent to which a road and its adjacent land uses are used beyond movement and traffic flow. The level of pedestrian activity on the road is an indicator to classify this demand. It considers the location of people and activities and the resulting demand for staying on the road, for instance, to shop or walk to work, to cross it, or travel along it. It mainly applies to built-up or urban environments such as cities, towns and villages, where economic activity, equitable access to opportunity, and inclusive social connectedness are as important as transport needs. Still, in sparsely built-up or rural environments, the presence of VRUs can also be significant, for example in hamlets or linear rural settlements as well as on sites with schools, roadside trading or similar activities.

A road's **demand for movement of people and goods** describes the strategic importance of the road for safely moving people and/or goods, across all modes, and the scale of movement it intends to accommodate.

Roads can be categorized based on which type of demand is dominant. **But when these demands compete, the safety of VRUs should be prioritized**. This means:

- Roads or road sections with many VRUs must have limited movement and be oriented to pedestrians and other vulnerable road users, especially children and/or the elderly. Speeds should be set at a maximum of 30 kph. This is true for most roads in urban areas
- On roads or road sections that need to accommodate both VRUs and the movement of people and goods, priority should always be given to VRUs and speeds should therefore often be lowered to 30 kph. Still, such roads can reach a maximum of 50 kph where VRUs are protected from motorized traffic by safe crossing facilities in addition to adequate sidewalks and cycling lanes
- Where the primary need is to move people and goods, and virtually no VRUs are present, roads must still be designed to move all vehicles and occupants safely and to restrict access by VRUs. VRUs should be separated from motorized traffic with adequate crossings or diverted to an attractive alternative route

This relatively simple categorization is broadly applicable, practical to apply and provides the basis for the R4L framework to assist with balancing the competing demands on a certain road or road section.

The R4L framework can be used on new or existing roads on a network-wide scale, as well as on a specific road or road section. Use cases of the framework include:

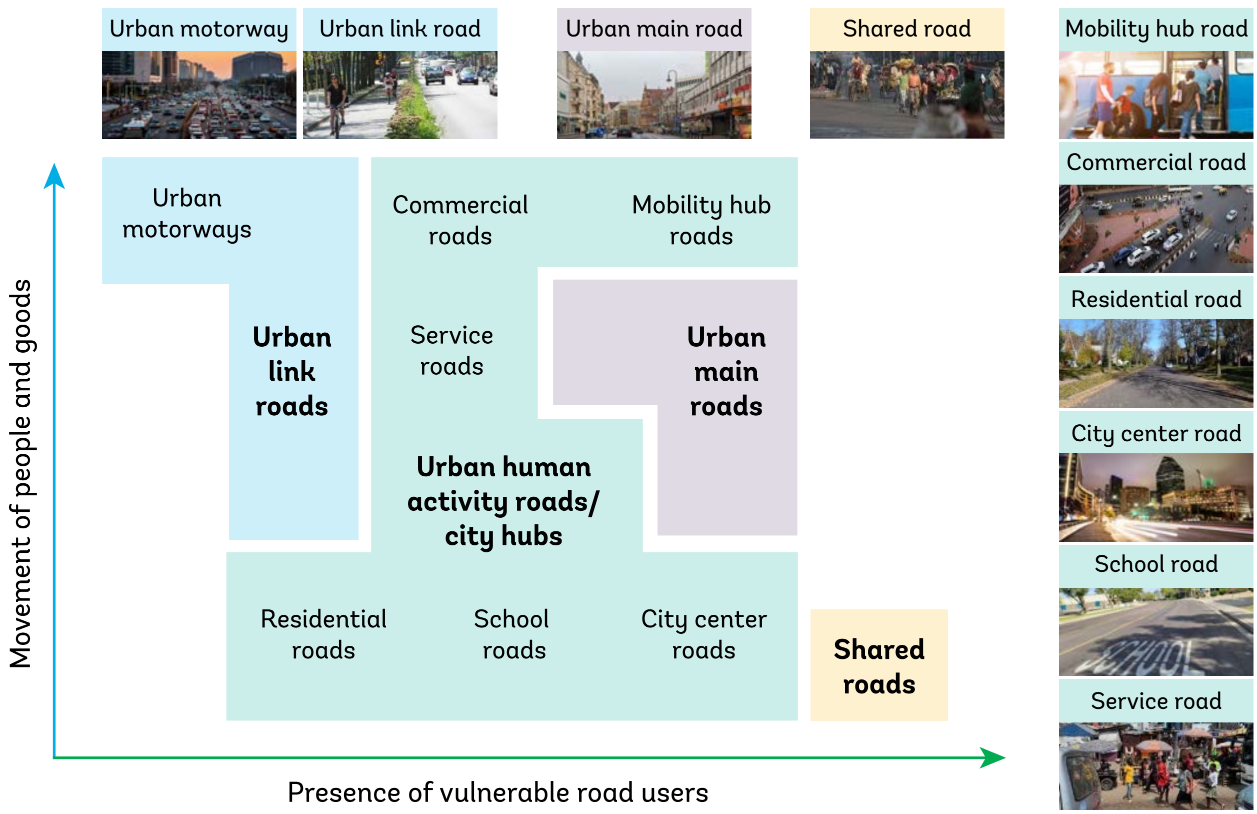
- **Assessment of a road network to set speed limits** by defining the nature of the different network zones and assigning the pertinent safe speeds
- **Review of new development or major changes,** for example to accommodate zoning change or set safe speeds
- **Tool for community engagement** to collect input on road use, perceived crash risk and potential responses and interventions
- **Evaluation of speeds at hot spots for injuries and fatalities** identified by public input or crash data
- **Assessment of infrastructure provisions** needed to make roads safe if higher speeds are required

The speed limits provided by the R4L framework are maximum limits and may need to be lower when the actual situation on the road or road section warrants it. The following sections detail different types of roads or road sections, and corresponding recommended maximum speed limits, for urban and rural areas.

2.2. Roads-for-Life framework for urban roads or road sections

This typology covers not only cities, but other built-up areas such as city-outskirts and towns and villages. These roads or road sections have a mix of users, often many pedestrians and/or cyclists, and many intersections over short distances. In some cases, the use of the road can change throughout different times of the day. The different road types present in urban areas are shown in Figure 7.

Figure 7. Roads-for-Life framework for selecting safe speed limits for urban roads or road sections. This figure includes a matrix of urban road types in relation to their demands and a table with corresponding recommended speeds



Type of road or road section and description	Safe speed limit
Shared road	
Road space where pedestrians and other vulnerable road users use the same road space as motorized vehicles; including road spaces within schools, hospitals, nursing homes or similar social infrastructure	Max. 10kph
Urban human activity road/city hub	
Road space where people gather, live, play and/or work on/next to the road and where people are likely to cross	Max. 30 kph
Urban main road	
Road space which provides mobility and connects with the wider transport network, while accommodating for a high presence of vulnerable road users, on-road activity and public life	Max. 30 kph - 50 kph*
Urban link road	
Road space which provides mobility for people and goods between city districts/strategic centers and mitigates the impact on adjacent communities and where vulnerable road users are protected from motorized traffic (e.g., by adequate sidewalks, cycling lanes, safe and signalized pedestrian crossings) or even prohibited (i.e., access-controlled urban motorways)	Max. 50 kph - 80 kph

* Speed limits higher than 30 kph only for urban main roads with safe, adequate, and attractive provision for all vulnerable road users, including sidewalks/cycling paths with an adequate width and safe and adequately spaced crossing facilities.

A maximum speed limit of 10 kph should be applied on shared roads where pedestrians are a priority, and they and other VRUs occupy the same road space as motorized vehicles. This includes walkable historic town centers and roads within schools, hospitals, nursing homes or any other similar social infrastructure, regardless of whether these roads are embedded in an urban or less populated setting. The needs and vulnerability of children, the elderly and persons with disabilities should be specifically considered in road design.

Urban human activity roads/city hubs include all roads or road sections on or next to which people gather, live, play and/or work, in cities, city outskirts, towns and villages. Urban human activity roads include:

- School roads: roads or road sections close to schools or similar infrastructure
- City center roads: roads or road sections with very high-density mixed use (e.g., high-rise residential/office buildings), downtown commercial use (e.g., shopping boulevards), and civic spaces
- Residential roads: roads or road sections which provide residential access for people of all ages and abilities, foster neighbourhood spirit and facilitate local community access (in the traditional functional road classification system, some of these roads are called "local roads"). In some cases there may be limited commercial activity mixed with residential properties.
- Commercial roads: roads or road sections which provide access by various modes of transport to shops and services
- Mobility hub roads: roads or road sections with dense activity and a high demand for all modes of transport, especially public transport
- Service roads: roads and road sections that run parallel to wider, urban main roads and provide access to markets, shops, houses, factories or other buildings along them

With their mix of users, these roads should have a maximum speed limit of **30 kph**. Safe, adequate, and accessible provisions for all VRUs, including motorized two- and three-wheelers should be provided (see BOX 2.3). If higher speeds are required, then provisions must be made to separate VRUs from motorized traffic, such as wide enough sidewalks for them to avoid any obstacles, and safe crossing facilities.

Quick tip for practitioners

To have better acceptance, speed limit changes should start where the strategic impact of a speed reduction is high. In this context, school areas are often ideal, as these areas have some of the most vulnerable road users. It is very hard for local stakeholders as well as the general public to not support protection of school children by limiting speeds. Strive to ensure the school zone is not too small and that access roads also maintain a low speed.

Urban main roads connect cities, outskirts, towns and villages with the wider transport network. VRUs are present but there is also significant motorized traffic and demand for movement of people and goods to support businesses. The traditional functional road classification system labels some of these roads "collectors" or "arterial roads". For urban main roads with adequate sidewalks as well as a limited demand for crossing and/or adequate crossing facilities, a maximum speed limit of **50 kph** may be allowed. Where vulnerable road users cross or walk along the road and safe infrastructure provisions are lacking, a maximum speed limit of **30 kph** should be used.

Urban link roads provide mobility for people and goods between city districts and strategic centers and mitigate the impacts of road traffic on adjacent communities. In the traditional functional road classification system these roads are often called "arterial roads", "highways" or "urban motorways". For divided urban link roads where pedestrians and cyclists are not present or expected, a maximum speed limit of **60 kph** should be used. Where medians are provided, **70 kph** is a possibility. At intersections and junctions with roundabouts, raised intersections or other provisions to prevent collisions, a maximum speed limit of **50 kp**h should be set.

For access-controlled urban link roads (e.g., urban motorways), where VRUs are prohibited and directed to separate attractive alternate facilities (e.g., urban motorways or expressways) a maximum speed limit of **80 kph** is possible. In urban contexts, higher speeds are not recommended even with adequate infrastructure, due to noise, air pollution and traffic flow considerations. Where road quality is not good or where controlled access cannot be guaranteed (e.g., due to a lack of enforcement) lower speed limits should be applied, even if the road is categorized as an access-controlled urban link road.

Box 2.3. Speed management for motorcycles in urban areas

Motorcyclists are amongst the most vulnerable on our roads. Riders can reach high speeds and are not protected by the vehicle structure during or following an impact, so there is great potential for serious injury. Thus, the percentage of road crash deaths caused by motorcycles in low-income countries (39%) and middle-income countries (34%) is relatively high (Yousif et. al., 2020).

Safe speeds for motorcyclists are still the subject of research. However, guidance from studies like Jurewicz et. al (2016) suggest that speed limits needed to protect pedestrians should apply to cyclists and motorcyclists until more specific evidence is assessed.

Valderrama et. al (2023) identified that in an urban setting motorcycle safety requires speed management measures along corridors rather than just at hotspots or intersections.

To protect motorcyclists and reduce speed along corridors, cities should install cameras that correctly capture a motorcycle's license plate in the necessary direction (with images captured from the rear of the motorcycle). Average-speed enforcement over a corridor (rather than at point locations) is also key for curbing compensating behaviors. In Bogotà, speed cameras helped reduce overall fatalities by 21%, although riders and drivers only lowered speeds in camera locations.

Sources:

Jurewicz, C., Sobhani, A., Woolley, J., Dutschke, J. and Corben, B. 2016. *Exploration of vehicle impact speed–injury severity relationships for application in safer road design*. Transportation Research Procedia 14. 4247-4256.

Valderrama, S.L., Palacios, M.S., Botello, V.P., Perez-Barbosa, D., Arrieta, J.V., Kisner, J. and Adriazola-Steil, C. 2023. *On Speed Management, Public Health, and Risky Behaviors: Examining the Side Effects of Automated Speed-Enforcement Cameras on Traffic Crashes in Bogotá, Colombia*. Transportation Research Record.

Yousif, M., Sadullah, A. and Kassim, K. 2020. *A review of behavioural issues contribution to motorcycle safety*. IATSS Research. 44 (2). 142-154.

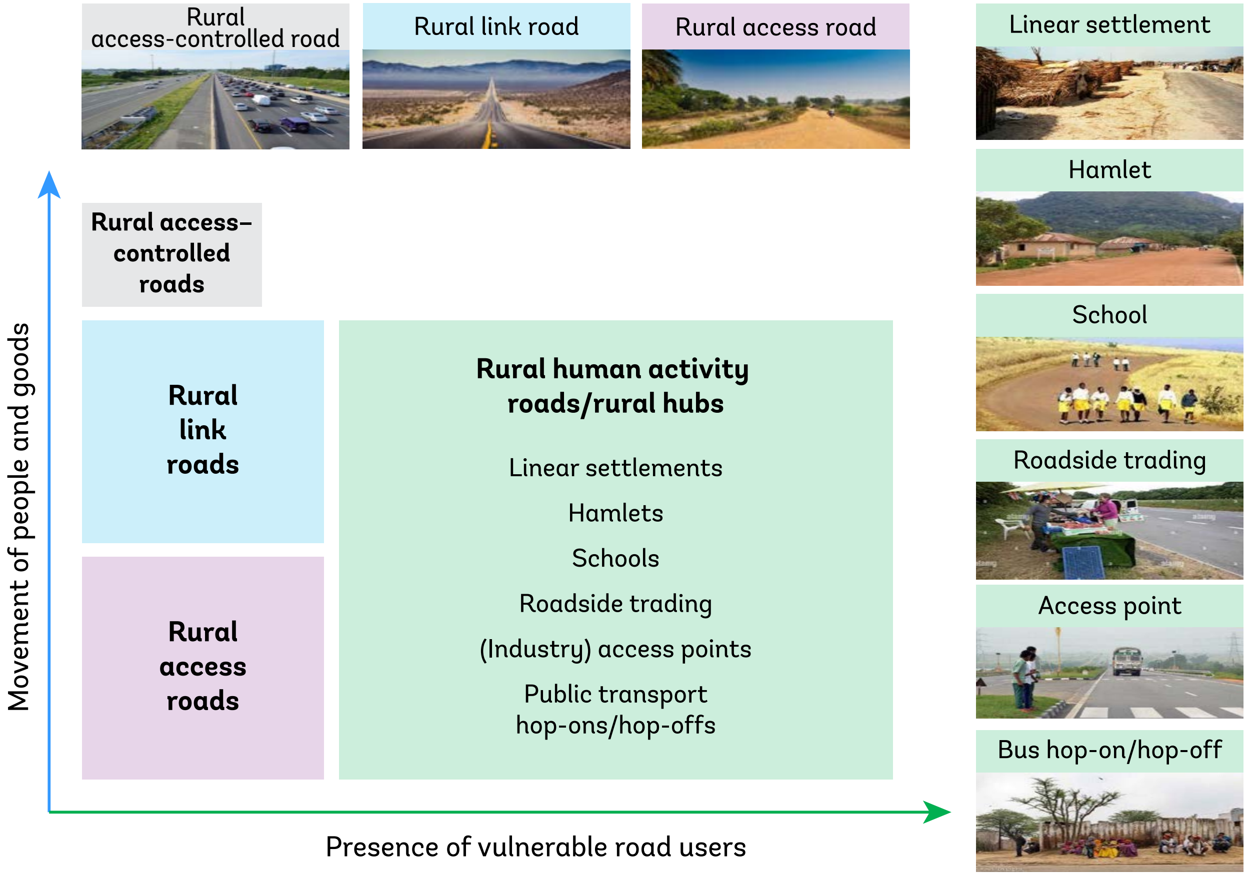
2.3. Roads-for-Life framework for rural roads or road sections

Roads or road sections in rural areas include major and minor roads outside cities, city outskirts, towns, or villages. These roads connect urban areas to the surrounding regions for the movement of people and goods, and link smaller rural settlements and their residents to markets, workplaces, schools, places of worship and other key destinations. Compared to urban roads, rural roads are usually characterized by long stretches followed by curves and intersections and may include dips and crests. Severe and fatal crashes are disproportionately common on these roads due to inappropriately high speeds combined with a lack of safe infrastructure.[51] These roads are often poorly maintained, with no physical separation of lanes, and mixed traffic without a dedicated infrastructure for each type of road user.

In Figure 8 the different road types present in rural areas are shown.

[51] IIHS (Insurance Institute for Highway Safety). 2023. *Fatality Facts 2021*. https://www.iihs.org/topics/fatality-statistics/detail/urban-rural-comparison

Figure 8. Roads-for-Life framework for selecting safe speed limits for rural roads or road sections. This figure includes a matrix of rural road types in relation to their demands and a table with corresponding recommended speeds



Type of road or road section and description	Safe speed limit
Rural human activity road/rural hub	
Road space in a rural area where people gather, live, play and/or work on/next to the road or cross it to reach adjacent land-uses (e.g., linear settlements, hamlets, schools, roadside trading, (industry) access points, public transport hop-ons/hop-offs)	Max. 30kph
Rural access road	
Road space in a rural area which provides access to residential or industrial activity and supports these activities	Max. 50 kph - 70 kph*
Rural link road	
Road space in a rural area which provides the link between rural access roads and rural access-controlled roads	Max. 70 kph - 80 kph
Rural access–controlled road	
Road space with access control where vulnerable road users are prohibited	Max. 100 kph

* Speed limits higher than 50 kph only for rural roads with no or very limited built-up development, good visibility, no sharp curves and roadside protection as well as safe, adequate, and attractive provision for vulnerable road users (if present), including sidewalks/cycling paths with an adequate width and safe and adequately spaced crossing facilities

Rural roads tend to be perceived as remote, low-density areas that should allow higher speeds, when in reality, some rural areas are home to numerous VRUs who require the same consideration as those in cities. Speed levels should be set to prioritize their safety. Rural roads in LMICs are particularly likely to have stretches where large numbers of VRUs are active in or next to the road, with no separation from motorized traffic.

In this context, **rural human activity roads/rural hubs** are roads or road sections, where people gather, live, play, work and/or cross due to adjacent land-use such as linear settlements, hamlets, schools, places of work or worship, or public transport stops. These are high-risk areas for which a maximum speed limit of **30 kph** is necessary. If higher speeds are needed, adequate separation of road users is required.

Rural access roads provide access to residential or industrial activity in rural areas. These are primarily poorer quality roads in sparsely populated lower traffic areas that are not designed for higher-speed travel. In some cases, they will be unsurfaced (e.g., dirt roads, or roads with a gravel overlay). They are often owned by local authorities, connect different communities and provide market access to farms and farmland. In the traditional functional road classification system, some of these roads are called “rural local roads”. For low quality rural access roads with unprotected roadside obstacles or hazards such as trees or poles, sharp curves, low visibility, steep grades or poor surface quality as well as frequent at-grade intersections or junctions, a maximum speed limit of **50 kph** should be provided.

The traffic composition on unpaved or low-quality roads tends to vary from private vehicles to agricultural machinery and animal-drawn carriages. Poor maintenance can compromise the structural integrity of these roads, and uneven road surfaces can damage vehicles and cargo, but these conditions can also enhance safety by encouraging drivers to slow down.

Some rural access roads pass through smaller villages and linear settlements with sporadic roadside developments where pedestrians, cyclists, and motorists stop and start. In such situations, a maximum speed limit of 50 kph is possible, but where more VRUs are present even lower speeds **(e.g., 30 kph)** might still be required.

For rural access roads with adequate protection from roadside hazards but no median or barriers between opposing traffic flows, a maximum speed limit of **70 kph** is possible. However, at intersections and junctions, speeds should be reduced to **50 kph** to ensure safety. This can be achieved by using infrastructure solutions such as roundabouts.

Rural link roads connect significant rural towns and villages and may also link rural access roads to rural access-controlled roads. In the traditional functional road classification system, some of these roads are categorized as “rural collectors”, “highways” or “arterial roads”. These are two-lane or multilane roads with high-quality infrastructure, adequate protection from roadside hazards, facilities at intersections or junctions (such as roundabouts), but no median or barriers between opposing traffic flows - a maximum speed limit of **70 kph** is possible.

Higher speeds may be allowed on rural link roads at sparsely populated locations in remote or natural areas with a median or barrier between opposing traffic flows and protection from roadside hazards. **Maximum speed limits of 80 kph** may be set where such protection is provided to minimize the likelihood and severity of head-on crashes. Speeds still need to be lowered and managed at intersections, where impact speeds above 50 kph are not typically survivable.

Rural access-controlled roads are
high-speed roads (usually motorways) with a maximum speed limit of **100 kph**. Traditional functional road classification systems refer to some of these roads as "interstates" or "arterial roads". Access-controlled roads restrict motor vehicles, sometimes requiring legally binding minimum speeds. Pedestrians, cyclists, slow-moving vehicles and public transport are prohibited, and given safe, attractive, alternative routes to follow. Grade-separated intersections and interchanges are required. These intersections have ramps long enough for acceleration and deceleration to allow continuous vehicular flow. Vehicles traveling different directions are physically separated (e.g., by median barriers). Roadside shoulders, emergency lanes or clear zones, which are places where drivers can pull off, must be free from fixed objects or shielded with adequate safety barriers.

Whether a maximum speed limit of 100 kph is "safe" can depend on vehicle quality and compliance with laws such as those requiring seatbelts and child restraints or prohibiting slow-moving pedestrians, cyclists, or human- or animal-powered carriages. Where some of these conditions are not met, or other hazards are present, much lower speed limits are needed. One hazard to consider is the placement of public transport, bus or minibus stops. These vehicles often stop in places that force passengers to walk along or cross busy, high-speed traffic lanes. These stops must be moved off the access-controlled roads to routes where safe stopping and boarding is possible. Most importantly the safety of the passengers must be considered in the planning process.

3

How to implement safe speeds

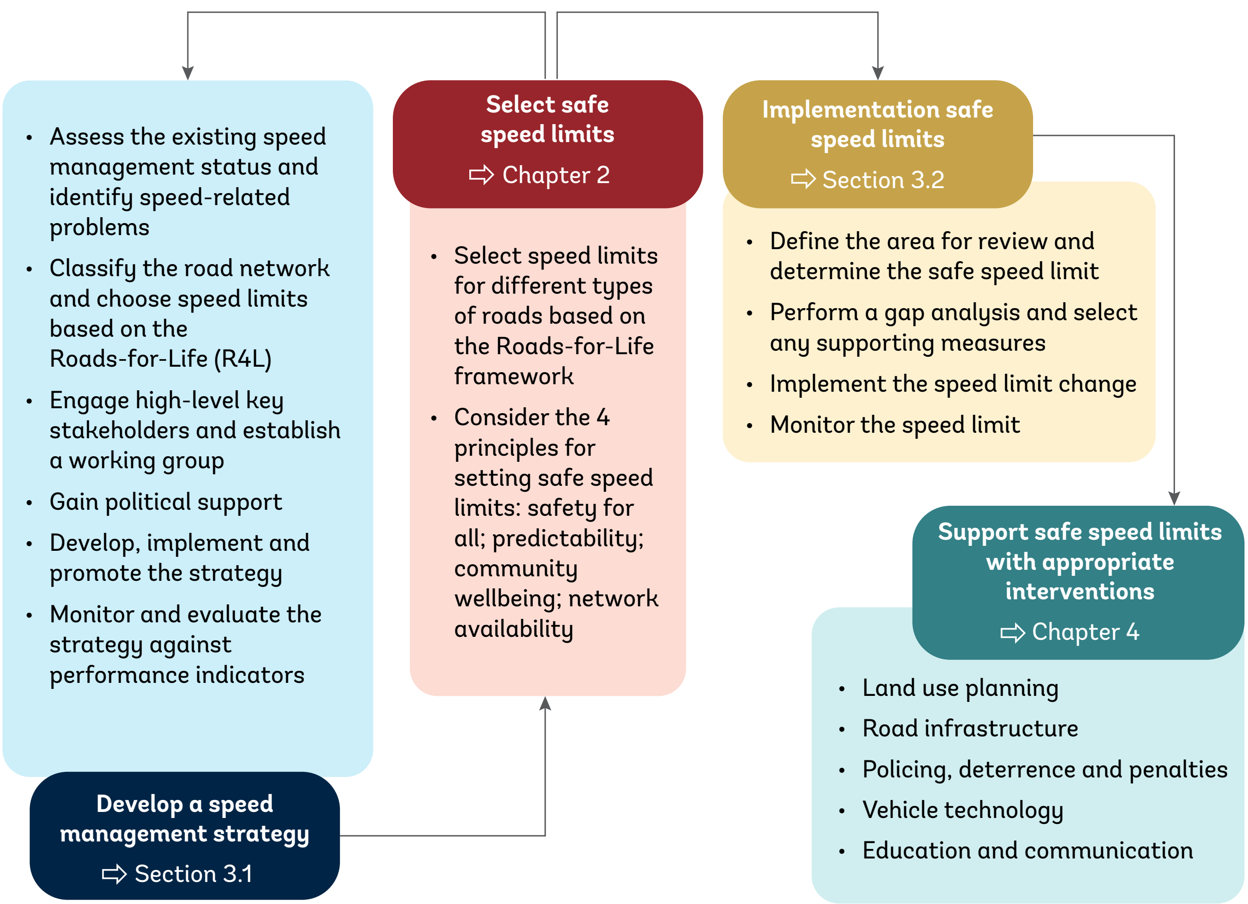
Speed management is one of the most complex aspects of road safety and should be treated as a comprehensive process. Ideally, it should be based on a speed management strategy and include identifying, setting and implementing safe speed limits, supported by appropriate interventions. This can ensure that speed management, as well as speed limit setting, are robust and consistent, and that changes with the greatest road safety impact are prioritized.

A speed management strategy can be a powerful instrument to help implement change. This is a long-term high-level document for implementing safe speeds across a road network, often at a national level. A speed management strategy should be supported by **speed management action plans**. However, a speed management action plan could also be developed locally, without being part of a high-level strategy or if a strategy is missing.

Once the safe speed limits are selected, the next step is the actual **implementation of these speed limits**, for example, in a city or region, on a corridor, on a road or road section, or on a high-risk location. A stepwise process for the implementation is presented **later in this chapter**.

Appropriate interventions in the fields of land-use planning, road infrastructure, enforcement and deterrence, vehicle technology as well as education and communication are often needed **to support the safe speed limits** and are presented in **Chapter 4**.

Figure 9. Speed management process showing the major steps and the potential links between them. The selection of speed limits can be part of a full process or the first main step on its own, depending on conditions and opportunities



The complete speed management process is detailed in Figure 9 Selecting safe speed limits (red box in Figure 9) is a central part of this speed management process. It can also be part of speed management strategy development but need not necessarily be based on or linked to a speed management strategy, if none has yet been developed. Often, where there is no national or regional strategy or management process in place, urgent change may be needed, or important opportunities may present themselves (such as new political support for an urban 30 kph general speed limit). Seizing opportunities based on robust evidence (including the guidance in this chapter), can improve road safety and save lives (see BOX 3.1).

Box 3.1. A national vision for safer, healthier, more sustainable and livable cities in Spain

In May 2021, the Ministry of Interior in Spain promulgated a measure that sets speeds throughout Spanish cities, aiming to improve road safety, reduce traffic crashes, and create more livable urban environments. The decision came after a surge in urban crashes caused many fatalities and serious injuries. It supports the national Road Safety Strategy Seguridad Vial 2030, designed to consolidate a culture of safe mobility, advance Spain towards the goal to achieve zero traffic fatalities and serious injuries by 2050, and contribute to other mobility policy objectives.

The Ministry's road safety policy is aligned with the Safe System approach that emphasizes the risk caused by speeds over 30 kph, and the 2020 Stockholm Declaration. It sets speed limits on urban roads and crossings as follows:

- 20 kph on roads that have a single roadway and sidewalk platform
- 30 kph on single lane roads in each direction of travel
- 50 kph on roads with two or more lanes in each direction of travel

With this, Spain joined many pioneer cities in Europe that adopted 30 kph speeds on their roads. Extensive experience with 30 kph zones in cities across Europe, including Spain, has demonstrated the benefits for road safety, by reducing crashes by up to 40% as well as improving mobility and health, boosting walking and cycling, and benefitting the environment.

According to the Spanish Ministry of Interior's National Road Safety Observatory, in the first year after speeds were reduced (May 2021 – May 2022) fatal crashes fell by 20%, fatalities by 18%, and serious injuries by 9%, below what they were in 2019.

Spanish Minister of Interior, Fernando Grande-Marlaska Gómez called the new policy a powerful tool for city councils to use to distinguish between and manage different roads with different needs, such as "calles de estar" "roads for human activity", that should be calm and used mainly by residents, and "calles de pasar" "roads for movement", with higher speeds that are used for medium- and long-distance traffic in the city.

Grande-Marlaska also credited all Spanish cities that, over the last decade, have worked to advance livability and safety on their roads, for setting an example and making this national policy possible. The Spanish Federation of Municipalities and Provinces, other ministerial departments, and various civil society groups played decisive roles as well.

Source: Dirección General de Traffico. 2022. Estrategia de seguridad vial 2030. Madrid.

3.1. Developing a speed management strategy

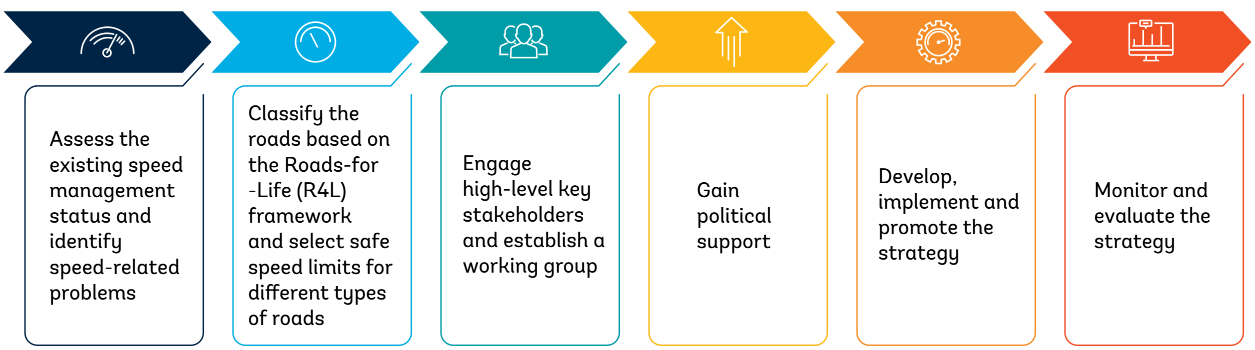
> **Quick tip for practitioners**
>
> When there is momentum and community support for reducing speeds to 30 kph in an urban corridor or area, use it and scale it up through communication campaigns and pilot projects.

A speed management strategy (also known as a speed management program) is a long-term document for implementing safe speeds across a road network, often at country-level. Strategies are usually established in line with the national road safety program and other high-level documents related to road safety and transport. Because of their numerous co-benefits, speed management strategies sometimes fall within equity, economic development, and climate change agendas. **A national speed management strategy is ideal to ensure national consistency. In the absence of such a strategy, or where the strategy does not yet embed Safe System principles, regions or cities can proactively develop their own strategies within existing legal frameworks and based on the principles outlined in this guide.** Regions or cities that value safe speeds and understand the local context can set a powerful example for decision makers at the national level.

A speed management action plan should be prepared for implementing a speed management strategy. An action plan can be created as part of a speed management strategy, or separately, and it can be helpful in selecting and implementing interventions and monitoring and evaluating planned activities. When an action plan is created separate from a strategy, it is important to make it consistent with country policies and legal frameworks and to align it with any emerging national or local strategy.

Figure 10 shows a suggested sequence of steps for developing a strategy. A different sequence is possible depending on local context and circumstances.

Figure 10. Developing and implementing a speed management strategy



Each of the steps in Figure 10 are described below in more detail.

Assess the existing speed management status and identify speed-related problems

When agencies start developing a speed management strategy, the first step is to understand and evaluate the current status of speed management and the existing laws and institutions. It is also important to establish, early in the process, who the key political leaders are and which administrative bodies and levels of the government (federal/national, state or local) have the ability to enact speed limit change. Relevant agencies should be involved in the process from the outset to ensure that any changes in speed limits can be legally enforced. These may include ministries such as public works departments that wield authority over roads; interior departments responsible for police; transport departments that manage general road safety issues and programs; and departments that handle planning, zoning and the environment.

Data that illustrates how speeding affects road safety and the severity of crashes and injuries can establish the way forward, and lay the foundation for a robust speed management strategy. For example, analyzing crash data can identify speeding problems and determine their causes. Compelling data showing the detrimental impacts of speeding can also galvanize support from politicians and the public. Although complete and reliable crash data is an ideal starting point, a lack of data should not prevent the development of a speed management strategy.

Assessing current laws and governing authorities is a step usually carried out on a national level, but it can also be carried out at a local level when developing a local speed management strategy.

Gathering this information makes it possible to identify weaknesses in the current system and opportunities to improve it. The findings from this initial analysis should answer the following questions:

Political and legal structure:

- Who are the key political authorities and important stakeholders?
- Which administrative entities set current speed limits?
- Are authorities limited to the national level? How are national roads that cross local jurisdictions managed?
- What are the guiding legal documents for setting speed limits and for road signs and markings?
- Where in the current speed management system is there a lack of resources (knowledge, human and/or financial)?

Road design and engineering:

- Who makes decisions on road design codes, standards and manuals and what are there flaws in these documents?
- Who makes decisions on investing in changes needed to make roads safe?
- Who makes decisions on city expansion or on new projects?
- Are there national or local guidelines for safe infrastructure?

Policing and deterrence:

- Is current road policing focused on speed compliance and is it carried out in the most efficient way, according to the Safe System approach?
- Are speeding fines adequate or too low?
- Does the country/region/city use electronic enforcement? If so, is the electronic enforcement only employed for certain road types or speed limits?

Vehicle technology and safety management:

- What possibilities do the tax, public grant, and/or insurance systems offer to promote vehicle technologies that manage speed? For instance, reducing insurance premiums in exchange for installing crash data recorders.
- Could taxes be lowered, or grants provided for equipping vehicles with technologies to manage speed, such as speed limiters or intelligent speed adaptation (ISA)?
- What possibilities exist in public procurement, legislation and regulation for procuring vehicles with technologies to manage speed?
- Could safe speed regulation and practice be embedded in contracts, standards, corporate codes of conduct, and other business relations?

Education, communication, and capacity building

- Is education on speed and road safety required for getting a driver's license and is there an educational curriculum for road engineers and other professionals?
- Do the public and decision makers understand the importance of safe speeds, and what speeds are expected on different parts of the road network? What are their current perceptions?

Existing legislation should also be evaluated to understand what changes need to be made to enact effective speed management. The legislation that needs to be reviewed includes:

- Road Code: to understand necessary changes so it becomes easier to lower speed limits.
- Drivers' licensing legislation: to ensure that driver training and examination focus enough and provide evidence-based information on speed.
- Procurement legislation and regulations: to assess the importance of public procurement in fostering road safety, especially the inclusion of speed limiting vehicle technology.

Classify the roads based on the Roads-for-Life (R4L) framework and select safe speed limits for different types of roads

After determining the existing status of speed management and its legal and organizational framework, actors developing the strategy can make recommendations on the changes necessary for successful speed management. This includes road classification and selection of safe speed limits for different circumstances and road types based on the R4L framework and Safe System survivable speeds. Note that these safe speed limits are determined for different types of roads (e.g., city hubs or rural access roads) and not for a specific location (see BOX 3.2).

Box 3.2. How general speed limits influence speed management

General (or “default”) speed limits are typically set at a national level by law, and apply to all roads in a country unless varied because of local circumstances. Because they are general and have a basis in the Road Code or similar legislation, they typically do not require speed limit signs, but should rather be known by all drivers. This helps ensure that speed limits are consistent throughout the whole country. These speed limits also form the basis of enforcement and penalty regimes. Setting general speed limits is an important step in managing speeds, especially in countries where local speed guidance for individual roads is missing or needs updating. Changing general speed limits can result in wide ranging and almost instant safety benefits.

Based on the Safe System survivable impact speeds, the following general speed limits should be applied:

- 30 kph for roads/road sections where VRUs are present, for instance in urban areas where there is a typical, predictable mix of cars, cyclists, and motorcyclists, unless strong evidence exists to support higher limits
- 50 kph for roads/road sections with frequent intersections in non-built-up areas and roads/road sections in urban areas where VRUs are separated from motorized traffic by sidewalks/cycling lanes and adequate crossing facilities
- 70 kph for roads in non-built-up areas that do not have either median separation or controlled access
- 100 kph for access-controlled motorways

The general speed limits outlined above set the basis for safe mobility, providing the legal basis for speed limits on all roads within a country. However, road networks are complex, and there are often local factors which mean that different speed limits will be required to minimize vulnerability of all road users. These local speed limits differing from general speed limits need to be clearly marked. They need to fit within the legal framework but reflect the local conditions. The Roads-for-Life framework presented in Chapter 2 can also be used to determine these safe speed limits.

Speed limits should be agreed upon by key stakeholders and supported by legislation to guarantee a consistent approach throughout the country, and a legal basis for enforcement.

Ideally this process would be part of developing a national speed management strategy. Where no national action has been taken, speed limit setting can happen as a standalone activity at national or local level or as part of a local speed management strategy. For example, even without a national blueprint for doing this, a city may decide to implement 30 kph limits. As long as the city can legally make this change and enforce it, it should happen.

A step-by-step discussion of the speed limit setting process is detailed in Section 3.2.

Engage high-level key stakeholders and establish a working group

Because speed can be a contentious issue, engaging with stakeholders and affected communities to gain their support is key to managing the process and achieving long-term goals. One way to achieve smooth and successful engagement is through a speed management working group. This working group would be responsible for coordinating the different stakeholders, seeking their support and commitment, and finding consensus on the contents of the speed management strategy.

Involving external organizations in the working group and assessing their support or opposition can influence both the content and political feasibility of a strategy.[52] Coalition building across the different stakeholders is vital, not only to develop the speed management strategy, but also to foster long-term commitment and build momentum for implementation. Some of the key organizations to be included in a speed management working group are:

- Governmental organizations responsible for speed management, such as the National Road Safety Agency, the National Road Authority, the Ministry of Justice, the Ministry of Education, the Ministry of Health (emergency services) as well as (traffic) police
- Regional or local road administrations
- Other organizations with a vested interest in speed management such as road concessionaires, automobile clubs and mobility organizations, or universities and research institutions
- NGOs involved in advocacy and evidence-based road safety programs work
- Media professionals (e.g., Journalists)

The National Road Safety Agency might act as the lead agency to steer the working group and ensure that all stakeholders work together to achieve smooth and successful results. But a designated lead agency is not a prerequisite to engage with high-level stakeholders.

Quick tip for practitioners

If setting up a speed management working group is complicated in your country, work with the willing agencies and interested groups to get the process started.

NGOs have been instrumental in advocating for lower speeds, particularly in areas with high numbers of VRUs. A 2018 survey[53] indicated that many NGOs had shifted from being downstream implementers of services like school training, to engaging in upstream policy work on national strategies and legislation. This presents a major opportunity for NGOs to actively encourage setting appropriate speed limits (see BOX 3.3).

The media can also play a role in speed management efforts by dispelling misconceptions and accurately report on speed and road safety incidents. For example, the city of Bogotá engaged journalists through a series of workshops on Vision Zero and speed management from the early stages of the speed management implementation process in 2016. The purpose was to explain the importance of these efforts and give journalists the right tools to report on them.[54]

[52] GRSP (Global Road Safety Partnership). 2008. *Speed management: a road safety manual for decision-makers and practitioners*. Geneva.

[53] Brondum, L. and Kinyanjui, P. 2019. *Transforming road safety in Asia: Non-governmental organizations contributing to effective change*. Transport and Communications Bulletin for Asia and the Pacific. 89.

[54] TheCityFix. 2019. Q&A: *How Bogotá is Harnessing Leadership to Redefine Road Safety and Save Lives.*

Box 3.3. How Chile's civil society impacted the implementation of the "modes coexistence law"

In 2002, after maximum urban speed limits were raised to 60 kph, Chile's cities witnessed a jump in traffic crashes and fatalities that persisted for years. In 2015, a bill was introduced to modify the current traffic laws and allow various transportation modes in urban areas to coexist more safely. It called for greater recognition of non-motorized modes of transport through lower speed limits, standards for bike infrastructure, new road signs, and better traffic regulation.

The "modes coexistence law" was approved in March 2018, with the exception of a central article which would have cut speed limits in urban areas from 60 to 50 kph. After months of advocacy by over 100 civil society organizations of cyclists, pedestrians, and families of road traffic victims, lawmakers reversed themselves and approved the lower speed limit in August of that year. Thus, the influence of civil society was crucial.

In Chile, civil society involvement like this is facilitated by a law enacted in 2011 that established Civil Society Councils (COSOCs) to advise the various government ministries. For example, the Ministry of Transport retains its own council that includes victims' organizations and VRUs who provide input on policies and programs.

The effect of reducing the speed limit in urban areas has yet to be evaluated as the data is still too premature and collected during years (2019 and 2020) disrupted by the COVID-19 pandemic and political unrest. The push now is to improve speed enforcement in cities around the country using automated enforcement technologies.

Source: Government of Chile. 2020. *CONASET participates in World Road Safety Conference and signs declaration to reduce traffic fatalities by 2030*.

Gain political support

Speed management often does not enjoy widespread political support. The general perception of political stakeholders is that the public does not want speed management. In reality, this strongly depends on the public understanding of what speed management really is and on the impact of lower speeds, especially on local communities. In some cases, speed management arouses skepticism from motor vehicle drivers and others, in part because the risks of speeding are not widely publicized or understood.

Some people think lowering speeds exacerbates congestion or dismiss speeding as just a minor traffic offense. Many blame crashes on poor driving, rather than speed, even though speeding is the major road safety problem in most countries. Few people understand how much even a slight increase in average speed impacts the number and severity of crashes. In economic terms, it's easy to see the advantage of moving people and goods fast, but harder to recognize or factor in the health care burdens, productivity losses, and other costs that crashes impose on society. However, public perceptions are starting to change, and politicians need to be attuned to these changes (see BOX 3.4 and BOX 3.5).

Box 3.4. Shifting public opinion on lower speeds in rural France

In 2012, then-president Francois Hollande announced a 2020 target to reduce road deaths by 50 percent. To achieve this goal, the Committee of Experts of the French National Road Safety Council (CNSR) issued four proposals, one of which was to reduce speed limits from 90 kph to 80 kph on two-lane national roads. Between 2015 and 2017 a pilot project took place on three of these two-lane national roads.

Results showed an average speed decrease of 4.7 kph for all vehicles, prompting proposals to reduce the speed limit by 10 kph on all two-way rural roads with no separator. The then-prime minister Edouard Philippe implemented this measure, effective July 1, 2018. After 18 months of implementation, road deaths decreased approximately 12 percent on the rural network compared to the rest of the road network in mainland France. In other words, 331 lives were saved over the 18-month period.

Average speeds on the network dropped by 3.3 kph, shifting from a previous average of 86.4 kph to 83.1 kph. Communities located on the rural road network initially opposed the speed reduction. Prior to implementation, over two thirds of respondents (69.6 percent) disagreed or strongly disagreed with it. People feared that travel times would substantially increase. However, data shows that there was only a 1 second/km increase in travel time after the reduction. A survey after June 2020 shows that acceptance has steadily grown, and 48 percent of respondents agree or strongly agree with the change. This highlights the importance of promoting the positive impacts of lowering speeds and rectifying myths. In this case, pilot projects played a major role in gaining the public's acceptance.

Sources:
Interview with Gilles Duchamp Deputy Director of Mobility Department, CEREMA 2021
CEREMA. 2020. *Lowering the speed limit to 80 km/h.* Final assessment report. Paris.

Box 3.5. How political leadership changed the speed culture in Paris

When Anne Hidalgo entered office as the mayor of Paris in 2014, one third of the city had a 30 kph speed limit and the rest, a 50 kph speed limit. In her second term, Hidalgo embarked on an ambitious sustainability plan for the city, much of which focuses on clean transport, road safety, and active travel. At the end of 2020, 60 percent of Paris had a speed limit of 30 kph. Now, apart from its ring road, the whole city does. City officials expect this lower speed limit to reduce total traffic crashes by 25 percent and fatal crashes by 40 percent.

Source: Ville de Paris. 2021. *La vitesse limitée à 30 km/h dans la majorité des voies parisiennes*. Paris.

Myth 6

The public wants higher speed limits.

Reality 6. There is increasing public demand for safe and comfortable speeds.

A survey led by the European Survey Research Association (ESRA) with more than 45,000 respondents across 48 countries showed that most road users recognize speeding as a leading cause of road crashes. Less than one in five respondents found driving faster than the speed limit acceptable, and for built-up areas, this fell to one in 10. In some places, 90 percent of the respondents suggested that traffic rules on speeding should be stricter. In some of these countries, citizens' groups (such as the 20's Plenty for Us movement in the UK) are campaigning for urban speed limits of 30 kph and interest groups and vocal minorities who promote higher speeds do not represent the mainstream view.

Source: E-Survey of Road Users' Attitudes. https://www.esranet.eu/

In most cases, support (e.g., from media or NGOs) must be actively sought – often over a long period. In this context the following actions might be helpful:

1. Data and evidence:

- Provide the media, politicians, and staff in key ministries with empirical evidence of the impact of speed and speeding on road safety and public health
- Provide the media and politicians with individual accounts and stories of people impacted by excessive speed
- Gather evidence on how speed management can reduce noise and emissions and create more pleasant local environments that encourage active transport
- Show results from interventions in similar environments using evidence from "before-after" evaluation studies

2. Pilot projects and tactical urbanism (see BOX 3.6):

- Present the possibility of a phased approach to instigating speed change, such as pilot projects or tactical urbanism, to test interventions on a small scale. Tactical Urbanism uses short-term, low-cost, and scalable interventions to catalyze long-term change
- When implementing interventions, start with high-risk locations first (e.g., near schools, or where many VRUs are present)
- Conduct evaluations to highlight the value of interventions and widely disseminate the results

3. Community input:

- Conduct rigorous surveys to determine the public response to crash risk, speeding and possible interventions, and use this to counter negative comments from a vocal minority opposed to speed management
- Involve victim groups, especially the families of speeding crash victims, in communication

4. Decision-maker and stakeholder engagement:

- Team up with senior government officials within key ministries and stakeholders who influence speed management activities
- Brief politicians in key ministries and their direct staff regularly on the benefits and successes of speed management for safety and other important outcomes
- Engage with media outlets regularly to ensure the public is well-informed at every step of the speed management process

Box 3.6. The effects of lowering speed limits in Addis Ababa, Ethiopia

In 2015, there were 443 road crash-related fatalities reported in Addis Ababa. Ninety percent of those who died were pedestrians. To tackle this problem, Addis Ababa launched a speed reduction campaign, lowering vehicle speed limits to 50 kph on major arterial roads, 40 kph on minor arterial roads, 30 kph on local roads, and 15 kph on shared roads. The city installed 253 speed limit signs and the Transport Management Agency (TMA) installed traffic calming measures, namely temporary speed humps and rumble strips, at 10 crash-prone sites. In addition, tactical urbanism and pavement markings were applied to make busy roads and intersections safer for pedestrians and channel and improve the flow of various types of traffic. To publicize these changes, the city created media campaigns targeting TV, radio, and newspaper outlets. Since then, communities have begun to request temporary speed humps be installed in their neighborhoods, most frequently in response to fatal crashes that occur in these areas. The police have also promoted speed humps by encouraging residents to apply to have them put in.

As a result of these measures, the share of vehicles speeding decreased from 49 percent to 39 percent from June 2015 to August 2018. The mean speed at intervention sites observed dropped from 42 kph to 24 kph. The design of the speed humps and rumble-strips as well as the road environment and land use contributed to this speed reduction. Then, between March and August 2018, speeding rates dropped again after speed limits were reduced further and new speed limit signage was placed on highways. Even though speeding in 2018 was down overall from previous years, it has increased since then in places outside of the intervention areas. Traffic speeds stayed lower the longest in locations where infrastructure-based solutions were provided, along with slower posted speeds. This is possibly due to insufficient and inconsistent speed enforcement. In countries where enforcement capacity and compliance are low, infrastructure-based solutions should be prioritized, at least at key locations such as "black spots", where crashes are highly concentrated.

Addis Ababa – Tactical urbanism before (above) and after (below) showing the painted curb and ʻmedian extensions, crosswalks and lane markings added to narrow the road and prioritize pedestrian safety

After its success with speed humps and speed limit signage, the city now plans to implement different traffic calming measures, such as chicanes (where roads are narrowed to create "S" movement) and low-speed zones. The city also aims to collect speed data at various implementation locations to assess how lower speeds are affecting the economy and the environment.

Sources:
Addis Ababa Annual Road Safety Report 2018 -2019
WRI. 2020. *Data and analysis on the speed reduction evaluation program in Addis Ababa.* Washington, DC.
Interview with Yohannes Legesse, BIGRS Initiative Coordinator, Addis Ababa. 2021.

Develop, implement and promote the strategy

This step includes a coordinated approach to developing, implementing and promoting the speed management strategy based on the outcomes of the previous steps outlined above. The main contents of a speed management strategy will depend on country context, but usually comprise of:

- Vision and targets for speed management based on the Safe System approach, including performance indicators to help reach required targets
- Clear guidance on safe speed limits for all different types of roads, e.g. R4L framework
- Necessary legal and/or organizational/administrative changes to support speed management
- Measures for speed data collection and management
- Definition of research needs in speed management
- Connection between land use planning and speed management
- Definition of broader (national/regional/local) goals and objectives for the following focus areas:
    a. Road infrastructure
    b. Policing and deterrence
    c. Vehicle technology
    d. Education and communication

The process of drafting the strategy should be evidence-based and data led. The strategy should describe the main challenges, set concrete goals and objectives, and define responsibilities and resource estimates for each objective.

Progress towards the long-term targets should be supported by interim objectives such as incremental reductions in speed-related fatalities and serious injuries. For example, the city of Bogotá developed and implemented a Speed Management Program[55] based on traffic crash hotspot data that indicated which high-speed arterials were the most dangerous roads in the city. In its first phase, the Program targeted arterial roads and reduced the speed limits from 60 kph to 50 kph before expanding citywide (see BOX 3.8). During implementation, and as part of a speed management action plan (see BOX 3.7), interim objectives establish a course of action for achieving goals and selecting the most appropriate interventions at the local level. A combination of engineering, policing, technology, communication, and education interventions translate the strategy to tangible changes on the ground.

Promoting a strategy throughout development to implementation is the key to success. Communication campaigns and education make road users aware of any changes and more likely to comply and support them.

[55] https://www.movilidadbogota.gov.co/web/sites/default/files/Paginas/23-09-2021/programa_de_gestion_de_la_velocidad.pdf

Box 3.7. How speed management action plans support the success of speed management strategies

Speed management action plans are typically derived from the speed management strategy. They define concrete actions for managing speeds at the national, regional or city level. These plans are usually issued by the responsible road authority or road operator, e.g., by a local administration such as a region or city or a public or private entity such as a motorway operator/concessionaire. The action plan delineates specific activities and steps for implementation, such as changing speed limits on select roads. The action plan also includes information for engineers, enforcement agencies and other partner organizations to identify and treat high-risk locations.

The steps for developing a speed management action plan are broadly consistent with those outlined above for the development of a speed management strategy. However, the difference is that the action plan will focus on delivery of specific actions, often for specific parts of the road network. Because of this, data collection, engagement, implementation and monitoring usually occur at a more local level.

An action plan selects a set of interventions to minimize the severity of speed-related crashes, based on risk, location, speed reviews, and contributing factors identified from data (where possible). This includes selecting one or more of the many interventions described in Chapter 4 targeting road infrastructure, enforcement policing and deterrence, vehicle technology, as well as education as well as and communication.

Once selected, interventions need to be prioritized, sources of funding identified and support from local politicians, stakeholders and communities gathered. Finally, at the implementation stage, pilot projects may be helpful for introducing a new engineering measure (e.g., a roundabout) or an enforcement method (e.g., point to point speed cameras). They allow data to be collected and assessed (e.g., speed and/or crash data) before and after the pilot to determine how well it is working. Reliable and up-to-date databases must be maintained to ensure before-after measuring, monitoring and accurate evaluation. Monitoring and evaluation should be used at local level interventions, for instance, to assess local implementation of a change.

Monitor and evaluate the strategy

Monitoring and evaluation are critical for assessing the success of a speed management strategy. The strategy should define targets and performance indicators in line with its set vision, focus areas, and goals. Then, the implementing agency collects data based on these targets to allow regular monitoring, inform the evaluation process, and identify the need for any changes. Before the strategy is implemented, the necessary "before" data needs to be compiled. This is often forgotten. Data collection needs to continue throughout the duration of the strategy, as monitoring and evaluation allow strategies to be improved and adapted if necessary. A comprehensive evaluation of the strategy should also be undertaken after its full completion.

Using Key Performance Indicators (KPIs) – also referred to as SPIs (Safety Performance Indicators) in the road safety context – is recommended to monitor the progress toward speed management targets and should form part of the strategy. A KPI is a measurement related to speed crashes or injuries used to indicate safety performance, understand the processes that lead to crashes, and determine measures to reduce the number of speed-related crashes.[56] KPIs help assess the existing speed-related road safety situation, set achievable but ambitious improvement targets, evaluate the effect of actions and measures, monitor progress over time, and forecast further evolutions. KPIs should be focused on outcome and not only output. For speed management, the following KPIs could be relevant depending on the monitoring goal:

- Number of speed-related road crashes
- Number of speed-related road fatalities
- Number of speed-related serious road injuries
- Number of speeding citations issued
- Percentage of vehicles in free-flowing traffic that are travelling within the speed limit. (This compliance measure has been adopted as the minimum measure as part of the Baseline project in Europe)
- Speed below which 85% of vehicles are driving (V85) (with standard error and deviation)
- Average speed
- Self-reported attitudes, awareness, and behavior regarding speeding

More information on road safety data definitions and collection is available in the Guidelines for Conducting Road Safety Data Reviews.[57]

Quick tip for practitioners

Start with a small set of indicators that are easy to track and assess. Other indicators can be added as the process develops.

Evaluating individual projects such as changes to laws or infrastructure, is also important for tracking progress toward targets. An evaluation study can determine if implementation has significantly affected the frequency or severity of crashes. If it has, the evaluation will provide justification for the project. If it has not, it can help identify the reasons and point to possible adaptations or course corrections. Evaluations should be planned early in the process of designing interventions to make sure pre-implementation data is collected and evaluations are effective.

[56] Baseline. 2023. *Conclusions and Recommendations*. Programme Support Action (PSA) to support Member States in collecting Key Performance Indicators (KPIs) for road safety.

[57] Martensen, H., Duchamp, G., Feypell, V., Raffo, V., Burlacu, A., Turner, B. and Paala, M. 2021. *Guidelines for Conducting Road Safety Data Reviews*. World Bank. Washington, DC.

Box 3.8. Managing speed in Bogotá, Colombia

According to a study by Johns Hopkins University and Los Andes University, speeding was the most common risk factor in Bogotá and was one of the main road safety issues contributing to fatalities and injuries. In 2016, VRUs accounted for 96 percent of all fatality victims and 72 percent of all fatalities occurred on arterial roads. As part of the local road safety plan (RSP), the development of a Speed Management Program (SMP) was carried out to help reach the annual goal of reducing the number of road crash victims by 3.5 percent.

The SMP began implementation by lowering the speed limit from 60 kph to 50 kph on the five most critical arterial corridors with the highest rates of road traffic injuries and fatalities. These corridors had high population and human activity density, but were classified as high-speed arterials. Avenida Boyacá, one of the prioritized corridors, was the site of 10% of all traffic fatalities in the city between 2013 and 2017.

These pilot programs and temporary interventions were used to test and improve methodologies and actions. After the five initial corridors, five more were added to the program along with twenty-two 30 kph zones and eight commercial zones.

The SMP is being executed in phases to better understand the speed management processes and their impacts before implementing at the city-scale. For each of the identified areas — arterial corridors, commercial zones and 30 kph zones — different actions were implemented. On the arterial corridors, improved signaling was complemented with speed cameras, police enforcement, and a communication strategy. The program also introduced infrastructure measures to slow traffic on local roads with high concentrations of traffic crash victims.

To understand the impacts speed records between November and February from 2017 to 2019, as well as records of road crash fatalities and injuries were examined. On corridors with speed management, average speed reduction was 1.48 kph during the day and 3.04 kph at night were examined. On corridors without speed management, average speed reduction was 0.7 kph during the day and 2.2 kph at night. WRI worked with the city to set speed limits on other roads, collect further traffic crash data, and analyze the impact of interventions.

On corridors with speed management measures, fatalities dropped by 16.6 percent. The number of crashes with injuries did not fall as expected. In fact, it rose by 10.5 percent. But the severity of the crashes decreased and the type of incidents with injuries changed. This sudden rise in injuries is believed to be attributed to an improved crash reporting system, meaning injuries were likely underreported previously. In the first half of 2020, there were 33 fewer fatalities than in the first half of 2019. An estimated 46 lives were saved in the first 14 months after the implementations (October 2018-December 2019). Bogotá's Secretary of Mobility estimates that, from 2020 to 2023, reducing the speed limits saved 268 lives.

Continuity has been key to the success of Bogotá's Speed Management Program. Concerted efforts towards speed management began in Bogotá in 2015 under Mayor Gustavo Petro, when the city joined the Bloomberg Philanthropies Initiative for Global Road Safety. Petro's successor

Box 3.8. Managing speed in Bogotá, Colombia (cont.)

Enrique Peñalosa expanded the city's speed management efforts, culminating in the creation and launch of the Speed Management Program in 2018. With the election of Claudia López in 2019, Bogotá has continued to advance the Speed Management Program with the 50 kph speed limit expanded citywide in 2020. Bogotá's success has gone on to inspire the Colombia National Road Safety Agency to establish a 50 kph speed limit in all Colombian cities through the 2251 Julián Esteban Road Safety Law.

Since Bogotá executed its plan, the city has saved US$12.6 million in property damage, medical, administrative, and human costs. These benefits accrued despite the 2017 Constitutional Court ruling, that limited the ability for automatic ticketing when speeding and reckless driving were detected, due to the possibility of drivers being misidentified. The tool has proven effective in enforcing the reduced speed limit. Recently, the Constitutional Court has adjusted the ruling to allow automatic ticketing to the vehicle owner, regardless of driver identity, which allows owner to contest in case of theft.

Sources:
Alcaldía Mayor de Bogotá.2018. *Plan Distrital de Seguridad Vial 2017-2026*. Bogotá.

López, J., Pérez-Barbosa, D., Lleras, N., Hidalgo, D. and Adriazola-Steil, C. 2021. *Effects of Reducing and Enforcing Speed Limits in Selected Areas of Bogota*. International Journal of Engineering, Social Justice and Peace. 8 (2). 50-71.

3.2. Implementing safe speed limits based on the Roads-for-Life framework

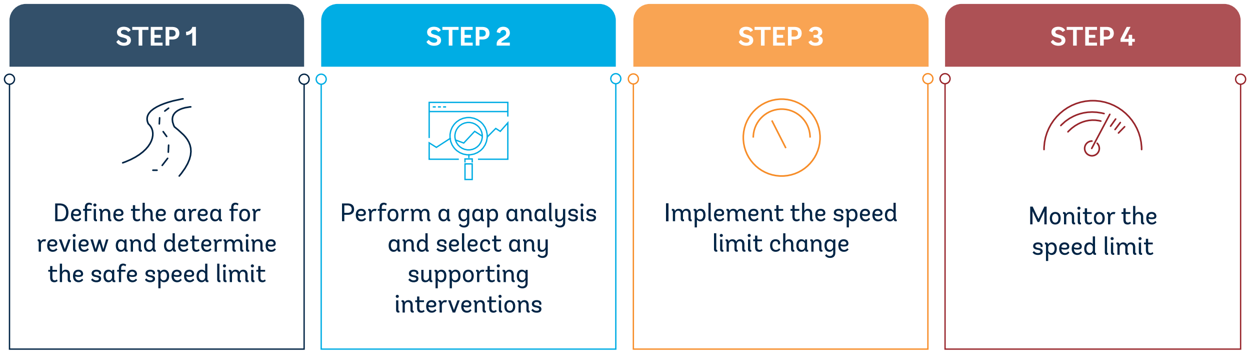
This section outlines the process for making speed limit changes – by reviewing existing conditions, selecting speeds from the R4L framework, and implementing speed limits. Changes should be consistent with a broader strategy, where present, and follow good practice and existing legal frameworks.

Whether speed limits are being changed at specific locations, or as part of a broader process to improve a road corridor, whole city, or region, the same 4 basic steps are required:

1. Define the area for review and determine the safe speed limits using the Roads-for-Life framework. This is done by comparing the area's characteristics to the nearest example from the Roads-for-Life tables (Figure 7 and Figure 8), combined with local knowledge on risks, to assign the appropriate speed limit.
2. Compare this newly assigned speed limit to the existing one to identify supporting measures needed to assure compliance with the speed limit change.
3. Implement the new speed limit. This includes meeting legal obligations, updating speed limit registers, informing the public, providing supporting activity if required, and installing signs and related road or enforcement infrastructure.
4. Monitor the new speed limit and assess the impact of the new speed limit on road safety.

This 4-step process is demonstrated in the flow-chart in Figure 11 with more detailed descriptions for each step provided in the following paragraphs.

Figure 11. Speed limit setting process



This 4-step approach adapts a best practice framework to various local needs. It allows countries or cities to improve different parts of their system as their resources allow and provides basic guidance for each stage, regardless of how robust existing systems are. It is possible to improve these systems as resources and expertise allow.

Step 1: Define the area for review and determine the safe speed limit

The first step involves three sub-steps:

a) Define the area under review and the roads it includes

b) Gather data and perform risk assessment

c) Determine the safe speed limit based on the R4L framework

For **sub-step a),** the scale may range from just one road or road section, to a city or a whole region. Areas to target may have been recognized and prioritized in a Speed Management Action Plan. Such plans help ensure that areas, corridors, or locations that are a higher priority can be addressed first. However, new knowledge about a high-risk location may emerge, or changes in road networks may require attention. **When the review is aimed at a whole city, where most roads run through high density, urban, built-up areas, it is important to differentiate between major, complex roads, which may require further review, and other areas such as the city center, residential neighborhoods, and local roads and school zones, where speeds can be more quickly set at 30 kph. This will allow the process to move faster and focus on higher risk areas (see BOX 3.9).**

Box 3.9. Fast tracking safe speed limits in cities

In many cities or city centers it may be possible to lower the default speed limit from 50 kph to 30 kph relatively quickly. If a new political leader is chosen, who supports lower speeds, this opportunity should be seized without spending time on detailed studies. It is already clear from a Safe System perspective, that 30 kph is the maximum safe speed on roads or road sections where many pedestrians and/or cyclists are present. This is the case for most roads in urban areas, and therefore, 30 kph is the maximum speed that should be set. Still, parts of the speed limit setting process shown in Figure 11 can be used to determine if additional infrastructure and/or enforcement are needed to support the new 30 kph speed limit.

The roads under consideration must be divided into homogeneous sections (with uniform traffic volume, road design parameters, cross sections, and contexts), because as a road changes, a different speed limit may be required.

Quick tip for practitioners

The lack of “perfect” data must not be used as an excuse for inaction in speed management. Even rudimentary data in combination with some simple spot speed measurement can be sufficient.

Once areas are identified, in **sub-step b),** data and information should be gathered to help better understand how roads are used, existing challenges, and what could change. For instance, plans for a new school should be factored into setting speeds. Based on these data a simple risk assessment can be performed.

In order to understand the current issues, including the risks to road users, it is usually important to visit the location, section or area under consideration. This site visit is in addition to data gathered from other sources mentioned later in this section. A structured approach to the visit and the assessment of risks can be useful to ensure a thorough assessment is made. The table below provides a template for a basic risk assessment approach that might be used. This table shows an example of a risk assessment based on a site visit at a busy urban intersection, where pedestrian risks exist that need to be considered when selecting the appropriate speed.

Risk type	Issue	Consequence	Impact
Collision with pedestrians	Pedestrians cross the road at this location, and there are inadequate crossing facilities.	Potential impact between vehicles and pedestrians, often at high speed.	High
	There are people selling goods, mixing with motorized road users on the roadway.	Potential impact between vehicles and vulnerable road users, often at high speed.	High
	Pedestrians travelling along the sidewalk are forced into the traffic lane due to roadside selling that obstructs the sidewalk.	Potential impact between vehicles and pedestrians, often at high speed.	High
Intersection crashes	Poor visibility at the signalized intersection	Rear end crashes/shunts may occur due to vehicles breaking	Low
	.....	.....	.....
.....	.....	.....	.....

The information from the risk assessment can be combined with other pre-existing data on the site, and an assessment made on the road users, risks and the safe speed limit.

In **sub-step c)**, the safe speed limit for each road or road section is determined based on the R4L framework by selecting the most similar road from Figure 7 or Figure 8.

A multi-stakeholder workshop is the best forum for assessing safe speed limits, because local knowledge is needed. The public and/or other partner organizations such as traffic police provide insights on local context including current road use and risks, including whether existing infrastructure and speed limits are insufficient to prevent serious or fatal crashes. If so, speed limits need to be reduced to an appropriate crash survivability level. Where the risk is especially high, the speed limit will most likely need to be lower than dictated by the table, and/or the quality of the infrastructure will need to be improved.

A speed review will not always result in a recommendation for a lower speed limit. In some instances, a higher speed limit may be required based on broader considerations. But then, adequate infrastructure will be needed. The type of infrastructure that might be required can be derived by comparing the provisions for different types of roads in the R4L framework. For example, in rural areas, 60 kph roads do not need the same separating infrastructure (such as medians or barriers) that 80 kph roads do.

While previous crash locations are helpful to learn more about the context, a proactive approach to this risk assessment should be the default. Speed limits should be reduced where there is risk; not just where crashes have occurred. This is in part because crash data may not always be collected or be complete, especially in LMICs.

For more complex reviews involving multiple roads or corridors, a visual representation of the current and proposed situation can be very beneficial. This might involve highlighting routes and areas in different colors on a map to identify current and proposed speeds.

Outcome from Step 1: For all roads/road sections subject to the speed limit review, a recommended "risk assessed" speed limit is assigned. In some cases, changes in infrastructure will also be recommended.

Step 2: Perform a gap analysis and select any supporting interventions

This step requires comparing the current speed limit to the recommended risk assessed speed limit. If they differ, then actions need to be taken.

The recommended speed limit also needs to be compared with not just posted speeds, but actual existing operating speeds. This step should not be a burden or barrier to lowering speeds, especially when setting speeds at or below 30 kph in cities. Knowledge of current vehicle speeds is ideally obtained through speed survey data. This is the only time in the speed limit setting process when current vehicle speeds should be referenced. This information does not influence the speed limit to be selected. It is only used to determine what else may be needed to ensure the speed limit compliance. Some countries still use current vehicle speeds, for instance the 85^{th} percentile speed, to select a speed limit. As highlighted above (see BOX 2.1), this is not good practice.

In situations where road users exceed the recommended risk assessed speed limit, for instance, where the mean speed is 5 kph or more above it, steps are needed to improve compliance with this speed limit. Enforcement can encourage the appropriate speed; however, providing infrastructure to create a self-explaining road environment is preferred. A self-explaining road is one designed to match the required speed and give users a clear message about the appropriate speed. Road authorities and equivalent agencies should provide clear design guidance on infrastructure to ensure self-explaining roads are practical and achievable.

Various road elements act as visual and physical cues for slower or faster travel. Narrower roadways, physical traffic calming measures, different road surface texture, and other design elements give a clear message that slower speeds are required. Wider roadways, including those with multiple lanes of traffic, give the impression that higher speeds are possible. Consistent application of such measures across the road network creates clear guidance to road users, signaling to motorists what is expected, where low speeds are required, or where higher speeds might be safe.

To achieve this, engineering interventions that reduce the risk of severe crash outcomes and support the desired speed limit should be considered (see Chapter 4). Where high speeds are required, significant interventions may be needed, and speed limits should not be increased until such improvements are made. On the other hand, speed limits in hazardous places should be lowered right away and remain low until safer infrastructure is in place.

Outcome from Step 2: A speed limit may need to be supported by infrastructure or enforcement provisions. A decision is made on this.

Step 3: Implement the speed limit change

Once new speed limits are agreed on, there are several processes to ensure successful implementation. These include considering legal obligations, updating speed limit registers, informing the public, installing signs, and providing supporting infrastructure, enforcement, and communication activity if required. Informing the public of the benefits of the new limits is very important because new speed limits should be supported by local stakeholders, community decision makers and the communities themselves.

Legal obligations vary in different countries and sometimes even within countries. The ability to enact speed limit changes may reside at different levels of government, federal/national, state, or local. The relevant agency must be involved from the outset, so the right processes are followed, and changes are confirmed using the correct legal framework. This ensures that any changes in speed limits can be legally enforced.

It is important to maintain a register of speed limits, including any changes made. In some cases, this is legally required. In recent years such registers have moved from being paper based to being digital. These speed limit databases can be shared publicly and are increasingly used by companies as part of fleet management systems to ensure that company vehicles are travelling at safe speeds. They are also used by vehicle manufacturers and others to provide information to motorists on current speed limits where they are driving.

Informing the public about any changes in the speed limit is key. It is useful to highlight why this change is occurring, and the likely impacts this will have on road safety outcomes. This is especially crucial for general default speed limits that rely less on signage and more on public awareness. Once these speed limits are issued and incorporated into traffic laws and regulations, they should be clearly disseminated to all road users to make them aware of the changes and ensure the speed limits are implemented and consistently enforced. Dissemination takes place through driving training, licensing tests, and media campaigns.

Another key step in the implementation of any speed limit change and for ensuring its success and compliance from road users, is implementing required supporting interventions. These interventions are usually a combination of infrastructure changes and enforcement tools, in addition to communication campaigns to inform the public about the changed speed limits. For local speed limits, signs indicating the new maximum speed need to be installed and visible to road users. In some cases, advance warning should be provided to inform road users that speed limits will change.

Outcome from Step 3: The speed limit change, as well as the necessary legal processes and needed interventions, are implemented.

Step 4: Monitor the speed limit

Speed limit changes should be monitored to ensure they are having the intended impact and are not having unintended consequences. It is important to visit sites where speed limits change, and collect free-flow vehicle speed data, before and after changes are implemented to determine impact. The ideal time for a full evaluation is after a year's worth of data is collected, but starting to collect it right away is important to ensure the change is yielding the benefits expected, with no adverse impacts.

Longer term it can be useful to compare crash outcomes, for several years before and after the speed limit change. Vehicle mean speed change and crash outcomes can be influenced by a variety of factors, so correcting for these with a "control group" is important. This would mean comparing the road "treated" to a similar one where no such interventions have occurred. This evidence can be used to encourage other speed limit changes by clearly showing the link to safety improvements.

Outcome from Step 4: The speed limit changes are constantly monitored. Indicators and targets are defined, and data is collected to allow a comparison between current conditions and the baseline. This leads to the assessment of changes made and implementation of adaptations where necessary.

Box 3.10. How to measure success

To successfully assess the effectiveness of reducing vehicle travel speeds, it is crucial to differentiate between monitoring and evaluating. Monitoring primarily involves gathering information about speed limit violations to assess compliance. Evaluating encompasses a more comprehensive analysis of the impact of altered travel speeds to gain insights into the responses of drivers, the effects on crash rates and severity, and other broader consequences.

Conducting a thorough evaluation requires collecting relevant data such as comprehensive crash records showing the number, types, and fatality rates of crashes. Road conditions, the results of site reviews, and data from speed enforcement activities, such as issued speeding tickets, should also be considered when available. Data on the average free travel speed should be assessed. This is the average speed that a motorist would travel if there were no congestion or other adverse conditions, such as bad weather.

One way to assess whether interventions have reduced vehicle speeds is to determine percentage of drivers exceeding the posted speed limit. Another is to compare the observed mean speeds and 85th percentile speeds both before and after an intervention (e.g., engineering or enforcement measure). Ideally, free travel speeds on a "control" road should also be measured pre- and post-implementation to determine whether external factors may have influenced the speed change. The recommended timeframe for a speed evaluation after a major engineering change (e.g., a new speed limit or road design element) is one year. This allows motorists to get acclimatized to the intervention and experience it in all seasons. A formal speed study will provide the complete speed profile for the road.

Many private companies, like cell phone, delivery, and ride hailing, collect this type of speed data, which should be shared with governments to save lives. Innovations in speed modeling have also helped enhance speed data analysis.

For example, tools are now available that collect average speeds from data recorded with smartphones. This data allows a detailed diagnosis of the geographical distribution of vehicle speeds in a city and can be particularly useful when compared with geocoded crash data, as it will show where speed is posing the greatest risk. Even if crash data is not available, speed data can help cities identify highest priority speed corridors for diagnosis and speed management.

International Road Assessment Program (iRAP) assessments and Road Safety Audits (RSAs) of existing roads or road infrastructure are useful tools for identifying existing challenges and risks, especially for countries that do not have high quality crash data. Instead, they assess potential road safety risk, as an input for where to prioritize the speed management processes. Risks they can identify would include a lack of safe crossing infrastructure or wide travel lanes, etc.

Thierry et. al (2023) have also introduced a methodology for collecting crash data called the Local Record Keeper (LRK) methodology, which relies on trained community members and a new supervisory and quality control process to record road crashes. The LRK methodology was implemented in Bangladesh, where the record keepers were able to record significantly more crash data than the Police. They also provided details on crash location and road user involvement that were instrumental in developing the speed management program, and in identifying the appropriate interventions for a number of rural roads.

Source: Thierry, M., Vet, J., Uddin, K.B. and Wegman, F. 2023. *A New Methodology for Road Crash Data Collection in Bangladesh Using Local Record Keepers*. Journal of Road Safety. 34 (1).

Note: A Road Safety Audit (RSA) of an existing road is also called Road Safety Inspection (RSI).

4

What interventions can be used to support safe speeds

In addition to defining safe speed limits, countries and jurisdictions should develop a comprehensive and holistic package of speed management interventions based on the Safe System approach. A mix and match of various interventions may be required for each road, road section, or the whole network, depending on the types of road users, vehicles, the way roads and roadside infrastructure are designed, and other external conditions, including weather.

The following sections summarize information on speed management interventions in the fields of land use planning, road infrastructure, policing, deterrence and penalties, education, communication and capacity building, and vehicle technology. This chapter also highlights special concerns to consider when selecting interventions. The discussion starts with the importance of land use planning and urban design in managing speed and creating safe roads for all. It is key to offering a wide range of sustainable mobility options and reducing the need for car trips as well.

4.1. Land use planning

Land use planning lays the foundation for safer roads and slower speeds by reducing road user's needs for vehicular trips and offering improved accessibility to a wide range of sustainable mobility options. Urban design and land use planning affect road safety by influencing travel behaviors, like route and mode choice. These issues are clearly highlighted in the World Health Organization's new Global Plan for the Decade of Action for Road Safety (2021-2030).[58]

When people live in proximity to their destinations and/or have access to safe and reliable alternative transport options, they can reduce motorized individual travel and exposure to crash risk, creating a positive feedback loop for road safety and sustainable mobility overall. In large cities with dense populations and high land use diversity, where more people use public transport, cycle or walk, road fatalities per 100,000 residents are significantly lower than in their low-density counterparts (see BOX 4.1 and BOX 4.2).[59] Conscious planning policies and urban design guidelines provide the right conditions for multimodal, compact, and well-connected communities. This sets the stage for the successful implementation of speed management and broadens the positive impacts of implementing safe speed limits.

Land use and urban design[60,61] affect transport and speed in a variety of ways:

Land use mix: A mixed-use neighborhood removes barriers between residential, commercial, and institutional uses and decreases distances to key destinations such as schools, stores, hospitals, transit etc. This increases the use of alternative modes, especially walking, and steers people away from driving vehicles, which lowers the risk of speeding. One meta-analysis found that the number of vehicle kilometers traveled is strongly related to the accessibility of destinations, and that therefore, making destinations more accessible can decrease vehicle travel and improve safety.[62]

[58] WHO (World Health Organization). 2021. *Global Plan for the Decade of Action for Road Safety 2021-2030*. Geneva.

[59] Schepers, P., Lovegrove, G. and Helbich, M. 2019. *Urban Form and Road Safety: Public and Active Transport Enable High Levels of Road Safety*. In: Nieuwenhuijsen M., Khreis H. (eds) *Integrating Human Health into Urban and Transport Planning*. Springer. Cham.

[60] Victoria Transport Policy Institute. 2019. *Land Use Impacts on Transport: How Land Use Patterns Affect Travel Behavior*. Transportation Demand Management Encyclopedia. Melbourne.

[61] WRI (World Resources Institute). 2015. *Cities Safer By Design: Guidance and Examples to Promote Traffic Safety through Urban and Street Design.* Washington, DC.

[62] Ewing, R. and Cervero, R. 2010. *Travel and the Built Environment.* Journal of the American Planning Association. 76:3. 265-294.

Box 4.1. How land use affects road safety outcomes

Land use and urban design play a central role in road safety by shaping crash-related factors such as access to destinations and travel distances. Higher density directly correlates with lower road fatalities due to its link with increased walking and mass transport and less vehicle travel. A 2009 study found that for each increase in density of 100 persons / square mile, there was a 6 percent drop in injury crashes and a 5 percent drop in all crashes, after controlling for amount of travel, road connectivity, and land use.

A study of 448 counties in 101 metro areas in the United States showed that urban sprawl was directly related to road fatalities, including pedestrians. Another study of 366 Latin American cities found that higher population density, higher GDP per capita, and the presence of bus rapid transit or subway systems, all correlate with significantly lower road-traffic mortality, while higher isolation (lower density) is associated with higher road-traffic mortality.

Sources:

Ewing, R. and Cervero, R. 2010. *"Travel and the Built Environment: A Meta-Analysis."* Journal of the American Planning Association 76. 265-294.

Dumbaugh, E. and Rae, R. 2009. *"Safe Urban Form: Revisiting the Relationship Between Community Design and Traffic Safety."* Journal of the American Planning Association 75 (3). 309–329.

Ewing, R., Schieber, R.A. and Zegeer, C.V. 2003. *"Urban Sprawl as a Risk Factor in Motor Vehicle Occupant and Pedestrian Fatalities."* American Journal of Public Health 93. 1541–1545.

Quistberg, D., Hessel, P., Rodriguez, D., Sarmiento, O., Bilal, U., Caiaffa, W., Miranda, J., de Pina, M., Hernández-Vásquez, A. and Diez Roux, A. 2022. *Urban landscape and street-design factors associated with road-traffic mortality in Latin America between 2010 and 2016 (SALURBAL): an ecological study*. Lancet Planet Health. 6 (2). 122-131.

Connectivity and access to destinations: A well-connected road network is one that provides the most direct travel path between destinations, reducing travel distances and vehicle travel, and allowing more cycling or walking, also by providing high-quality walking and cycling infrastructure. A study on suburban multifamily developments in different parts of the United States showed that residents of more connected developments were more than twice as likely to walk or cycle to local amenities than residents in less connected developments.[63]

Public transit accessibility: Communities that make it easy to access high quality transit, especially by walking or cycling, are less likely to rely on vehicle travel. One study found that households located within a kilometer of high-quality public transit service travel an average of 18 km lesser per day in vehicles, regardless of land use density and vehicle ownership rates in their neighborhoods. Households in transit-oriented neighborhoods with quality transit services and one car per household can travel 45 percent fewer miles annually by car than automobile-dependent households with more cars and fewer other travel options.[64]

Population density: In combination with mixed land uses and multimodal infrastructure, development density can play a major role in lowering motorization and increasing walking and

[63] OTREC (Oregon Transportation Research and Education Consortium). 2010. *Overlooked Density: Re-thinking Transportation Options in Suburbia*. Minneapolis.

[64] ICF International. 2007. *Public Transportation and Petroleum Savings in the U.S.: Reducing Dependence on Oil*. American Public Transportation Association. Washington, DC.

cycling as distances to key destinations decreases. In addition, increased density generally leads to higher traffic density which can lower speeds. Density tends to increase the cost efficiency of multimodal infrastructure which can support the case for investing in higher quality sidewalks, cycle lanes and transit.

Block size and road widths: Physical features of the road, such as block size and road and lane widths are directly related to road safety and traffic speeds. A study from Guadalajara, Mexico shows a strong link between the total length of all approaches to intersections (the distance to the intersection without any interruption) and the number of injuries and fatal crashes at intersections.[65] On longer blocks, drivers are more likely to go over posted speed limits since there are no intersections and crossings to stop them. In addition, pedestrians will continue to cross where it is quickest and most convenient, and they can walk the shortest distance to do so. This increases the risk of mid-block crossing along arterials and high-traffic roads. Similarly, wider roads encourage speeding by giving drivers a false sense of safety as they do not have the "perception of impediment to motion" that narrower roads give. A study, based on more than 650,000 observations from Texas, United States, found speeds 3.5 kph (2.2 mph) higher for a 3.7 m (12 ft) lane than for a 3.4 m (11 ft) lane.[66] In addition, wider roads force longer crossing distances on pedestrians which increases risk. More information about physical features can be found in Section 4.2.

Access to safe pedestrian and cycling infrastructure: Creating an environment that prioritizes non-motorized active transport like walking and cycling is critical to ensure connectivity and access between different land uses. Well-designed, safe, and accessible pedestrian and cyclist infrastructure can decrease dependency on motor vehicles, contributing to lower vehicle speeds and enhanced overall road safety. This includes provisions for wide and well-maintained sidewalks, safe and dedicated bicycle lanes, pedestrian crossing points, cyclist-friendly signals, and other traffic calming measures. By making walking and cycling safer and more convenient, such infrastructure encourages people to choose these modes of travel over private vehicles, thereby reducing the overall volume of motor traffic and the associated risks of speeding.

A concrete example of this approach is the transformation of urban infrastructure in Bogotá, Colombia. The city implemented a comprehensive program to improve its pedestrian and cyclist infrastructure, embedded within a broader land use planning strategy. A significant part of this initiative was the development of an extensive network of bicycle routes (Ciclorutas), which by 2007, covered over 300 km, making it one of the most extensive in the world. Along with the implementation of Ciclorutas, the city also pedestrianized several roads and implemented the TransMilenio Bus Rapid Transit system. These combined efforts slashed traffic fatalities by more than 50%, from about 1,300 per year in the mid-1990s to 600 per year in 2010.[67] In addition, the proportion of trips made by bicycle in Bogotá increased from 0.2% to 5% between 1996 and 2005.[68]

[65] Duduta, N., Lindau, L.A. and Adriazola-Steil, C. 2013. *Using Empirical Bayes to Estimate the Safety Impact of Transit Improvements in Latin America.* Transportation research record 2317(1). 8-14.

[66] Fitzpatrick, K., Dixon, K. and Avelar, R. 2016. *Evaluating Operational Implications of Reduced Lane and Shoulder Widths on Freeways*. Journal of Transportation Engineering. 142 (11).

[67] WHO (World Health Organization). 2015. *Global status report on road safety 2015*.

[68] Montezuma, R. 2005. *The transformation of Bogota, Colombia, 1995–2000: Investing in citizenship and urban mobility.* Global Urban Development. 1 (1).

Myth 7

Speed limit signs will convince people to drive slower.

Reality 7. Speed limit signs alone may only marginally reduce speed.

In most cases, a traffic sign is not enough to convince road users to drive at or below the posted limit. Drivers often flout these limits despite being aware of them. A self-enforcing speed limit uses the road's design and appearance to encourage compliance with the posted speed limit.

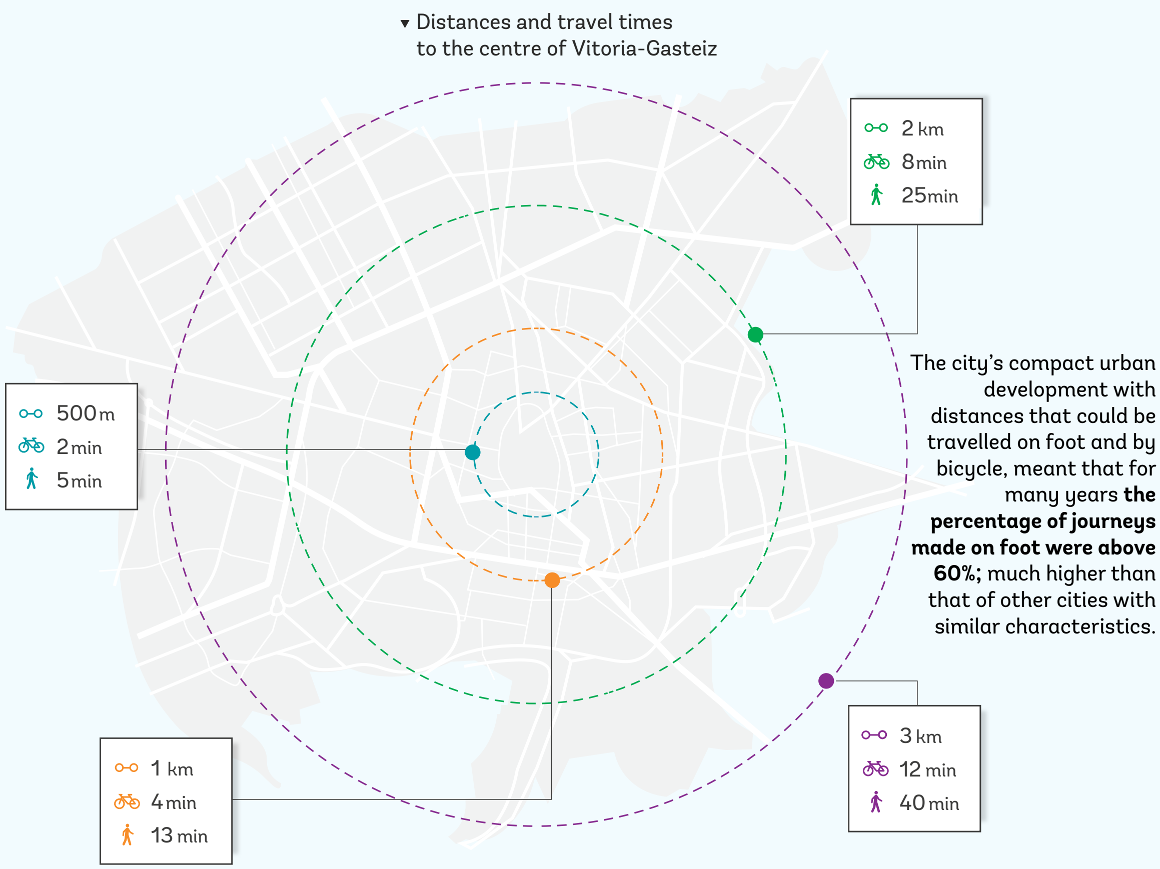
Studies show that without additional engineering interventions, a new (lower) posted speed limit typically reduces travel speeds by around 3 kph for every 10 kph reduction in speed limit, if no additional measures are used to enforce the new speed limit. While any reduction in speed can improve safety, engineering treatments must often be applied in addition to speed signs to encourage drivers to obey these signs.

Source: Theeuwes, J. *Self-explaining roads: What does visual cognition tell us about designing safer roads?*. Cognitive Research: Principles and Implications. 6. 15.

Box 4.2. Case study on land use planning in Vitoria-Gasteiz, Spain

In the 20th century, Vitoria-Gasteiz, the capital of Spain's Basque country, saw rapid population growth, urbanization, and motorization. In response, the city took action to prevent itself from becoming congested and car-centric by prioritizing sustainable urban development to keep the city livable, walkable, and green. A key component of this sustainability initiative has been to maintain compact and mixed land use while improving mobility throughout the city. Vitoria-Gasteiz has used a network of rehabilitated green spaces that surround the city as a de facto border, limiting outward growth and promoting densification. This effort has effectively kept the city to a diameter of 6 kilometers.

To ensure the city remained walkable and bike-friendly, Vitoria-Gasteiz implemented traffic calming measures as well as a 30 kph speed limit on local roads, a 50 kph limit on arterials, and a 20 kph limit in the highly traversed historic downtown area. As a result, Vitoria-Gasteiz has seen low traffic fatalities and injuries. Between 2013 and 2017, the city only registered 6 traffic fatalities, averaging a fatality rate of 0.5 deaths per year.



Density and land use in Vitoria-Gasteiz allowing short walking and cycling trips to the center

Source: Vitoria-Gasteiz City Council

Box 4.2. Case study on land use planning in Vitoria-Gasteiz, Spain (cont.)

Vitoria-Gasteiz is also one of the leading cities around the world in implementation of superblocks. Superblocks group together traditional city blocks to form an "urban cell" that prioritizes pedestrians and cyclists and prohibits through - traffic except for residents, deliveries, and emergency vehicles. The internal speed limit for these superblocks is set at 10 kph, and the roads surrounding the block are typically traffic calmed to ensure the safety of pedestrians and cyclists. Together, compact land use, speed management, and innovative mobility planning have led Vitoria-Gasteiz to a modal share where half of all trips are made by foot and 10% by bike. As the city expands its land use and mobility initiatives, it expects the walking modal share to reach upwards of 70% of all trips.

Sources: CEA (Centro de Estudios Ambientales) of the Vitoria-Gasteiz City Council. 2020. *Vitoria-Gasteiz Green Capital - A Human-Scale City*. Sustainable Mobility and Urban Green Infrastructure.

4.2. Road infrastructure

Road infrastructure plays a significant role in determining traffic speeds. A self-enforcing, or self-explaining roadway is one that is planned and designed to maximize compliance with safe speed limits. A self-explaining road can minimize the need for additional measures such as enforcement. Road infrastructure should be designed to consider the context, the mix of road users, the site condition, and the need to safely integrate all non-motorized and motorized transport modes.

The influence of road design on operational speeds

The essence of road design under the Safe System approach is to provide a road environment where fatalities and serious injuries are not able to occur. Thus, road design aligned with Safe System principles should provide the road users with:

- *Positive guidance* to safely navigate the mobility system
- *Clear direction* for adopting appropriate speeds according to the situation and context
- *Space to recover* from human errors, when errors do occur (and they will occur)
- *Protection* from fatal and serious injuries when crashes do occur

A road designer is required to identify problems and choose the optimum from a range of workable interventions. The optimum intervention depends on various design elements that have an impact on the operational speed of vehicles such as:

- Type of vehicle (motorcycle, moped, passenger or heavy vehicle)
- Road environment (city, city outskirts, towns or villages, non-built-up areas)
- Presence and interaction with vulnerable road users (pedestrians, cyclists and motorcyclists)
- Road type and cross-section (more lanes will lead to higher speeds)
- Footpaths (presence of footpaths may lead to lower speeds)

- Roadside objects (utility poles, signs, plants and trees etc. may lead to lower speeds)
- Presence of public transport and bus stops (may lead to lower speeds)
- Number of access points
- Alignment (straight long roads encourage drivers to speed up)
- Technical standards
- Costs

Building safety into the design represents the interaction of these elements. The design influences speed and vice versa, and both affect drivers' decisions about what speeds are appropriate. Designing infrastructure improvements, such as building in-lane separation, can both address situations where speeds exceed Safe System levels, and influence drivers' decisions about appropriate speeds.

Road conditions and the road environment affect safe operational speeds. A consistent geometric design, particularly along rural roads, can improve safety. Where terrain topography and other constraints make this impossible, lower speed limits may be needed. Table 3 shows several road design and layout characteristics that influence driving speed.[69]

Table 3. Road design and layout characteristics influencing driving speeds

Road design and layout characteristics	Decrease driving speed	Increase driving speed
Pedestrian facility	Pedestrians mix with other traffic	Absence of pedestrians
Bicycle facility	Cyclists mix with other traffic	Absence of cyclists
Parking facility	Parking on the roadway	No parking on the roadway
Number of lanes	One carriageway	More than one lane per driving direction
Intersection design	Junctions at grade without priority indication; roundabouts, smaller turning radius	Grade-separated junctions; pedestrian bridges; wide turning radius; prioritized roads at junctions
Distance between Intersections	Shorter distances	Longer distances
Alignment	Curved sections (also by chicanes, etc.)	Straight road sections

[69] Aarts, L.T., Nes, N.V., Wegman, F.C., Schagen, I.V. and Louwerse, R. 2009. *Safe Speeds and Credible Speed Limits (SaCredSpeed): New Vision for Decision Making on Speed Management.* 4th International Symposium on Highway Geometric Design. Valencia.

Road design and layout characteristics	**Decrease driving speed**	**Increase driving speed**
Vertical deflection (e.g., speed humps, raised platforms)	Vertical deflection present	No vertical deflection present
Road/lane width	Narrow roads/lanes	Wide roads/lanes
Road surfacing	Uneven surfacing (rough)	Even surfacing (smooth)
Bus stop design	Bus stops on the side of the road, island-type bus stops	Bays for buses or central median stops
Density of road environment	Dense vegetation or built-up area	Sparse vegetation or non-built-up area

Aligning road design with speed limits

Table 4 summarizes infrastructure interventions to support safe speed limits. Their ultimate goal is to achieve a self-explaining road, where appropriate design minimizes the requirement for additional measures such as enforcement.

Myth 8

Speed humps and rumble strips are unsafe, damage vehicles and create noise.

Reality 8. Speed humps and rumble strips increase road safety, but design and placement are essential to avoid adverse effects.

Studies from Norway show that humps reduce the number of injury crashes, for a given amount of traffic, by around 50 percent. However, these elements should not be used as stand-alone measures but as part of a broader area-wide speed management approach.

Speed humps are very effective in slowing drivers down, especially in urban areas and locations with pedestrian traffic. If carefully designed and built with the correct height, ramp profile and width, and with the correct advanced warning and level of visibility, they result in negligible damage to vehicles while also minimizing noise. Designing speed humps tailored to different speed settings is crucial. Speed humps can be utilized outside of 30 kph-zones without issues, but their design should differ from those intended for 30 kph zones. Additionally, ensuring good visibility of speed humps is important to prevent surprises for road users. Visible and clearly marked humps contribute to safer and more predictable driving conditions and do not cause damage to vehicles traveling at moderate speeds (e.g., below 50 kph).

Rumble strips induce higher noise levels than speed humps. Thus, rumble strips are typically not used in residential areas but may be used as a gateway treatment at the entrance of a town or village to encourage drivers to decrease their speed through the built-up area. They can be used in advance of risk locations on high-speed rural roads where the noise impact on local communities will be limited.

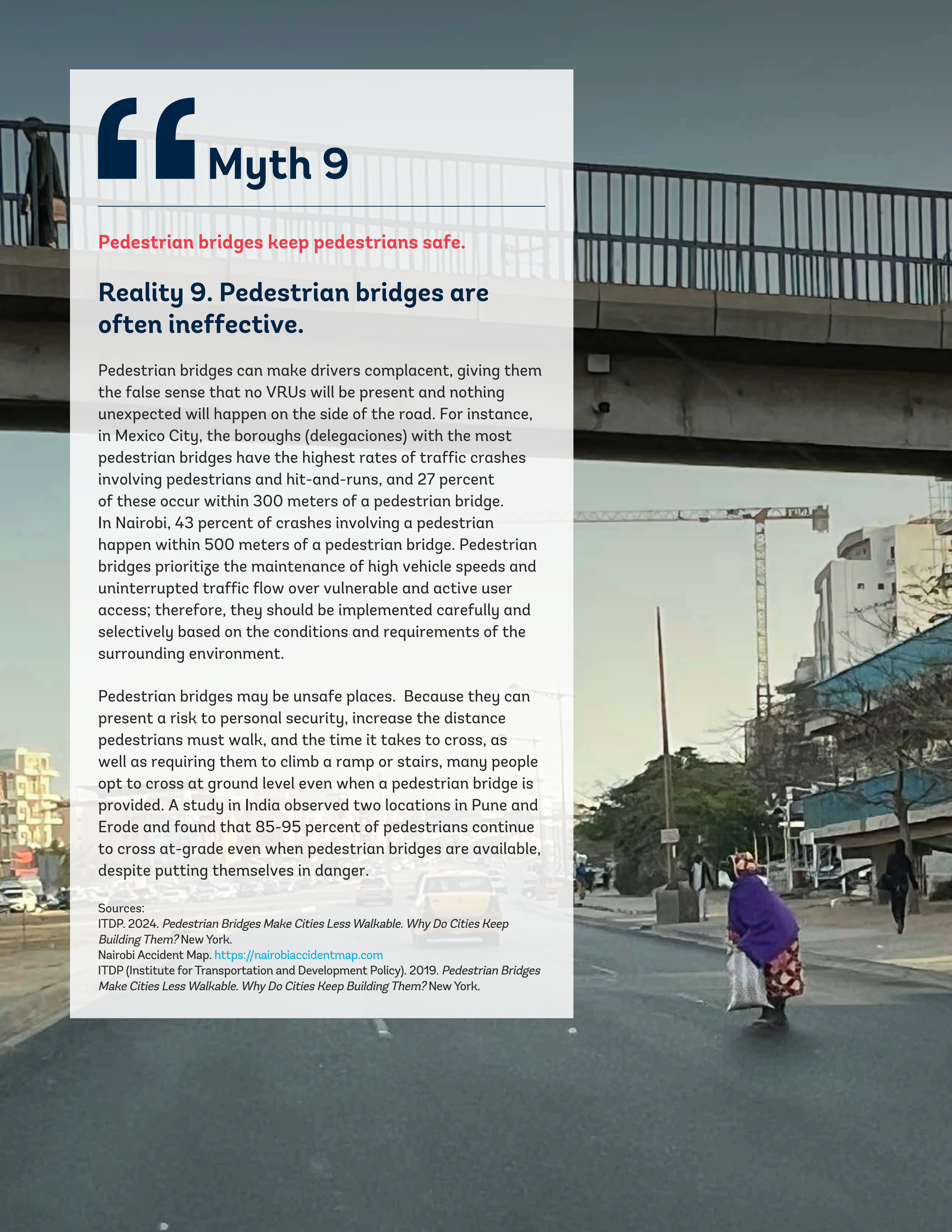
Source: WRI (World Resources Institute). 2015. *Cities Safer By Design: Guidance and Examples to Promote Traffic Safety through Urban and Street Design.* Washington, DC.

Table 4. Infrastructure interventions to support desired safe speed limits

Desired safe speed limit (ranges)	Infrastructure interventions and relevant considerations
max. 10 to max. 30	Speed limit signs do not ensure the safety of vulnerable users; therefore, for these roads or road sections, infrastructure measures often need to be implemented along with other speed management tools to ensure safe motor vehicle speeds. Speed on these roads should be primarily managed with physical interventions (such as speed humps, chicanes, or road narrowing) that still allow delivery traffic or larger freight vehicles to provide services in the zone. Most of the common traffic calming measures presented in the table in Appendix A are appropriate in low-speed zones. However, cycling lanes should be used with caution, and not used at all when the roads are meant to be shared, as segregating traffic can have the effect of increasing vehicle operating speeds.[70] Where low speeds can be guaranteed, sharing the road by cyclists and motorized traffic should be the default.
max. 50	Roads or road sections within this speed range are often used by mixed vehicle traffic, trucks, buses, light vehicles, bicycles, motorcycles and crossing pedestrians. They are best managed with infrastructure to keep pedestrians and cyclists separate from traffic (such as separated cycling lanes and sidewalks). Adding medians with pedestrian islands has been very successful in reducing the width of a road and exposure of people walking. Road-level crossings with a speed reduction to a maximum 30 kph supported by calming treatments are far safer and more efficient than pedestrian bridges. Introducing road furniture, plantings and crossings that follow pedestrians' desired walk lines, or places where pedestrians naturally cross, creates predictability about the presence of pedestrians. At intersections, roundabouts can be a safe solution. Where traffic enters lower speed environments, gateway treatments such as road narrowing and signs can inform drivers that they need to slow down. Traffic calming devices should increase driver awareness that they are transitioning to a different environment, with slower speeds needed to protect vulnerable users and accommodate the movement and service needs of buses and other public or shared transport options. In commercial zones there is usually on-road parking, which can reduce carriageway width and therefore, speed. On-road parking for motorized vehicles and bicycles could be provided, but car parking zones should be wide enough for doors to open safely.

[70] Sharpin et. al. 2021. *Low-speed zone guide. Empowering communities and decision-makers to plan, design, and implement effective low-speed zones.* World Resources Institute. Washington, DC.

max. 60 **to** **max. 70**	On roads or road sections within these speed ranges (e.g., in city outskirts) permanent changes to the infrastructure and traffic light systems are typically more appropriate than traffic calming devices. However, to address road safety concerns, it's important to plan and design such roads in a way that minimizes the presence of VRUs. When VRUs need to cross these roads, speeds should be reduced to 30 kph or less. Making needed infrastructure improvements to manage speed takes time, so shorter-term measures such as stricter speed enforcement and other types of control are needed as well while the existing infrastructure is improved. In some cases, roundabouts can be used as well, as they can lower speeds to below 50 kph at intersections. The traffic light network can and should be coordinated to ensure vehicles maintain the set speed. Traffic lights can be timed and programmed to reward drivers who travel at the safe and posted speed limits, by creating "green waves" that allow them to sail through as many green lights as possible. If speeders get slowed down by red lights, they are less apt to speed. The best strategy to control speed is a combination of traffic light programming and automatic speed enforcement. Traffic lights can effectively regulate road segments where junctions with traffic lights are relatively frequent. When they are farther apart, speed detection equipment should be added to deter speeding.
max. 80	Speed on such roads or road sections is typically controlled through appropriate road geometry (e.g., horizontal and vertical alignment, cross sections, intersection design) and enforcement. Special consideration should be given to locations where vehicles exit the road and integrate into slower moving urban traffic, to ensure that drivers apply the brakes and slow down sufficiently. Transitioning from areas of higher speeds to lower speeds presents a risk to users. Drivers do not often slow down as quickly or fully as they should, especially if they are coming from such a high-speed environment where the road design does not physically require them to slow down.
max. 100	Roads or road sections with such speeds are usually motorways. These are higher cost road types, and extreme care must be taken to avoid high risks caused by cost-cutting, or a failure to provide alternative, parallel routes for local traffic and the vulnerable road users. Pedestrians, cyclists, motorcycles under 50 cc, and animal-drawn vehicles must be prohibited, kept off these motorways, and given separate, protected roads and facilities. As an example, when constructing a motorway bridge over a large river or a valley, it is vital to build parallel bridges for slow moving traffic in the vicinity to avoid fatal crashes caused when pedestrians want to take advantage of the motorway shortcut. Roads through mountainous regions should provide emergency braking ramps for vehicles that lose their brakes due to over-heating. A rural motorway must also offer frequent, safe crossings over bridges or through tunnels for slow-moving vehicles and vulnerable road users, as well as animals living in the area. This is important in agricultural zones where landowners or rural labor must be able to access their fields. In the planning process, landowners should be encouraged to "land swap", by exchanging lots in order to limit the need for crossing.



Myth 9

Pedestrian bridges keep pedestrians safe.

Reality 9. Pedestrian bridges are often ineffective.

Pedestrian bridges can make drivers complacent, giving them the false sense that no VRUs will be present and nothing unexpected will happen on the side of the road. For instance, in Mexico City, the boroughs (delegaciones) with the most pedestrian bridges have the highest rates of traffic crashes involving pedestrians and hit-and-runs, and 27 percent of these occur within 300 meters of a pedestrian bridge. In Nairobi, 43 percent of crashes involving a pedestrian happen within 500 meters of a pedestrian bridge. Pedestrian bridges prioritize the maintenance of high vehicle speeds and uninterrupted traffic flow over vulnerable and active user access; therefore, they should be implemented carefully and selectively based on the conditions and requirements of the surrounding environment.

Pedestrian bridges may be unsafe places. Because they can present a risk to personal security, increase the distance pedestrians must walk, and the time it takes to cross, as well as requiring them to climb a ramp or stairs, many people opt to cross at ground level even when a pedestrian bridge is provided. A study in India observed two locations in Pune and Erode and found that 85-95 percent of pedestrians continue to cross at-grade even when pedestrian bridges are available, despite putting themselves in danger.

Sources:
ITDP. 2024. *Pedestrian Bridges Make Cities Less Walkable. Why Do Cities Keep Building Them?* New York.
Nairobi Accident Map. https://nairobiaccidentmap.com
ITDP (Institute for Transportation and Development Policy). 2019. *Pedestrian Bridges Make Cities Less Walkable. Why Do Cities Keep Building Them?* New York.

Prioritization

As resources are typically limited, infrastructure interventions and locations for investment must be prioritized. This can be based on issues such as risk, need, ease of implementation, and impact on the community. A proactive approach should be the basis for identifying areas with high risk for crashes. This can be done through different sources of information on risk, including collection and analysis of data on vehicle speeds and risk locations, including public knowledge of gaps and risks. New sources of speed data from mobile phones can give a good indication of operating speeds on roads. For instance, Google API or other similar products can provide speed data at different times of day at different locations. This can reveal free-flow conditions to identify the highest and riskiest speeds. If land use data is available, it can show whether speeds are appropriate for particular roads, their context, and the way they are being used. Observational studies or field road safety inspections can gauge actual risks and their relationship with speed. When available, crash data is another useful tool to identify gaps and assess risk.

The table in Appendix A introduces the most common infrastructure and road design interventions to manage speed with brief definitions, pictures and links to additional sources. It describes the different interventions and indicates which ones work best for different speed ranges. These interventions often have the greatest impact when used in combination (i.e. two or more interventions) as part of an integrated approach.[71] On their own, single interventions may have only limited effect.

[71] Turner, B., Partridge, R., Turner, S., Corben, B., Woolley, J., Stokes, C., Oxley, J., Stephan, K. and Steinmetz, L. 2019. Safety solutions on mixed use urban arterial roads. Journal of Road Safety, 30 (3).

Box 4.3. Case study on using infrastructure interventions to create self-explaining speed environments in Auckland, New Zealand

Point England in Auckland, New Zealand is an established neighborhood with a mix of houses, shops, schools, and churches. It was selected for road safety improvements due in part to its road crash history. The city created a low-speed environment through a "self-explaining road" design approach to better cater for residents, pedestrians and cyclists. The surrounding collector roads also got additional improvements.

The city created a 30 kph design speed for local roads using a combination of trees planted in the center of the road and landscaped "community islands", designed to limit forward visibility. In addition, it installed mountable central islands, and removed road markings to create a less formal environment. Significantly, the existing speed limit of 50 kph was not changed, but rather the reduced speed environment was created through the use of infrastructure changes alone.

Observations showed large reductions in speed. Mean speeds on local roads dropped from 44.4 kph to 29.6 kph, and variability of speeds also decreased. Preliminary analysis found that crashes fell by 30 percent per annum and crash costs plummeted 86% per annum, indicating a reduction in crash severity. The changes also resulted in more pedestrian and less vehicle activity on local roads.

The average vehicle speeds on the local roads also dropped to the design speed of 30 kph through infrastructure measures alone, and without any change in speed limit, enforcement, or speed restriction signs.

A self-explaining 30 kph speed environment created through infrastructure design such as narrow lanes, tree plantings and medians.

Source: Mackie, H., Charlton, S., Baas, P. and Villasenor, P. 2013. *Road user behaviour changes following a self-explaining roads intervention*. Accident Analysis and Prevention. 50. 742-750.

4.3. Policing, deterrence and penalties

The policing of traffic laws and attentiveness to road safety should be a core value and practice among police agencies. This will improve the quality of life in communities facing road traffic risks. Policing can dramatically reduce the number of road crashes. Studies show that a 2 percent increase in speed enforcement can be expected to reduce road crashes by 20 percent.[72] The actual impact in any country will depend on local context, especially the current amount of enforcement. Still, effective policing alone cannot fully address road safety problems and is more effective when coupled with well-designed engineering solutions and effective communication.

Detecting and penalizing speeding drivers is the most important aspect of policing in speed management. Frequent detection of drivers who routinely exceed speed limits increases deterrence. The level of deterrence is related not just to actual, but to perceived levels of enforcement. Publicity related to enforcement can increase the perception that unsafe drivers will be caught, but only when high levels of speed policing are occurring. The general principles and guidelines for effective speed enforcement should be included in any speed management strategy.

Specific deterrence is the impact of the actual legal punishment on those who are apprehended. It results from actual experiences with detection, prosecution, and punishment of offenders. Because only a fraction of drivers experience this, the potential impact of specific deterrence may be more limited than that of programs relying on the general deterrence mechanism.

General deterrence can be defined as how the threat of legal punishment for violations affects the public at large. General deterrence strategies target all speeding road users, irrespective of whether they have previously offended. It results from the public perception that traffic laws are enforced and that there is a risk of detection and punishment when traffic laws are broken.

The general assumption underlying road policing for speeding is that the most effective mechanism to increase deterrence is to maximize detection of those breaking speed limits. Road users will change their behavior when they perceive there is a high risk of being caught and penalized. More enforcement reduces serious crashes[73] and high volumes of speed enforcement are required for general deterrence.

However, a variety of approaches to speed enforcement may be needed. It was demonstrated that covert mobile speed patrols did more to reduce casualties from crashes than overt (visible) speed enforcement, but that the largest casualty crash reductions were found during times when both marked and unmarked police cars were in operation in rural regions.[74] In general, the dominant expert guidance is to combine visible enforcement with hidden enforcement.[75]

[72] European Road Safety Observatory (ERSO). 2016. *Speed Enforcement Summary*. European Commission. Brussels.

[73] Elvik, R. 2011. *Developing an accident modification function for speed enforcement*. Safety Science - SAF SCI. 49. 920-925.

[74] Diamantopoulou, K. and Cameron, M. 2002. *An evaluation of the effectiveness of overt and covert speed enforcement achieved through mobile radar operations*. Monash University Accident Research Centre. Report 187.

[75] European Commission. *Speed Enforcement*. https://road-safety.transport.ec.europa.eu/eu-road-safety-policy/priorities/safe-road-use/safe-speed/archive/speed-enforcement-0_en

Policing methods and tactics

Methods available for speed enforcement include non-automated and automated approaches. Non-automated speed enforcement involves a police officer who detects the speed offence stopping the speeding vehicle and immediately issuing a penalty notice to the driver. Tools for non-automated speed enforcement include:

- Stationary patrols: a police officer, conspicuous or inconspicuous, with speed detector (e.g., speed gun) alongside the road, visible or hidden
- Mobile speed patrol: conspicuous or inconspicuous police cars traveling with traffic to detect speed offences in the immediate vicinity of the police car

Multiple stationary or mobile marked patrol cars can be used to remind the public that policing is present and to increase the actual and perceived risk of detection among the driving public.

Automated speed enforcement (ASE) covers all techniques where the license plate number of a speed-violating vehicle is photographed, and the penalty notice is later sent to the registered owner of the vehicle. Tools for automated speed enforcement include:

- Fixed or mobile speed cameras
- Time over distance cameras or point-to-point enforcement (section control) speed measured between two points on the road network

Automated speed enforcement requires complex support systems such as enabling legislation, accurate vehicle and driver license databases, efficient processing systems for penalties, and rigorous enforcement of rules requiring that license plates are visible. The requirements that need to be in place to successfully operate automated enforcement systems are explained in detail within the *Guide for determining readiness for speed cameras and other automated enforcement*.[76]

A country's legal system, especially liability and privacy legislation on identifying license plate holders, determines which automated speed enforcement tools can be used. There is no single best method for enforcing speed limits. Each jurisdiction needs to customize a combination of technologies and tactical methods to enforce speeds that works best for its community and road safety problems.[77]

Highly effective and cost-effective speed management interventions include a mixture of manual speed enforcement, speed cameras, overt and covert deployment, combined with a communication program that supports and explains the enforcement activities.[78]

General speed enforcement works best if police deployment practices are random and unpredictable as to time and location. If enforcement is predictable, speeding drivers will become aware of where and when enforcement is likely, and only adjust their behavior at those sites or times. Random road watch (RRW) is an enforcement resource management technique that randomly schedules levels of

[76] Job, S., Cliff, D, Fleiter, J.J., Flieger, M. and Harman, B. 2020. *Guide for Determining Readiness for Speed Cameras and Other Automated Enforcement.* Global Road Safety Facility and the Global Road Safety Partnership. Geneva.

[77] Job, S., Cliff, D, Fleiter, J.J., Flieger, M. and Harman, B. 2020. *Guide for Determining Readiness for Speed Cameras and Other Automated Enforcement.* Global Road Safety Facility and the Global Road Safety Partnership. Geneva.

[78] WHO (World Health Organization). 2017. *Save LIVES - A road safety technical package.* Geneva.

Myth 10

Speed enforcement is not for road safety but to generate money for the government or police.

Reality 10. Speed cameras and manual speed enforcement effectively manage speed, reduce crashes, and save lives.

When undertaken effectively, speed enforcement contributes directly to reducing the incidence of speeding and, consequently, the frequency and severity of crashes. It can also complement and maximize the effectiveness of infrastructural and educational measures. Speed enforcement is essential if the speed problem is not solved structurally by road design, engineering measures or in-vehicle technology.

For speed enforcement using automated technologies, it is important to be transparent and engage the community on decisions concerning where and why cameras are being installed and how funds collected as fines are used. In some countries, these funds are directed back to road safety improvements.

Source:
Sakashita, C. Fleiter, J.J., Cliff, D., Flieger, M., Harman, B. and Lilley, M. 2021. *A Guide to the Use of Penalties to Improve Road Safety.* Global Road Safety Partnership. Geneva.

police enforcement to provide the reality and perception of long-term, widespread coverage. Speed offenders are stopped and penalized by police. A RRW program in Queensland, Australia, generated a 31 percent reduction in fatal crashes on the roads included in the program.[79] The benefit-cost ratio for the program was estimated to be 55:1.

The importance of proper sanctions

To ensure the integrity and enhance the deterrent effect of enforcement systems, detected offenses must be followed by sanctions. Penalties must be certain, unavoidable, swift, and fair. When combined with legislative change, enforcement and broader advocacy campaigns, penalties can be an effective method for reducing road trauma. Various categories of sanctions include fines, demerit points, withdrawal/ suspension of the driving license, and vehicle impoundment.[80]

Trust plays a vital role in encouraging individuals to comply with road traffic laws and regulations. To build trust, enforcement actions must be unbiased and corruption-free. By ensuring integrity and transparency in enforcement practices, governments and enforcing agencies can both cultivate trust and reinforce the belief that penalties are applied in a fair and consistent manner. This trust, in turn, motivates individuals to comply with traffic laws, resulting in improved road safety.

Evidence clearly links greater certainty of punishment to a lower rate of offences.[81] Extensive use of penalties is more effective than scarce or sporadic use. Drivers in countries with strong enforcement commit fewer traffic offences than drivers in countries with relaxed enforcement because of their awareness of the consequences of these offences.

For some types of offences, penalties should be graduated based on severity of activity, with higher penalties for worse, or repeated offenses. For example, penalties for repeat, or high-speed offenders (traveling more than 20 - 25 kph over the speed limit) could include losing their license and having their vehicle impounded. Severe punishment discourages such offenses.

Penalties should be issued as quickly as possible because re-offences are less likely if the punishment is administered immediately after the offence is committed.[82] Options swifter than postal mail (such as electronic mail or SMS) may be preferable.

Establishing an effective speed enforcement program will initially require adequate funding for personnel, vehicles and other equipment, operating costs, and maintenance. A program's cost-effectiveness depends on how sustainably it was set up. Speed enforcement should not be dependent on grant funding, which is uncertain from year to year. At the same time, it should be presented as an initiative to increase safety in the community and not as a tool for revenue collection.

[79] Newstead, S., Cameron, M. and Leggett, L. 2001. *The crash reduction effectiveness of a network-wide traffic police deployment system. Accident Analysis & Prevention.* 393-406.

[80] Sakashita, C. Fleiter, J.J., Cliff, D., Flieger, M., Harman, B. and Lilley, M. 2021. *A Guide to the Use of Penalties to Improve Road Safety.* Global Road Safety Partnership. Geneva.

[81] Sakashita, C. Fleiter, J.J., Cliff, D., Flieger, M., Harman, B. and Lilley, M. 2021. *A Guide to the Use of Penalties to Improve Road Safety.* Global Road Safety Partnership. Geneva.

[82] Sakashita, C. Fleiter, J.J., Cliff, D., Flieger, M., Harman, B. and Lilley, M. 2021. *A Guide to the Use of Penalties to Improve Road Safety.* Global Road Safety Partnership. Geneva.

Most research demonstrates that automated policing, such as speed cameras, generates substantial net benefits, and that the "pay back" period for this technology is fairly short. The funds this generates can then be re-invested into further road safety programs.

The most common enforcement interventions to manage speed are summarized in Appendix A.

4.4. Vehicle technology

Major advances in automotive technology for passive safety can play a significant role in managing speeds for private cars, commercial vehicles, and public transport. Manufacturers first introduce most passive safety systems as options in top-of-the-line models. As they prove effective, the systems become more popular and, in some cases, are made mandatory by lawmakers. More recently, understanding the benefits of speed management, other stakeholders such as fleet managers and insurance companies are introducing speed monitoring devices on board their vehicles. This is very beneficial, not only for passenger buses, but for all companies with vehicle fleets, to prevent speeding and decrease the number and severity of crashes.

Many in-vehicle technologies to control or monitor speed are already on the market. But widespread adoption may require promoting them as a part of a speed management strategy using fiscal, political, commercial, and other tools available. In-vehicle safety technologies can also be encouraged through public and private procurement for transport services or for purchase of vehicles.

Intelligent Speed Adaptation (ISA) also called Intelligent Speed Assistance is especially promising. It is an in-vehicle system that detects whether the vehicle is traveling at the speed limit in force at that location. ISA supports drivers in complying with the speed limit everywhere in the network. This is more effective than the speed limiters for heavy goods vehicles and coaches, which only limit the maximum speed.

The most common vehicle technology interventions to manage speed are summarized in Appendix A.

Box 4.4. Case study on benefits of Intelligent Speed Adaptation (ISA) in Europe

Intelligent Speed Adaptation (sometimes Intelligent Speed Assistance, or ISA) is one of the most promising IT systems for enhancing safety. It uses road-sign recognition cameras and GPS-linked speed limit databases to prevent drivers from exceeding the speed limit. It can advise drivers about what the speed limit is, or automatically restrict vehicle speed by limiting engine power unless overridden.

Field and driving simulator experiments of ISA show positive effects on speed management and predict significant safety benefits. ISA was found to be effective in reducing the speed in roads with 30-70 kph speed limit. Mandatory use of supportive ISA could reduce serious crashes by up to 50 percent. Swedish and Dutch research showed that speeds were slower and more uniform when using ISA. In Britain, speed behavior studies using driving simulators also provided positive evidence of safety benefits. Based on these and other results, ISA has been made mandatory in the European Union as of 2022.

Sources:
Várhelyi, A. and Mäkinen, T. 2001. *The effects of in-car speed limiters: field studies*. Transportation Research Part C: Emerging Technologies. 9 (3). 191-211.

Carsten, O. and Tate, F. 2005. *Intelligent speed adaptation: accident savings and cost–benefit analysis*. Accident Analysis & Prevention. 37 (3). 407-416.

4.5. Education and communication

Education and communication about safe speeds enhance both public awareness and compliance and help overcome misconceptions about the role of speed for road safety. Knowledge needs to be conveyed both internally, through capacity building for decision-makers and staff (designers, engineers and planners), and externally, using public campaigns and targeted driver education. The general principles and guidelines for these activities should be included in any speed management strategy and implementing them should be an important part of speed management action plans.

Active awareness and focused discussion are needed to agree on initial ways forward, and to continuously review and improve the Safe System implementation. Communication strategies should provide information to schools and communities to explain the Safe System principles that humans are vulnerable and make mistakes, but that death and serious injuries are unacceptable and can be proactively avoided. This can build demand and support for actions to make roads safer. Training journalists in road safety and Safe System objectives can improve media coverage and enhance public understanding of how crashes can and should be prevented.

Education

One of the most important educational efforts should be directed towards engineers who are traditionally trained to design roads and infrastructure to prioritize vehicle movement over the safety and well-being of all road users. These practices often neglect the needs and safety of pedestrians, cyclists, and other vulnerable road users. To address this issue, it is crucial to provide road engineers with comprehensive and periodic training that emphasizes the principles of safe and inclusive road design, including the role of safe speeds.

Education should also be focused on drivers. Those seeking licenses should be required to understand the risks associated with speed. They are highly motivated to pass driving tests, so it is an excellent opportunity to teach them about the effects of speed on crash and injury risk. Education on the effects of speed is a must for acquiring a licence to drive heavy trucks, delivery vehicles, buses and school busses, taxis or provide other public transit services.

In contrast, *post-license driver training programs* have been found to be ineffective and sometimes even harmful to road safety. Researchers discovered that any benefits gained through this knowledge and skill are outweighed by a greater risk from overconfidence following the training.[83]

In line with the Safe System approach, transport system designers within jurisdictions should be aware of their responsibilities, whether they are designing the infrastructure, setting speed limits or writing relevant policies. This includes strengthening individual knowledge and skills, promoting community education, exercising influence over, or helping to update university curricula, civil engineering training and workforce standards, or fostering coalitions and networks, and changing organizational practices.

Communication

Communication campaigns on their own produce only modest safety benefits. They can be key, however, in ensuring successful implementation of other measures, especially enforcement. There is a growing evidence base that campaigns are most effective, when combined with other measures such as better enforcement or changes in laws on allowable speeds. Publicity to support enforcement operations can make them more effective. It is essential that road users actually observe that the ramped-up enforcement being publicized is actually taking place. Otherwise, behavioral changes are only short term.

Communication with road users should:

- Emphasize that road safety is the goal of speed enforcement activities
- Explain how and why speeding leads to more severe crashes
- Explain the enforcement method and procedures
- Illustrate that penalties work

Campaigns should focus on specific issues and tested to see how the target audiences react. Messages that reflect local culture and demographics are essential, as is determining which media mix works best. Print and broadcast media have been losing their relevance over the last years and are being replaced by online and social media, especially, but not only, for younger target groups.[84]

The most common education and communication interventions are summarized in Appendix A.

[83] Ker, K., Roberts, I.G., Collier, T., Beyer, F.R., Bunn, F. and Frost, C. 2003. *Post-license driver education for the prevention of road traffic crashes.* Cochrane Database of Systematic Reviews. 3.

[84] WHO (World Health Organization). 2016. *Road safety mass media campaigns: a toolkit*. Geneva.

Myth 11

Only education and training will change behaviour and solve the speed problem.

Reality 11. Education and training alone often have little to no effect on user behaviour unless supported by enforcement and infrastructural measures.

Education delivers knowledge and training delivers skill, both of which are essential elements of speed management. Education and training should be focused on achieving safe driver behaviour and improved road safety outcomes, but they should be paired with safer infrastructure, clear and consistent signage, vehicle safety, and enforcement. Research shows that education, training, and public awareness or education campaigns are not suitable stand-alone interventions for changing how people drive.

Source:
Turner, B., Job, S. and Mitra, S. 2020. *Guide for Road Safety Interventions: Evidence of What Works and What Does Not Work.* Washington, DC.

Box 4.5. Case study on local campaigning for lower speeds in cities, towns, and villages

The community engagement campaign **20's Plenty for Us is a non-profit set up in 2007. It currently comprises 500 local groups campaigning to reduce speeds on residential and urban roads to 20 mph.** Thanks to its activities, around 25 percent of the UK population now live in local authorities where most roads have a speed limit of 20 mph.

20 mph 20's Plenty for Us
...making your place a better place to be

20's Plenty's approach is to **empower local communities**. It provides basic information, advice on how to campaign, and evidence. Its resources are designed to help community volunteers be effective and find all the answers they need to start and run a campaign.

Inspired by **20's Plenty for Us**, Transport for London, which is responsible for the transportation network in the city of London, has been implementing 20 mph speed limits on almost all roads in London's inner boroughs in a two-phase process. Phase 1 has been completed. Its goal was to lower the speed limit in central London to 20 mph by 2020. In Phase 2, speed limits will be lowered on 140 kilometers more of the road network in inner and outer London. The new limits were supported by signs and road markings as well as speed cushions, speed bumps, raised pedestrian crossings and traffic islands in the center of the road.

A community consultation on the proposed speed limits conducted in 2019 found that the public largely accepted and supported the initiative. Half of the people said the proposals would have a positive impact on walking with 31 percent saying that many more people would choose to walk. Almost two-thirds thought that the proposals would lead to more people cycling (59 percent).

Sources: Interview with Rod King, Founder & Campaign Director, 20's Plenty for US https://tfl.gov.uk

4.6. Special concerns to consider when selecting interventions

Mixing different types of road users

A variety of road users are present in all types of built-up areas including towns, villages and linear settlements, such as people traveling by motorized vehicle or actively walking, biking or traveling by any other mode. This mixture creates the need to plan and manage roads that cater to a variety of movement and speeds. Variation in travel speeds (i.e., speed differentials) is one of the greatest contributors to conflict on the road. Infrastructure and regulation must be designed to reduce speed variation and associated conflicts. Otherwise, it is necessary to provide sufficiently wide spaces or separated infrastructure to accommodate fundamentally different speeds, masses (weights) and dimensions, such as between people walking and those traveling by motorized vehicles.

Myth 12

Mass-media campaigns with TV spots are highly effective in changing driver behaviour.

Reality 12. Changing driver behaviour through public campaigns based on crash risk and consequences is very difficult, and the messages are often ignored at the time or soon forgotten.

Public awareness campaigns have mixed effects on road user behaviour. As stand-alone measures, they might increase community awareness of traffic safety issues, but have only minimal effect on actual road user behaviour. Without enforcement, a mass media campaign has virtually no direct impact on driver behaviour and the number of crashes. But in combination, campaigns can work well, and publicizing new enforcement measures is important to their success.

Source:
Turner, B., Job, S. and Mitra, S. 2020. *Guide for Road Safety Interventions: Evidence of What Works and What Does Not Work*. Washington, DC.

This is particularly relevant for high-density areas where slow-traffic, including low-powered motorized vehicles, share the road with faster traffic. This is often not perceived as a speed-related risk factor, but variations in travel speed can be fatal even at quite low magnitudes (< 30 kph). This is especially a concern among incompatible vehicles or road users. Homogeneity and separation of traffic of different types or speeds considerably lowers the likelihood of crash at all speeds. Service-roads for slower traffic are particularly effective in such instances of mixed traffic.

LMICs have traditionally experienced a variety of speeds and vehicle types, such as motorbikes, rickshaws, bicycle, 2- and 3-wheeler motorcycle taxis, vans, minibuses and other types of private or public transport and paratransit. But in recent years, advances in e-mobility such as e-bikes and scooters have broadened the range of vehicles on roads around the world.[85] Speeding is a significant contributor to e-scooter crash and injury risk (see BOX 4.6).

Box 4.6. How to safely integrate micro-mobility devices in urban transport

Micro-mobility devices, such as electric scooters (e-scooters) have proliferated in urban areas since the late 2010's because they offer more versatile mobility than other transport modes and seem to be faster than cars in congested urban environments. Still, in comparison to walking and cycling, e-scooters are likely to be more risky, less healthy and active, less environmentally friendly and more costly. The surging popularity of e-scooters raises significant safety concerns. In some places, like Paris, they have been banned. In a A systematic review of studies, links the proliferation of e-scooters, to a growing number of injuries both to riders and other vulnerable road users, including pedestrians. 93 percent of the reported injuries are due to single-user incidents, mainly falls. Beyond safety, e-scooters raise questions about health, environmental impact, and long-term costs. Policymakers and transportation authorities must address these issues through regulations, designated lanes, and public awareness. Additional risks include rider behavior, lack of standardized safety features and maintenance, parking and clutter issues, and theft and vandalism. Mitigating these risks requires educating riders, implementing quality control measures, establishing clear regulations, and investing in security measures.

Micro-mobility speed management

Bikes, electric scooters, and skateboards are dubbed micro-mobility devices. Because of the nature of their movements and the low level of protection against crash forces, micro-mobility device riders are considered VRUs. Therefore, when they share the road with micro-mobility devices, motorized vehicles should be held to 30 kph or lower. Maximum speeds of micro-mobility devices should be limited to 15-20 kph depending on the road infrastructure and the rider's age. This is mainly because higher speeds result in more crashes, especially falls, and more serious injuries both for riders and other VRUs hit by the devices. Research into e-scooter-related pedestrian injuries suggests that pedestrians with vision and/or hearing impairment, children, the elderly, and distracted pedestrians are more likely to suffer such injuries.

[85] The Royal Society for the Prevention of Accidents. 2020. *Road Safety Factsheet: Electric Scooters*.

Box 4.6. How to safely integrate micro-mobility devices in urban transport (cont.)

Micro-mobility devices should be prohibited from sidewalks, or if they must be accommodated on the sidewalk, the maximum speed should be limited to 10 kph.

Acoustic Vehicle Alerting Systems (AVAS) should be considered to generate sound to improve the safety of nearby pedestrians, especially those with hearing or vision impairments.

Compulsory helmet use and a minimum-age restriction (such as 14 or 15 years) should be implemented as it is in many European countries, because falls and head injuries for e-scooter riders are so common.

Speed limits should be enforced, at least initially, to raise and promote behaviour change amongst riders and other road users. Intelligent Speed Adaptation (ISA) and geo-fencing are recommended for enhancing the design and operation of micro-mobility devices, including the effective management of speed.

To gain a better understanding of the relationship between impact speed and associated crashes and injuries, it is crucial to collect comprehensive data on micro-mobility and pedestrian crashes. The International Transport Forum's report on "Safe Micromobility" supports this recommendation. Furthermore, advancements in technology have resulted in the development of safety features specifically tailored to two-wheelers. Anti-lock braking systems (ABS) and traction control systems (TCS) are examples of such technologies that enhance stability and control, particularly in challenging road conditions. While ISA, geo-fencing, ABS, and TCS contribute to safer micro-mobility, addressing broader infrastructure design and maintenance concerns first remains imperative.

Sources: International Transport Forum. 2020. *Safe Micromobility*. Paris.

Sikka, N., Vila, C., Stratton, M., Ghassemi, M. and Pourmand, A. 2019. *Sharing the sidewalk: A case of E-scooter related pedestrian injury*. American Journal of Emergency Medicine.

Toofany, M. et al. 2021. *Injury patterns and circumstances associated with electric scooter collisions: a scoping review*. Injury Prevention.

Linear settlements

A linear settlement is a small to medium-sized group of buildings formed on either side of a road. These settlements often surprise drivers who have been traveling in an otherwise non-built up or empty landscape. They pose a higher risk due to an increased presence of vulnerable road users as well as a variety of vehicles such as mopeds, motorcycles, farming machinery, horse carriages, and livestock. They often become high-risk crash locations due to crossing pedestrians, parked vehicles and decelerating and accelerating vehicles that come into conflict with fast moving through-traffic. For road safety in these linear settlements, speeds must be reduced to safe levels. In situations where VRUs are present, speeds of 30 kph or less are required.

Road-side trading

In many countries, roadside trading is very common. Trading activities, including markets, single stands, or individuals selling goods beside or on roads, can be found in cities, city outskirts, towns and villages. They are also likely to be present in non-built-up areas, especially on routes with higher traffic volumes. Many roads where trading takes place were not planned for commercial activities, making them dangerous. The presence of the traders, their carts or livestock, and customers along the road, is often unexpected and poses a serious risk to the traders as well as other road users. Vehicles illegally stopping for the vendors can also collide with through-traffic.

Traders should be encouraged to set up their businesses in areas where vehicles can safely stop and where the road operator has intervened to maintain safety.

Informal roadside trading can only be controlled if there are alternative sites set specifically for trading. Building a lay-by for trading purposes is one solution. Stands illegally placed beyond the safe trading zones that compromise road safety should be removed and monitored so they are not rebuilt. Often, trading stands are placed where there is need and opportunity, and this should be taken into account when planning and designing safe trading zones that are usable by the traders and are easy to enforce.

Transition zones

A transition zone refers to a road section approaching a built-up area where the speed limit drops. At such locations, drivers must reduce their speeds and prepare for the additional complexity and mix of road users associated with the city, town, or village ahead.

Speeding through transition zones is common, although actual speeds vary.[86] The different speeds combined with a high proportion of heavy vehicles, such as trucks, can cause drivers stuck behind slower vehicles to try risky maneuvers, such as overtaking other vehicles in tight and inappropriate locations. This can result in rear-end, head-on or side-impact crashes or hitting a VRU.

In a comparative study, crash rates in transition zones were found to be almost double that of rural roads (45 vs. 27 crashes per 100 million vehicle kilometers).[87] The key risk factors were inadequate road design and greater roadside development. These findings highlight the importance of properly designed transition zones to support lower speed limits, and alert road users to upcoming changes in road and traffic environments and potential hazards ahead.

[86] Biecheler, M. and Peytavin, J. (1998). *Drivers' speeding behaviour and attitudes to law enforcement: A multisite roadside survey in France*. Proceedings of Traffic Safety on Two Continents. Conference in Lisbon, Portugal, 1997.
[87] Tziotis, M. 1992. *Crashes on the approaches to provincial cities*. Monash University Accident Research Centre.

Intersections

Road intersections are risky for all types of road users. Intersections are complex locations where road users must decide what path/direction to take and whether to proceed or give way to other road users. Because impact speeds above around 50 kph heighten the risk of serious and fatal crashes, speeds at or below this level are required for safe interaction between vehicles. Where VRUs are present and using intersections, even lower speeds will be required, typically 30 kph.

Of all intersection types, uncontrolled intersections are often the most dangerous. Risks are greater at intersections with heavy traffic, a larger total number of lanes, where traffic moves at high speeds, and in densely populated areas. Still, in many parts of the world, signalized intersections also account for a large proportion of road trauma. Inconsistent road network design, intersection geometry and conflict angles (angles at which vehicles come at one another), as well as conflicting traffic movements, and high traffic volumes and speeds are often to blame.

Reducing speed and the number of conflict points, and/or impact angles helps. To reduce speeds and increase safety at intersections in low-speed environments, curb radii should be as tight as possible, while still allowing for the turning movements of any large vehicles such as emergency vehicles or buses that may need to use that route.

Roundabouts, when implemented correctly, can reduce exposure, likelihood, and the severity of crashes, in line with the Safe System philosophy. Through their design, roundabouts reduce vehicle entry speeds and the angle of conflict. At lower conflict angles (when vehicles are closer to moving in parallel than at right angles or in opposite directions) impact forces are lower if they collide. Roundabouts are one of the safest infrastructure treatments for intersections when installed correctly and designed considering pedestrians and especially cyclists. For example, pedestrian facilities can be embedded in roundabout design including raised pedestrian crossings (marked pedestrian crossings on flat-top road humps). At low speed single lane roundabouts, cyclists can safely share the road with motorized vehicles, but in higher speed environments, or at multilane locations, other facilities (e.g., separate off-road lanes) will usually be required to keep cyclists safe.

Run-off road and head-on collisions

Vehicles running off the road may come in contact with roadside hazards. This includes fixed, rigid objects such as a traffic signal pole, road lighting pole, tree, or a sidewalk or crosswalk. VRUs moving adjacent to traffic are also at risk in these situations. Alternatively, when a vehicle leaves its lane and travels into an opposing lane, this may result in a head-on crash. A combination of factors influences the likelihood and severity of a vehicle leaving its lane, and either running off the road or having a head-on crash. These can include driver fatigue, speed, and inattention, tire blow-outs and mechanical failure, and road hazards involving width, alignment, maintenance and roadside obstacles. Speed can also be a factor in the likelihood of such events, and certainly plays a role in the severity of the outcome. The chances of survival decrease with higher speeds, including when vehicles hit roadside objects, during head-on impacts, and when vulnerable road users are struck by vehicles.

By implementing effective safety measures and maintaining well-designed and hazard free roadsides, the risks associated with high-speed impacts, especially those exceeding 70 kph, can be significantly reduced. Proactive measures and positive changes in road infrastructure can greatly enhance road safety and protect the lives of motorists and vulnerable road users alike.

Roadworks

Work zones pose specific risks on all roads, not only to those driving through the complex arrangements of signs, road markings, and lane changes, but to the workers who must build, repair, and maintain the roads. Speed reductions in a work zone should always be aligned with these risks. Setting speeds in work zones which are unreasonably low relative to the risk causes unnecessary disruption to the road network, community dissatisfaction, and ultimately poor driver compliance. Providing adequate lateral safety is a better alternative. This means providing enough clearance, a large enough buffer at the edge of work zone, to separate workers and traffic and allow for traffic to safely pass work zones at higher speeds. Conversely, a low level of lateral safety will require reduced traffic speeds past the work zone, or measures such as safety barriers.

Appropriate advance warning of the oncoming speed reduction is vital. Drivers should receive advance warnings far enough away to allow sufficient time to understand and adopt the required speed, but close enough so that it is not perceived as premature and disregarded by the driver.

Figure 12. Typical examples of roadwork zones

Key takeaways

1 **Speed management is important for improving road safety and many other important societal outcomes**

- Strong evidence from around the world clearly demonstrates that higher speeds lead to a greater risk of a crash and a greater probability of serious injury if a crash occurs
- There is a strong, evidence-based relationship between impact speed and serious injuries and fatalities. Most vulnerable road users such as pedestrians or cyclists can typically survive impact speeds up to only 30 kph. Above this speed, the chance of survival falls dramatically. A similar impact speed applies to other unprotected road users such as those using powered two-wheelers (PTWs). This is because they are often completely unprotected or have very limited protection
- The benefits of speed management go much further than reducing crashes, saving lives and preventing serious injuries for all types of road users. Managing speed has positive impacts across all indicators for societal well-being – environment, health, equality, accessibility, and economy – that are all based on good evidence

2 **Safe roads are roads that cater to all road user needs**

- There is growing expert consensus that roads should prioritize not just motorized transport, but the safety and mobility of pedestrians and cyclists and especially vulnerable people including children, the elderly, and persons with disabilities
- This inclusive, user-centered approach can generate more equitable outcomes than traditional approaches and align with community wellbeing objectives as well optimal road use and infrastructure
- Using the Roads-for-Life Framework presented in this guide leads to speed limits that are safe (from a Safe System perspective) and considers the needs and vulnerabilities of all road users

3 **Evidence can overcome false beliefs and other obstacles to effective speed management**

- There are many myths and misperceptions relating to speed management, and these often act as barriers to change. The evidence presented in this guide helps to dispel these myths, thereby reducing the barriers to change
- Clear, unambiguous messages are required to help explain to the public and decision-makers the role of speed in death and injury and its negative impacts on societal well-being

4 Successful speed limit reduction is not possible without stakeholder support

- To ensure acceptance and support, speed limit changes should start in high-risk areas where impact of a speed reduction is likely to be significant. School areas are often ideal, due to their high concentrations of the most vulnerable road users and the public's interest in protecting them
- When implementing speed management interventions, pilot projects should be used to test, evaluate, and optimize new ideas. This allows stakeholders to experience the impact of an intervention firsthand and builds political will and public support for a permanent project

5 Speed management processes should be flexible enough to accommodate the variety of conditions in different countries and jurisdictions especially in LMICs

- The lack of "perfect" data must not limit action in speed management. Processes that follow the Safe System principles are not solely reliant on data. Even rudimentary data in combination with some simple spot speed measurement can be sufficient
- If setting up a speed management working group to lead the efforts is too complicated, the willing agencies and interested groups should get the process started
- When collecting data for monitoring and evaluation, indicators that are easy to track and assess should be used first. Other indicators can be added as the process develops

6 Speed limits should reflect surrounding land use and context and not only rely on road type.

- Roads around schools, hospitals, and other places frequented by vulnerable road users should have speed limits set at 30 kph or lower
- Roads within populated areas, with multiple land uses and a variety of road users, should have speed limits that are 50 kph or lower. Where vulnerable road users are present (on most roads in urban areas, and populated areas outside of cities) speeds of 30 kph or lower will be required
- High speed roads should not cut though villages or towns as they lead to community severance and impose high road safety risks

7 Speed limit changes should be supported by adequate interventions.

- Road infrastructure plays a significant role in determining driving speed. Applying appropriate infrastructure interventions helps to achieve a "self-explaining" road, where appropriate road design compels road users to comply with safe speed limits
- Where road infrastructure is not able to adequately encourage the safe driving speed, enforcement backed by appropriate penalties may be required to achieve compliance with speed limits.
- Education and communication about safe speeds can increase traffic regulation awareness and compliance. Public campaigns on their own yield only modest benefits, but they can be effective when combined with lower speed limits and stricter enforcement

Appendix A: Speed management interventions

Infrastructure and Road Design Interventions				
		Speed environment where interventions can be applied		
Intervention and brief description	Image	From max. 10 to max. 30	From max. 40 to max. 70	From max. 80 to max. 100
Vertical deflection				
Raised pedestrian crossings The pedestrian walking surface is raised above the surface of the roadway, providing a safer crossing. This intervention reduces vehicle speeds as well as increasing the visibility of people crossing. It can be used in conjunction with flashing lights where appropriate.		✓	O	X
Speed humps (also: speed bumps) Speed humps are raised sections of pavement with a parabolic or flat top that extends across the road to maintain the intended speed and cause abrupt discomfort when traversed at higher speeds. These are the most used traffic calming devices. They are made of either concrete or asphalt and are relatively inexpensive to maintain. The dimensions of the speed humps and the distance between them must be adjusted to the desired speed.		✓	O	X

Applicable = ✓ | Partially Applicable = O | Not Applicable = X

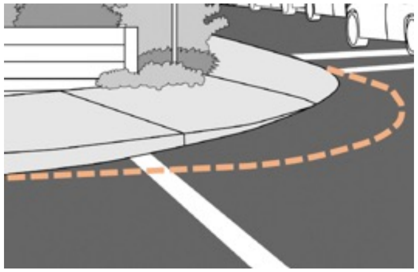
Infrastructure and Road Design Interventions				
		Speed environment where interventions can be applied		
Intervention and brief description	Image	From max. 10 to max. 30	From max. 40 to max. 70	From max. 80 to max. 100
Speed tables Speed tables are larger than speed humps or speed cushions. They may be designed in conjunction with curb extensions to narrow the roadway, creating a shorter crossing for pedestrians.		✓	X	X
Speed cushions (also: flat- topped cushions) Speed cushions are speed humps with wheel cut-outs to allow larger vehicles such as emergency or public transport vehicles to pass unimpeded. The cut-outs also allow bicyclists and motorcycles to pass with minimal risk of falling and increase stormwater conveyance. This measure may be implemented at junctions or in the middle of a block and is less expensive than raised pedestrian crossings, humps and tables. In areas with high rates of motorcycle use, the design may need to be reviewed to ensure that it also slows motorcycle speeds.		✓	X	X

Applicable = ✓ | Partially Applicable = ◯ | Not Applicable = X

Infrastructure and Road Design Interventions				
Intervention and brief description	Image	Speed environment where interventions can be applied		
		From max. 10 to max. 30	From max. 40 to max. 70	From max. 80 to max. 100
Intersections				
Roundabouts Roundabouts, when appropriately designed with deflection, signs, markings, and splitter islands, are considered one of the safest infrastructure treatments. They effectively manage speed by reducing vehicle speeds at the intersection and slowing down approaching traffic. However, the safety and effectiveness of roundabouts can vary depending on the specific context. In regions with a high prevalence of motorcycles and in certain LMICs, issues with adherence to priority rules have been an issue. To ensure safety, it is crucial to design roundabouts that cater to the needs of all road users and raise awareness among them.		✓	✓	✓
Compact roundabouts (also: mini roundabouts) Compact roundabouts are usually cheaper than traditional roundabouts and are often built within existing intersection.		✓	O	X

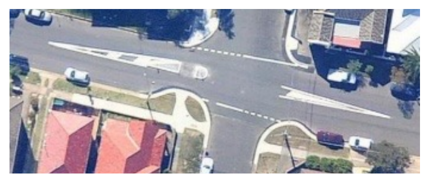
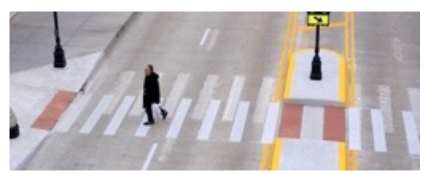
Applicable = ✓ \| Partially Applicable = O \| Not Applicable = X

Infrastructure and Road Design Interventions

Intervention and brief description	Image	Speed environment where interventions can be applied: From max. 10 to max. 30	From max. 40 to max. 70	From max. 80 to max. 100
Raised intersections (also: raised platforms, curb-elevated junctions) A similar concept to a raised pedestrian crossing and humps, the full intersection is raised to sidewalk level requiring motorists to reduce their speed moving through the intersection. They are more expensive due to their size. A less expensive intervention are "raised stop lines", which are basically speed humps on the approach to an intersection.		✓	○	X
Reduced curve radius Gentle curvature tends to lead to higher speeds at intersections. One intervention to reduce speeds at intersections is to reduce the curve radius (tighten curve), forcing road users to slow through intersections. This often brings the added benefit of reducing crossing distances for pedestrians.		✓	✓	○

Applicable = ✓ | Partially Applicable = ○ | Not Applicable = X

Infrastructure and Road Design Interventions

Intervention and brief description	Image	Speed environment where interventions can be applied: From max. 10 to max. 30	From max. 40 to max. 70	From max. 80 to max. 100
Road narrowing and horizontal deflection				
Medians Medians are raised vertical elements between opposing directions of travel that help physically narrow the roadway and separate opposing directions of traffic. They can be landscaped or hardscaped, accommodate pedestrian crosswalks to become pedestrian refuge islands (see below), and can be designed to be traversable by emergency vehicles. Medians help facilitate access management and can provide horizontal deflection to slow down motorists and provide visual guidance.		✓	✓	✓
Pedestrian refuge islands (also: (painted) splitter islands) Compared to medians, pedestrian refuge islands provide a shorter platform with the inclusion of a refuge space for pedestrians to stop and wait in the middle of the road, allowing the crossing of a lane or lanes in one direction of travel at a time. Splitter islands are often applied at roundabouts and minor intersection approaches where the stop sign is not readily visible to approaching motorists. They also narrow the travel lane, thus, reducing vehicle speeds.	 	✓	✓	○

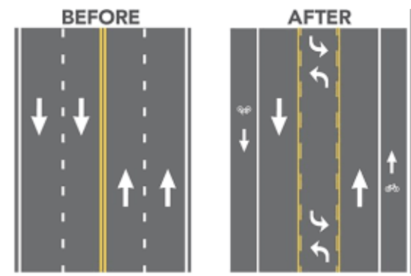
Applicable = ✓ | Partially Applicable = ○ | Not Applicable = X

Infrastructure and Road Design Interventions

Intervention and brief description	Image	Speed environment where interventions can be applied: From max. 10 to max. 30	From max. 40 to max. 70	From max. 80 to max. 100
Road (lane) narrowing (also: pinch points, bulb outs, chokers) Road lane narrowing is a technique that constrains drivers' speed by making them feel uncomfortable driving at higher speeds due to the narrowing roadway (and not the deflection as e.g., with chicanes). This can be achieved through narrowing of lanes, or even removal of lanes. Chokers are curb extensions located mid-block. They can accommodate a mid-block crosswalk and/or provide an area for landscaping. They slow motorized traffic by narrowing the road, or even introduce the need for vehicles to give way to oncoming traffic.		✓	○	X
Chicanes Chicanes introduce changes to the alignment of the travel lane that require drivers to weave through a designated area at slower speeds. The design adds side force on road users encouraging a slower speed to comfortably negotiate the chicane. These can be implemented using either retro-reflective pavement markings or physical measures. They can also be built using non-permanent materials such as road cones or even flowerpots. When designing chicanes, the turn radius and the transition distances must be taken into account.		✓	✓	○

Applicable = ✓ | Partially Applicable = ○ | Not Applicable = X

Infrastructure and Road Design Interventions

Intervention and brief description	Image	Speed environment where interventions can be applied		
		From max. 10 to max. 30	From max. 40 to max. 70	From max. 80 to max. 100
Road diets (also: lane reduction, road rechannelization, road conversion) A road diet is the reduction of the number or the width of lanes on a roadway cross-section to improve safety or provide space for other modes of transport and is especially useful to reduce speeds on roads that previously provided excessive capacity. For example, a two-way, four lane road might be reduced to one travel lane in each direction to provide a cycling lane and a footpath.		○	✓	○
Bus bulb (also: bus boarder, hourglass bus stops) This measure reduces the travel lane width to one lane in front of the stops preventing other vehicles from overtaking while the passengers get on and off the bus. This reduces vehicle speed and gives priority to public transport users crossing the road.		✓	○	X

Applicable = ✓ | Partially Applicable = ○ | Not Applicable = X

Infrastructure and Road Design Interventions

Intervention and brief description	Image	Speed environment where interventions can be applied: From max. 10 to max. 30	From max. 40 to max. 70	From max. 80 to max. 100
Sidewalk widening Extending the sidewalk or curb width is one way to narrow travel lane widths. The road space is reallocated to pedestrians, increasing pedestrian safety and reducing the opportunity for speeding.		✓	✓	X
Cycling Lanes (also: bicycle tracks) Cycling lanes provide designated spaces for cyclists alongside roads, either through pavement markings or physical separation. In areas where speeds are 30 kph or less, these lanes may not be essential, as cyclists can often coexist with vehicles on the road, promoting traffic calming, and in fact they are not recommended. However, in high traffic areas or on wide roads, separate cycling tracks can effectively regulate traffic and ensure lower speeds. For speeds of 30 km/h and above, it is highly advisable to implement physical separation for the safety of the cyclists.		X	✓	✓

Applicable = ✓ | Partially Applicable = ○ | Not Applicable = X

Infrastructure and Road Design Interventions				
Intervention and brief description	Image	Speed environment where interventions can be applied		
		From max. 10 to max. 30	From max. 40 to max. 70	From max. 80 to max. 100
Surface changes				
Textured surfaces Textured surfaces alert drivers about changes in the speed environment and encourage road users to decelerate. When using the right materials, they are also helpful to improve the skid resistance on the approaches to intersections, pedestrian crossings and on bends.		✓	✓	X
Transversal rumble strips Rumble strips are placed across the traffic lane to alert motorists that a change in speed environment (lower speeds) is to be expected and/or that there are hazards ahead (such as bends, intersections or areas of pedestrian activity). On their own they may have limited impact on speed, but when used in combination with other interventions (for instance vertical deflection) these can have additional benefit. Their generated noise and vibrations can be disruptive, particularly in residential areas, so their implementation needs careful consideration.		X	✓	✓

Applicable = ✓ | Partially Applicable = ○ | Not Applicable = X

Infrastructure and Road Design Interventions

Intervention and brief description	Image	Speed environment where interventions can be applied: From max. 10 to max. 30	From max. 40 to max. 70	From max. 80 to max. 100
Signs and markings				
Speed Limit Signs When an appropriate speed limit has been set, it is important to ensure that road users are aware of this limit. Speed limit signs are used for this purpose. They should be used at the point where the speed limit changes, and be clearly visible to all road users. In some situations, the speed limit should be repeated, through the use of "repeater" signs. Speed limit signs need to be maintained, including cleaning, and eventual replaced when they fade.		✓	✓	✓
Variable speed limit (VSL) signs (also: dynamic speed limit (DSL) signs) VSL signs show different speed limits, and can be adjusted based on road, traffic or weather conditions. They are also often used during road works.		X	✓	✓

Applicable = ✓ | Partially Applicable = ◯ | Not Applicable = X

Infrastructure and Road Design Interventions				
Intervention and brief description	Image	Speed environment where interventions can be applied From max. 10 to max. 30	From max. 40 to max. 70	From max. 80 to max. 100
Speed feedback signs These signs are triggered when an individual vehicle is above the posted speed limit. The signs can either show the actual speed of the driver or give them feedback on their speed behavior using emojis (smiling or angry faces).		✓	✓	✓
Side Road Activated Speeds (SRAS) SRAS detects when a vehicle is attempting to enter an intersection from a side road. This then triggers an electronic speed limit sign that reduces the speed on the main road.		X	✓	✓

Applicable = ✓ \| Partially Applicable = ○ \| Not Applicable = X

Infrastructure and Road Design Interventions				
		Speed environment where interventions can be applied		
Intervention and brief description	Image	From max. 10 to max. 30	From max. 40 to max. 70	From max. 80 to max. 100
Vehicle Activated Signs Vehicle activated signs are usually installed at known hazardous locations (e.g., at curves or intersections) with a history of speeding or speed related crashes.		✓	✓	✓
Warning signs These warn road users about upcoming hazards. When signs are used, it is essential that drivers understand the message and know how to take appropriate action for the situation. This might include the need to pay greater attention, or to slow down.		✓	✓	✓

Applicable = ✓ | Partially Applicable = ◯ | Not Applicable = X

Infrastructure and Road Design Interventions

Intervention and brief description	Image	Speed environment where interventions can be applied: From max. 10 to max. 30	From max. 40 to max. 70	From max. 80 to max. 100
Advisory speed signs These signs warn road users about the appropriate speeds through different risk locations. They also provide clear pictorial guidance on the reason for the slower speed. They most commonly include speeds at curves and off-ramps but are also used at intersections (roundabouts and raised intersections), road narrowing, and areas with rough road surfaces. In areas with speeds below 30 kph the road design should be made self-explaining by other infrastructure measure.		X	✓	✓
Pavement markings (also: horizontal signage) Pavement markings provide information, guidance, and regulation to drivers and pedestrians on the road. They include lane markings, crosswalk markings, stop lines, yield lines, and symbols/text markings. These signs help maintain traffic order, ensure safety, and facilitate the smooth movement of vehicles and pedestrians on the road. In some instances, they can also be used to effectively manage speeds.		✓	✓	X

Applicable = ✓ | Partially Applicable = ○ | Not Applicable = X

Infrastructure and Road Design Interventions

Intervention and brief description	Image	Speed environment where interventions can be applied		
		From max. 10 to max. 30	From max. 40 to max. 70	From max. 80 to max. 100
Other measures				
Gateway treatments Gateways are strategically employed to signal the transition into lower speed areas, such as towns, villages, or traffic-calmed areas like school zones or 30 kph zones. Features like road narrowing, prominent speed limit signs, town or village name banners, and colored pavement treatments contribute to these gateways. This visual cue helps to enforce compliance and enhance the safety of these lower speed environments.		✓	✓	✓
Tactical urbanism (also: pop-up urbanism) Tactical urbanism describes low-cost, temporary measures to improve the road environment for pedestrians and cyclists, usually in cities, such as creative pavement markings used to communicate a traffic calming message to the motorized traffic. The measures can be installed at intersections or along entire roads (e.g., pop-up cycling lanes). However, tactical urbanism is only a transitional measure, not a final solution. It serves as a testing ground for interventions and design improvements, providing valuable insights that guide the implementation of permanent, more substantial safety measures.		✓	X	X

Applicable = ✓ | Partially Applicable = ○ | Not Applicable = X

Infrastructure and Road Design Interventions

Intervention and brief description	Image	Speed environment where interventions can be applied		
		From max. 10 to max. 30	From max. 40 to max. 70	From max. 80 to max. 100
Separated non-motorized traffic lane (also: service road) These lanes run parallel to the main road and facilitate the safer, lower speed movement of vulnerable road users and non-motorized traffic, effectively separating high speed and lower speed traffic.		X	✓	✓

For more information on these and other interventions, refer to the GRSF Speed Management Hub's Frequently Asked Questions (FAQs) on speed management through infrastructure (see https://www.roadsafetyfacility.org/faq), or the iRAP Road Safety Toolkit (https://toolkit.irap.org/).

Applicable = ✓ | Partially Applicable = ○ | Not Applicable = X

Enforcement Interventions

Type	**Brief description**	**Image**
Mobile speed cameras	Portable laser or radar devices that are used to measure the spot speed of individual vehicles. These devices can be used by authorized agencies (typically the Police) to issue penalties such as fines and demerit points for those exceeding the speed limit. Their introduction is proven to reduce crash risk by creating a deterrence effect. For more information click here.	
Fixed speed cameras	Camera systems linked to speed detection devices, and mounted at set points on the roadside, usually at high crash risk locations. These cameras take photographs of vehicles that are exceeding a set speed threshold level. Penalties (e.g., fines) are sent to the road user. For more information see here.	
Speed and red-light cameras	At intersections, fixed speed cameras can be combined with red-light cameras. These red-light cameras take photographs of vehicles who enter the intersection after the traffic signals have turned red. Often such offences are coupled with an increase in speed as motorists attempt to clear the intersection before adjacent vehicles begin entering. This often results in high speed, high severity crash outcomes. For more information click here.	

Point-to-point measurements (also: section control, average speed cameras)	Average speed cameras track the speed of a motorist at multiple points over a stretch of road. A car can enter or exit anywhere along the road and, upon exiting, the average speed of the vehicle travelled is calculated and compared to the speed limit. Cameras are often placed many kilometers apart (8-10 km or even more), meaning that long stretches of roadway can be monitored with just a few sets of cameras. Penalties (e.g., fines) are issued to motorists who exceed the speed limit. For more information click here.	
Mobile speed patrols	Marked or unmarked vehicles traveling with traffic are used to detect specific offenders in the immediate vicinity of a moving patrol car. If the speed detection equipment is fixed to the vehicle, the enforcement vehicle does not necessarily have to be stationary and can measure speeds for vehicles travelling in the same direction, or in the opposite direction. Speeding vehicles are usually intercepted, and deterrent penalties such as fines and demerit points are issued. For more information click here.	

For more information on these and other interventions, refer to the GRSF Speed Management Hub's Frequently Asked Questions (FAQs) on enforcement (see https://www.roadsafetyfacility.org/faq).

Vehicle Technology Interventions

Type	Brief description	Image
Speedometer	These are the first and best known in-vehicle devices to track speed. Speedometers measure and display the instantaneous speed of a vehicle and are universally fitted to motor vehicles. They can be analog or digital and help the road user to maintain the desired speed. Usually, the speedometers are centrally positioned, and provide a visual indication of speed. Some versions provide warnings when a certain threshold speed is exceeded.	
Event data recorder (EDR) (also: black box)	These record many parameters before, during and after a crash, including vehicle speed. There are some indications that adoption of EDR can trigger changes in driver behavior, including reduced speed and crashes if the driver is aware about the device installation.	
Conventional Cruise Control (CCC)	A technology that can help automatically maintain and regulate the vehicle's speed as set manually by the driver. It operates by continually changing the fuel supply to sustain the speed despite variations generated by wind, rolling resistance or the gradient. It reduces driver workload as less concentration is required for speed control and maintaining the speed within the expected range.	

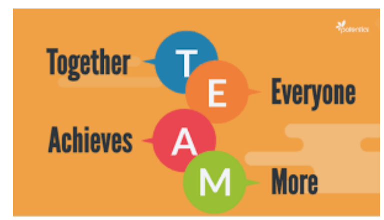
Vehicle Technology Interventions		
Type	**Brief description**	**Image**
Adaptive Cruise Control (ACC)	An evolution of Conventional Cruise Control which utilizes radar or laser sensors for detecting and tracking the speed of vehicles in front and adjusting speeds based on this. In addition to choosing cruise speed, it allows drivers to change the time gap and headway in the travel lane with the vehicle in front.	
Forward collision warning (FCW) system	An advanced safety technology that monitors the speed of a vehicle, the speed of the vehicle in front of it, and the distance between the vehicles. The FCW system will warn the driver of an impending crash if vehicles get too close because of the rear vehicle's speed. More than just warning the driver, when available, the Autonomous Emergency Braking, known as AEB, engages the main braking system when it detects an imminent crash.	
Intelligent Speed Adaptation (ISA) (also: Intelligent Speed Assistance)	A speed management device that utilizes cameras and/or an in-built GPS map to determine the speed limit of the road to provide warnings and/or limit the speed of the vehicle if the speed limit has been exceeded. This is one of the most promising vehicle systems for its potential effect on safety. ISA supports drivers in complying with the speed limit everywhere in the network. This is an important advantage in comparison to more traditional speed limiters for heavy good vehicles and coaches, which only limit the maximum speed.	

Vehicle Technology Interventions

Type	Brief description	Image
Tachograph	Tachographs track the speed, the overall distance travelled between the stops and the resting periods of a vehicle for the entire trip. Mechanical tachographs are commonly used in professional driving, particularly in heavy goods vehicles. They are used by the police and transport operators to monitor and enforce the amount of continuous driving and resting hours, as well as the maximum and average speed during a trip. Electronic tachographs are increasingly fitted on commercial vehicles voluntarily, which allow real-time speed monitoring, report service hours of drivers and other parameters, and track freight.	
Speed Monitoring Devices	These systems gather information related to a risk (often for insurance purposes), including distance driven, speed, and travel distribution by day and day of the week. Advanced speed monitoring systems consist of GPS technology which assists to monitor vehicle speed by dynamic tracking. Advanced data recorders can continuously record speeds and link them to speed-limit databases, tracking speed at any moment.	
Speed limiter (SL) (also: speed governors)	Device that prevents a vehicle engine from reaching a pre-programmed maximum speed. It has been found to be beneficial on trucks and buses for the setting of a maximum speed, typically lower than for cars in some countries. Since SL capability is standard, the cost of introducing SLs is negligible.	

For more information on these and other interventions, refer to the GRSF Speed Management Hub's Frequently Asked Questions (FAQs) on vehicle technology (see https://www.roadsafetyfacility.org/faq).

Education and Communication Interventions

Type	Brief description	Image
Education	Community road safety campaigns, road safety education at schools, road rules refresher guide.	
Public Campaigns	Public campaigns should never be used as stand-alone measure but to support the effectiveness of other measures (e.g., enforcement, legal changes). The most effective campaigns are often those that elevate the fact that if the driver gets caught it will cost them.	
Capacity building	Strengthening individual knowledge and skills of not only road engineers and designers, but also decision makers and politicians.	
Community Engagement	Community engagement is about mutual decision making. People, governments, and organizations work collaboratively to create – and realize – sustainable visions for their community's future.	

For more information on these and other interventions, refer to the GRSF Speed Management Hub's Frequently Asked Questions (FAQs) on Speed management through road user communication, education and engagement (see https://www.roadsafetyfacility.org/faq).

Appendix B: Key resources

Speed and road safety outcomes

Global Plan for the Decade of Action for Road Safety 2021-2030

Author/Publisher: WHO

This Global Plan has been developed by the World Health Organization and the United Nations Regional Commissions, in cooperation with partners in the United Nations Road Safety Collaboration and other stakeholders, as a guiding document to support the implementation of the Decade of Action 2021–2030 and its objectives.

Speed Management: a road safety manual for decision-makers and practitioners

Author/Publisher: Global Road Safety Partnership (GRSP)

This manual provides advice and guidance for policymakers and road safety practitioners and draws on the experience of a number of countries that have already initiated speed management strategies. Lessons from successful and non-successful initiatives are used to illustrate the advice provided. The manual consists of a series of "how to" modules.

The Power Model of the Relationship between speed and road safety

Author/Publisher: Rune Elvik/Institute of Transport Economics (TOI) Norway

This report contains an analysis on the relationship between change in speed, and the impact on road safety outcomes. The analysis is based on 115 previous studies, and represents one of the most comprehensive evaluations on this topic. Later studies also are available from this author that further refine this relationship.

Speed and Crash Risk

Author/Publisher: International Transport Forum (ITF-OECD)

This study aims to objectively document the relationship between vehicle speed and crash risks. The report reviews the current knowledge on the relationship between speed and crash risk, and also analyses eleven cases from ten countries. The analysis confirms the very strong relationship between speed and crash risk.

Recommendations from Academic Expert Group regarding a second Decade of Action for Global Road Safety

Author/Publisher: Swedish Road Administration

The recommendations are part of the Stockholm Declaration and intended to build upon those previously established in the Moscow Declaration of 2009 and the Brasilia Declaration of 2015 as well as prior United Nations General Assembly and World Health Assembly resolutions. The Academic Expert Group considers these additional recommendations to be essential strategic prerequisites for achieving the goal of reducing global road traffic fatalities by half by 2030.

Speed and broader impacts

NACTO and Global Designing Cities Initiative 2016

Author/Publisher: National Association of City Transportation Officials (NACTO)

Released by the National Association of City Transportation Officials (NACTO) and the Global Designing Cities Initiative, it is the first-ever worldwide standard for redesigning city roads to prioritize safety, pedestrians, transit, and sustainable mobility for an urban century. It sets a new global baseline for designing urban roads.

Road Crash Trauma, Climate Change, Pollution and the Total Costs of Speed: Six graphs that tell the story

Author/Publisher: Job, RFS. & Mbugua, LW./GRSF

This brief report provides information on the link between speed management and issues such as climate change, pollution, travel time and other policy objectives.

Addressing Key Global Agendas of Road Safety and Climate Change: Synergies and Conflicts

Author/Publisher: Sakashita, C. et al, Journal of the Australasian College of Road Safety

This piece considers the alignments and conflicts of actions for road safety and climate change to help identify common grounds to achieve both goals more efficiently and with more global and national political support, donor support and private sector support.

Noise Pollution

Author/Publisher: Siano, D. (editor), IntechOpen

This piece highlights a study on the impact of traffic on noise pollution levels. The findings show that if the traffic speed is 105 kph, it produces twice the perceived noise level than the 50 kph traffic flow. One heavy weight vehicle (HV > 3.5 tons) with a speed of 70 kph creates a perceived noise level of 28 lightweight vehicles (LV <3.5 tons).

Burden of disease from environmental noise - Quantification of healthy life years lost in Europe

Author/Publisher: World Health Organization (WHO)

This publication by WHO summarizes the evidence on the relationship between environmental noise and health effects, including cardiovascular disease, cognitive impairment, sleep disturbance, tinnitus, and annoyance. It estimates that more than a million healthy life years are lost each year in Western Europe alone from traffic noise, through effects such as sleep loss, cognitive impairment of children, and stress. Some countries, like Germany or Austria, have lowered speeds specifically to reduce noise.

Years of life lost and morbidity cases attributable to transportation noise and air pollution: a comparative health risk assessment for Switzerland in 2010

Author/Publisher: Vienneau, D. et al., International Journal of Hygiene and Environmental Health

This article aims to assess the health burden from transportation related noise and air pollution in Switzerland. The results show that in terms of total external costs the burden of noise equals that of air pollution. For air pollution, the effects on mortality are most relevant in terms of costs, whereas for noise, the effects representing impaired quality of life from annoyance and sleep disturbances are the strongest cost contributor.

Curbing Cars: Shopping, Parking and Pedestrian Space in SoHo

Author/Publisher: Transportation Alternatives

This study examines the travel, shopping and spending patterns of visitors, residents and workers on Prince Street, a vibrant commercial road in the historic SoHo neighborhood of Manhattan. The study assesses how changes in the allocation of space between pedestrians, parking and road vendors would affect the attractiveness of Prince Street as a place to visit, live, and work, and the likely effects on store and restaurant patronage. Results show that pedestrians experience frequent overcrowding on the sidewalks. Pedestrians interviewed say that Prince Street would be more attractive if more space were allocated to pedestrians, preferably by reducing the amount of space allocated to parking, and not by reducing the space for road vendors. These views are held by both visitors and residents.

Urban transport and community severance: Linking research and policy to link people and places

Author/Publisher: Anciaes, P.R. et al., Journal of Transport & Health

This article discusses the physical or psychological separation of neighborhoods caused by transportation infrastructure, with possible effects on the health and wellbeing of local residents. This issue, known as "community severance", has been approached by researchers from a range of disciplines, which have different ways of constructing scientific knowledge. The objective of this paper is to build bridges between these different approaches and provide a basis for the integration of the issue into public policy.

Understanding environment influences on walking – Review and research agenda

Author/Publisher: Owen, N. et al., American Journal of Preventive Medicine

This piece presents a review of studies on relationships of objectively assessed and perceived environmental attributes with walking. Aesthetic attributes, convenience of facilities for walking (sidewalks, trails); accessibility of destinations (stores, parks, beaches); and perceptions about traffic and busy roads were found to be associated with walking for particular purposes.

Quality Streets: Why good walking environments matter for London's economy

Author/Publisher: Transport for London (TfL)

This publication brings together the latest evidence, research, and findings on the economic benefits of walking and cycling, including case studies. It contains in-depth reports and studies and a summary pack of the best evidence from London and elsewhere. This can be used for making the economic case for walking and cycling investment.

Speed management strategy

Speed Management program plan

Author/Publisher: Federal Highway Administration, National Highway Traffic Safety Administration

This document was developed jointly by the National Highway Traffic Safety Administration, Federal Highway Administration, and Federal Motor Carrier Safety Administration to address speeding as a contributor to highway crashes and fatalities.

Creating a speed management program

Author/Publisher: Institute of Transportation Engineers (ITE)

This ITE website provides an overview and guidance on establishing comprehensive speed management programs and also presents a framework for how to create safety and mobility for all road users in the context of specific road conditions and across a vast road network.

Uniform Guidelines for State Highway Safety Programs

Author/Publisher: Federal Highway Administration, National Highway Traffic Safety Administration

These guidelines state that speed management involves a balanced program effort that includes: defining the relationship between speed, speeding, and safety; applying road design and engineering measures to obtain appropriate speeds; setting speed limits that are safe and reasonable; applying enforcement efforts and appropriate technology that effectively address speeders and deter speeding; marketing, communication, and educational messages that focus on high-risk drivers; and soliciting the cooperation, support, and leadership of traffic safety stakeholders.

Speed limit setting

Low-Speed Zone Guide

Author/Publisher: World Resources Institute (WRI) and GRSF (The World Bank)

The Low-Speed Zone Guide provides strategies for planning, designing, building, and evaluating low-speed zones. The guide covers all phases of low-speed zone project development, including planning, design, construction, and post-construction.

Checklist for setting speed limits

Author/Publisher: National Association of City Transportation Officials (NACTO)

Checklists are a starting point for analyzing how dense conflicts are on a given road and how active that road is, in order to determine a safe speed limit for a road. To support quantitative analysis, cities can determine specific thresholds (e.g., What does “high pedestrian volume” mean in your city?) based on local conditions. This guidance avoids determining thresholds so as not to be overly prescriptive.

Speed Management Guide: Road to Zero edition

Author/Publisher: New Zealand Transport Agency

This Guide provides a principles-based approach to setting speed limits and managing speeds. It gives guidance on setting speed limits that are based on Safe System principles; that provide for community wellbeing; that are linked to the national network framework (which is grounded in the Movement and Place approach); and supports these speed limits through regulation, enforcement, communication, engagement and monitoring.

Traffic Engineering Manual – Speed Zoning Technical Guidelines

Author/Publisher: Victoria State Government, Department of Transport

This document provides technical guidance for the application of speed zoning and covers a wide variety of situations and factors as every location has its unique characteristics. Engineering judgement must be applied to decide upon an appropriate speed limit, based on site specific, local and route factors.

Linking mobility and safety – Building on the mixed use arterials project

Author/Publisher: Turner, B. et al., 28th ARRB International Conference, Brisbane, 2018

This paper provides a detailed discussion on the importance of establishing the future use and function of road networks to make safety gains through the application of the movement and place approach. Examples are drawn and gaps in knowledge identified that need to be addressed. Successful application of such interventions will remove the perceived conflict between safety and network operations, and instead highlight the synergies between these two aligned areas of road management.

Integrating Safe System with Movement and Place for Vulnerable Road Users

Author/Publisher: Austroads, Australia

This report provides guidance to road operators for ensuring, or transitioning to, safe use of roads by vulnerable road users, namely pedestrians and cyclists. Road designers and system operators can apply the guidance when designing new or redesigning existing roads, and when making decisions about how these roads will operate.

Roads and Streets Framework

Author/Publisher: Auckland Transport

This document provides a systematic and consistent methodology for identifying the different functions of roads. It uses the concepts of "Place" and "Movement" to reflect the strategic role of each function within a city context.

Movement and Place in Victoria

Author/Publisher: Victoria State Government, Department of Transport

This document provides an overview of movement and place thinking and steps through the different modules in a Movement and Place Framework.

Speed management interventions – Road infrastructure

Cities Safer by Design

Author/Publisher: World Resources Institute (WRI)

Cities Safer by Design is a global reference guide to help cities save lives from traffic fatalities through improved road design and smart urban development. This hands-on guide taps examples from cities worldwide and includes 34 different design elements to improve safety and quality of life.

Safe Bicycle Lane Design Principles

Author/Publisher: World Resources Institute (WRI)

This guide aims to assist with the design of high-quality, safe, temporary cycling measures that also create the foundation for systemic and lasting changes that nurture a culture of cycling, facilitate the development of quality cycling networks, and move cities and urban mobility toward a sustainable future.

Methods for Reducing Speeds on Rural Roads: Compendium of Good Practice

Author/Publisher: Turner, B. and Makwasha, T./Austroads

This document provides information on the links between speed and safety outcomes, as well as the interventions that can be used to address speed. The guide focuses on rural roads and provides infrastructure-based interventions.

Achieving Safe System Speeds on Urban Arterial Roads: Compendium of Good Practice

Author/Publisher: Hillier, P., Makwasha, T. and Turner, B./Austroads

This publication provides guidance on speed management for urban arterial roads. The document highlights the interventions that can be used to address speed on these roads, with a focus on infrastructure-based interventions.

Self-enforcing Roadways: A Guidance Report

Author/Publisher: Federal Highways (FHWA)

This document provides guidance on how to produce self-enforcing roads and can be applied to planned and existing roadways.

Speed management interventions – Policing, deterrence and penalties

GRSF Speed Management Hub, Section 4

Author/Publisher: GRSF (The World Bank), GRSP (Global Road Safety Partnership)

Enforcement is an important and necessary measure for speed management. In many countries speed enforcement has significantly evolved over the past 10 years with a general increase in the focus of enforcement efforts and the increasingly widespread introduction of automatic speed control, which does give a new dimension to the enforcement effort. If undertaken appropriately, speed enforcement can be a very powerful measure (deterrent) that contributes directly to reducing the incidence of speeding and consequently, the frequency and severity of crashes.

Speed Enforcement Program Guidelines

Author/Publisher: Federal Highway Administration, National Highway Traffic Safety Administration

The National Highway Traffic Safety Administration and the Federal Highway Administration have developed Speed Enforcement Program Guidelines to provide law enforcement personnel and decision makers with detailed information on how to establish and maintain an effective speed enforcement program. These guidelines were developed with input from many of the most successful law enforcement agencies in the United States and include information that can help establish an effective speed enforcement program.

Guide-for-Determining-Readiness-for-Speed-Cameras-and-other-Automated-Enforcement

Author/Publisher: GRSF (The World Bank), GRSP (Global Road Safety Partnership)

This document contains a checklist that can be used to assess the level of readiness to implement automated enforcement, and determine what actions need to be taken to improve identified issues to allow an effective system to be implemented.

Speed enforcement detection devices for preventing road traffic injuries

Author/Publisher: Wilson, C., Willis, C., Hendrikz, J.K. and Bellamy N.

This Cochrane Database Systematic Review assesses whether the use of speed enforcement detection devices (SEDs) reduces the incidence of speeding, road traffic crashes, injuries and deaths.

Speed and Technology: Different Modus of Operandi

Author/Publisher: Belin, M.Å., Vadeby, A. (in: Edvardsson Björnberg, K., Belin, M.Å., Hansson, S.O., Tingvall, C. (eds). The Vision Zero Handbook).

This publication describes the rationale behind speed limits, speed management, and speed compliance strategies, in particular from a Vision Zero perspective. Various different approaches to speed camera systems in Europe are analyzed. Based on similarities and differences in these approaches, aspects concerning the setting of speed limits, speed management strategies that underpin the choice of camera technology, and modus operandi, safety effects of and attitudes towards cameras, are discussed.

Speed management interventions – Education and communication

Road Policing Capacity Building Programme

Author/Publisher: GRSF (The World Bank), GRSP (Global Road Safety Partnership)

The Road Policing Capacity Building Programme is dedicated towards three target groups: operational/front line road policing officers, senior road policing officers and supervisors and internal training providers. The programme helps strengthen the capability of the road traffic police to enforce traffic laws. This is fundamental to deterring road users from violating the laws, to reduce harm and to reduce inappropriate and unsafe behaviour on the roads.

Recommendations for Effective Road Safety Campaigns

Author/Publisher: Vital Strategies

This research summary presents findings from studies examining responses to road safety television advertisements on speeding.

Speed management interventions – Vehicle technology

Intelligent Speed Adaptation (ISA)

Author/Publisher: EU Mobility and Transport

Intelligent Speed Adaptation (ISA) is an in-vehicle system that supports drivers' compliance with the speed limit. ISA is in fact a collective term for various different systems. This document provides a brief summary on this important technology.

In-vehicle Performance Monitoring and Feedback

Author/Publisher: US Department of Transport

In-vehicle monitoring and feedback technology captures and reports safety-related information on driving performance. The technology is available through private vendors, car insurance companies, smart phone applications, and is built into some newer vehicles.

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