CAREC Road Safety and Sustainable Mobility Course

February 2024

Speed, Interventions and Enforcement

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Presentation's Content

- The impact of speeding

- Speed and perception

- Research perspective

- Speed management options

- Road design

- Setting speed limits

- Policing speed limits

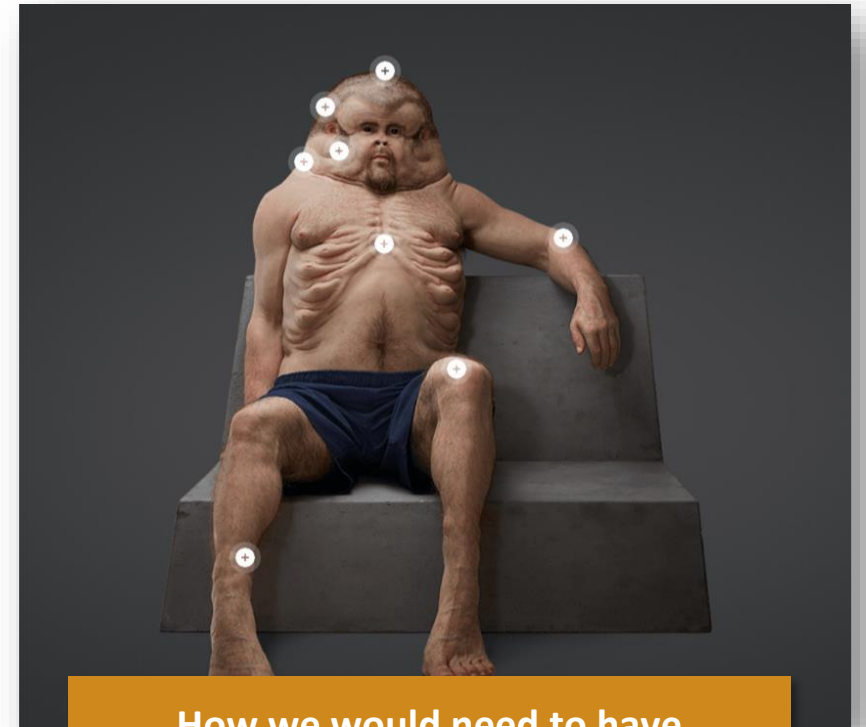- Public awareness and support

- Discussion

The Tolerance of the Human Body to Impact Speeds

- **How have our bodies changed over 200,00 years?**

- **What impact speeds can our bodies withstand?**

- The human body has a known, limited physical ability to tolerate crash forces before harm occurs.

Impact speed falling from 4 meters – about 30 km/h

How we would need to have evolved to surive high speed crashes

Speed and the Force of Impact

What causes fatal injuries during crashes?

- Struck at a speed too great to survive *(vulnerable road users – pedestrians and cyclists - often children)*.

- Collided with the interior of the vehicle at a speed too great to survive *(vehicle occupants, some not wearing safety belts, in vehicles without air bags or travelling in unsafe zero-star vehicles)*.

- Thrown out of the vehicle *(no safety belt worn)* or off the motorcycle *(particularly those not wearing helmets)* and struck the road surface, or another vehicle or roadside object at a speed too great to survive.

Regardless of what causes the crash, impact speed always decides injury severity. 10% increase in speed results in a 21% increase in impact energy.

The Three Crashes

Every crash results in three crashes

1st crash – Vehicle crashes into another object. Occupants still move forward at the same speed as the vehicle before the crash. (Inertia)

2nd crash – Occupants crash into the interior of the vehicle if not restrained by a seatbelt/child restraint. Can cause serious or fatal injuries.

3rd crash – The internal organs still move forward and crash into the body's extremities. Can cause serious internal injuries and fatalities.

Remember:
The faster you go, the bigger the mess

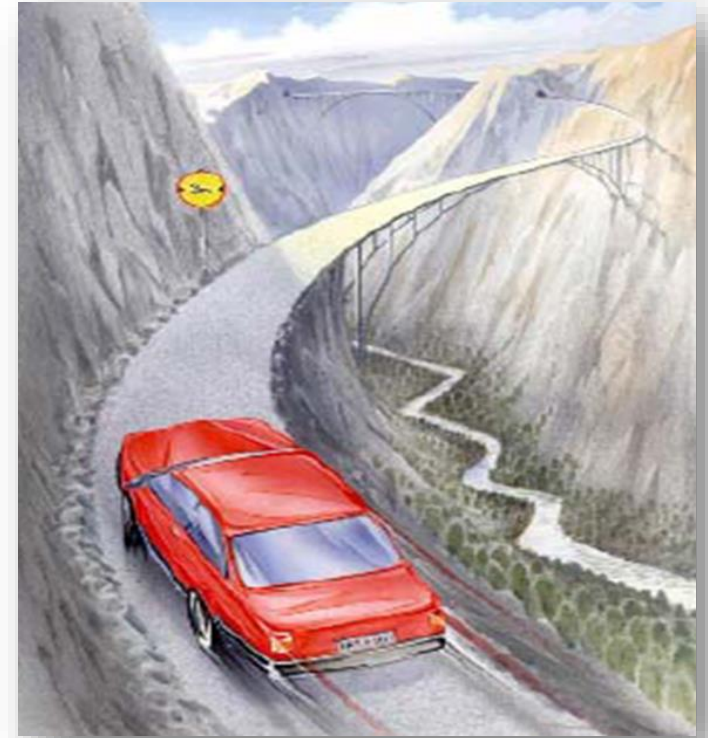# We Don't Perceive Speed Risks

- The risk of a resulting crash in this situation in terms of energy.

- We accept and do this every day **(50 km/h, 80 km/h zones – sometimes higher)**.

We Don't Perceive Speed Risks
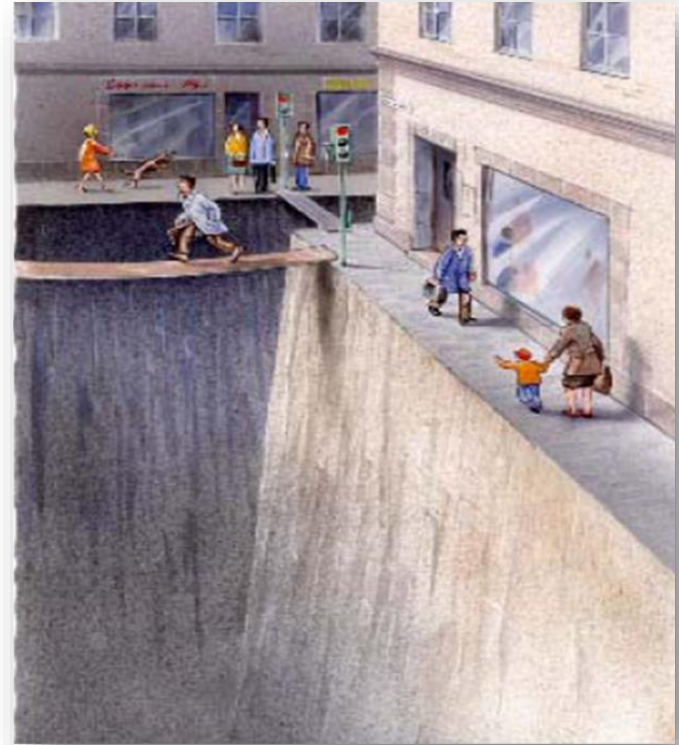
This situation for a vehicle

- Would a driver be prepared to use this road?

- **90 km/h falling over 10 stories**

- **70 km/h falling over 6 stories**

We Don't Perceive Speed Risks

Is identical to this situation for a pedestrian

- But, would we even consider doing this in our communities?

- **50 km/h – falling over 3 stories**

Speed and Stopping Distance

- '**Thinking distance**' - the length of road covered while the driver is assessing the situation, increases linearly with speed.

- Perception is affected because the faster the travel speed, the more difficult to estimate the speed of other road users and the approach speed towards fixed roadside objects.

- Divided attention skills are affected, because as speed increases, information is received at a faster rate and must therefore be processed in a shorter time period.

Legend: ■ Reaction Distance ■ Braking Distance ■ Stopping Distance
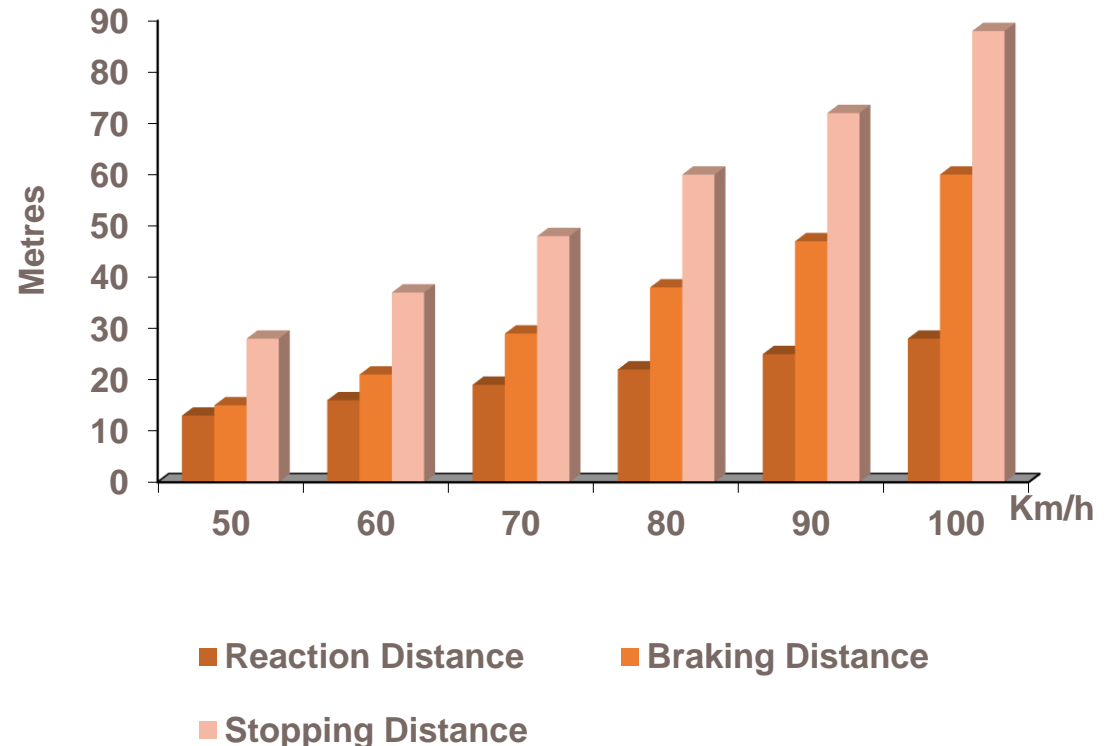
Risks – Crash Severity

- In the event of a crash, the higher the speed the greater the risk of serious injury or death (**crash severity**).

- Risk of serious injury or death—particularly for pedestrians, motorcyclists, and cyclists.

Pedestrian fatality risk as a function of the impact speed of a car
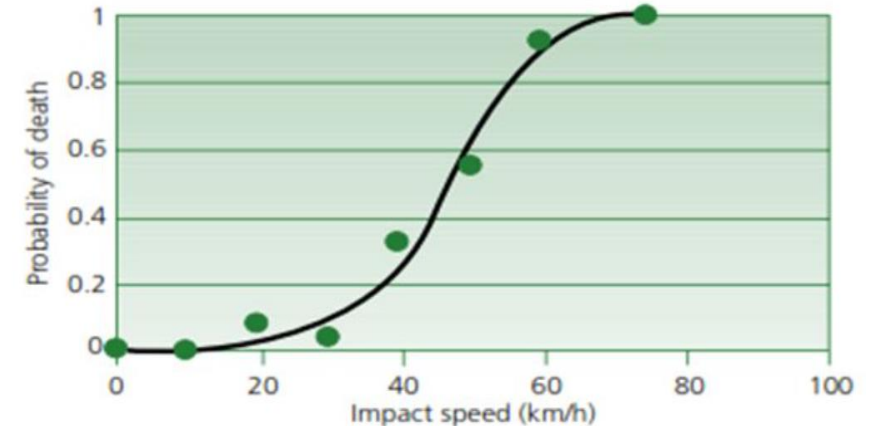
$$KE = \tfrac{1}{2}mv^2$$

Speed Effects

As speeds increase, four major results occur:

1. The vehicle becomes less stable and more difficult to control in certain driving situations *(e.g., cornering, heavy braking, wet road).*

2. The driver of the vehicle has less time to react to a potentially hazardous situation.

3. Other road users similarly have less time to react to the detected presence of the speeding vehicle.

4. The severity of the consequent crash increases.

Pedestrian Survival vs Speed of Impact

Impact speed	Survival % of pedestrians
60 km/h	15%
50 km/h	55%
30 km/h	95%

At least 85% of pedestrians struck at 60 km/h WILL be killed

What should the speed limit be in the central city or the neighbourhood where your children play?

Low-Level Speeding

Research perspective…

- Small drop in speed = large drop in trauma
- 5km/h ↓ = 32% ↓ pedestrian deaths
- 5km/h ↓ = 20% ↓ serious trauma
- **10km/h over limit in 100k zone – risk doubles**

Low-Level Speeding

Each 'one' *km/h* reduction in vehicle speed reduces the risk of crashing by 3%.

Monash University Accident Research Centre
(MUARC)

Real World Example from the USA

In 1987-1988, 40 US states raised the speed limit on interstate highways from 55 mp/h to 65 mp/h **(89 km/h to 105 km/h)**.

Results:
- Speeds increased by 3 mp/h **[5km/h]** on average.
- Deaths increased by between 20% and 25%.
- Further increases over the years, with similar results.

Lesson: Small increases in average speed result in large increases in trauma.

Public

Impact of Speed Limit Reduction - France

On 1 July 2018, speed limits on non-divided rural roads in France reduced from 90 to 80 km/hour. The French government (CEREMA) reported the impact for the 18 months after the reduction came into force (before COVID- 19 related influences).

- There was a 3.3 km/h drop in the average speeds.
- A 12% decrease in the number of crash deaths (excluding urban areas and motorways).
- For the 18 months after the implementation - decrease of 331 deaths on the effected network.
- Over the rest of the French road network, the number of deaths remained stable.
- The study reported than even greater death reduction could be achieved if drivers improved their compliance with the new speed limit.

Setting survivable speed limits on non-divided rural roads saves lives!

Rule of Thumb, the Bottom Line

A 5% decrease in average speed leads to approximately a 10% decrease in all injury crashes and a 20% decrease in fatal crashes.

Professor Ian Johnston, MUARC

Small reductions in speed – large reductions in trauma

Additional sustainability benefits:

- Saves fuel
- Reduces pollution
- Reduces noise
- Improved feelings of safety
- Reduces wear and tear

Magnitude of Problem = Risk X Frequency

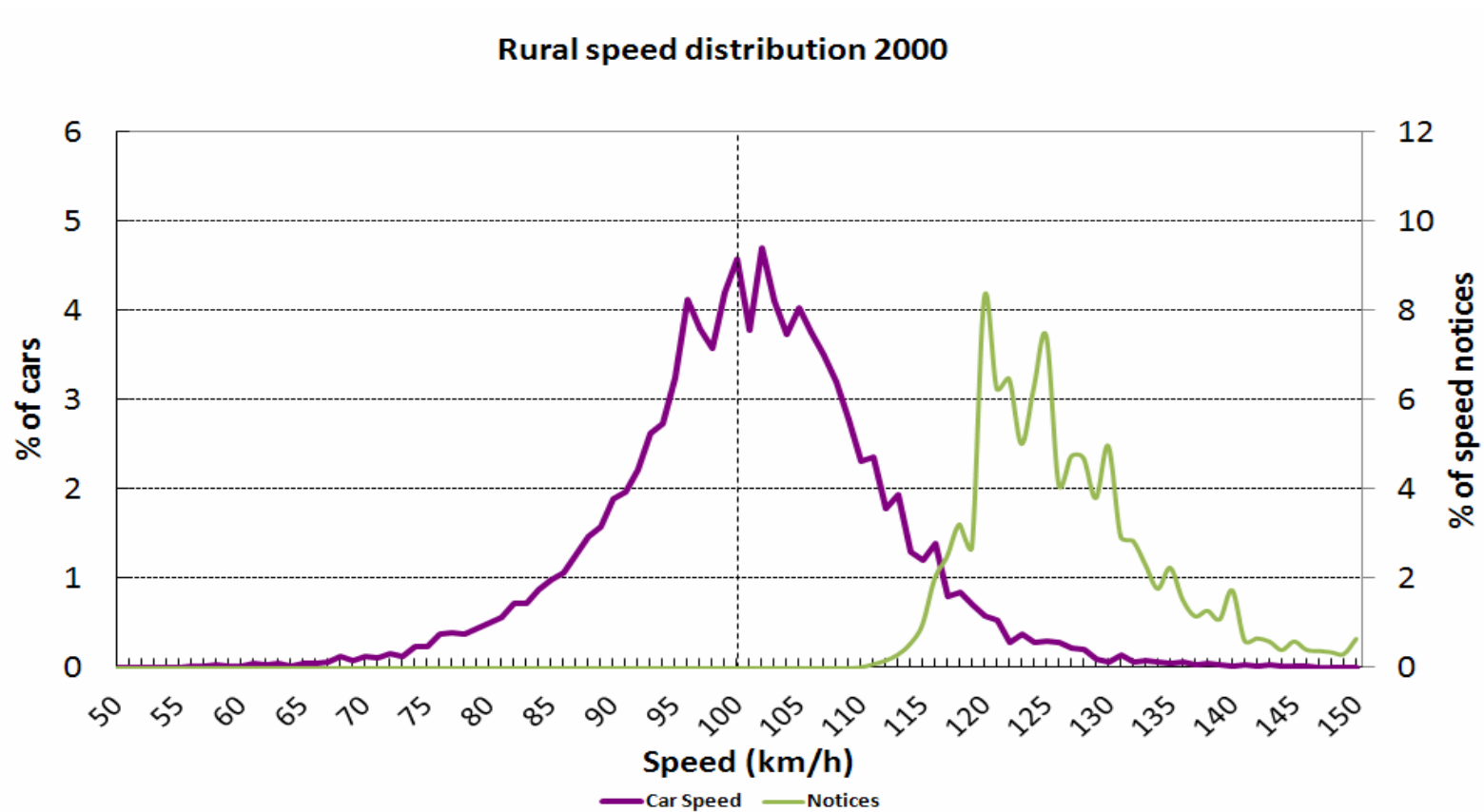**"Major" speeding offences (>15 km/h over limit)**

- Quite rare

- High or extreme risk

- **Significant safety problem**

"Low range" speeding offences (<15 km/h over limit)

- Very common

- Substantial risk

- **Significant safety problem**

Focusing enforcement on high-range speeding is not the solution!

Impact of Lower Speed Tolerance


Rural speed distribution 2000

What is Speeding or Excessive Speed?

- **Excessive speed** means speeds above a prescribed speed limit.

- **Inappropriate speed** means speeds too high for the prevailing conditions but within the prescribed speed limit.

- Speeding encompasses both excessive and inappropriate speed.

There is no such thing as "over speeding"!

Public

Effective Interventions to Reduce Speeding
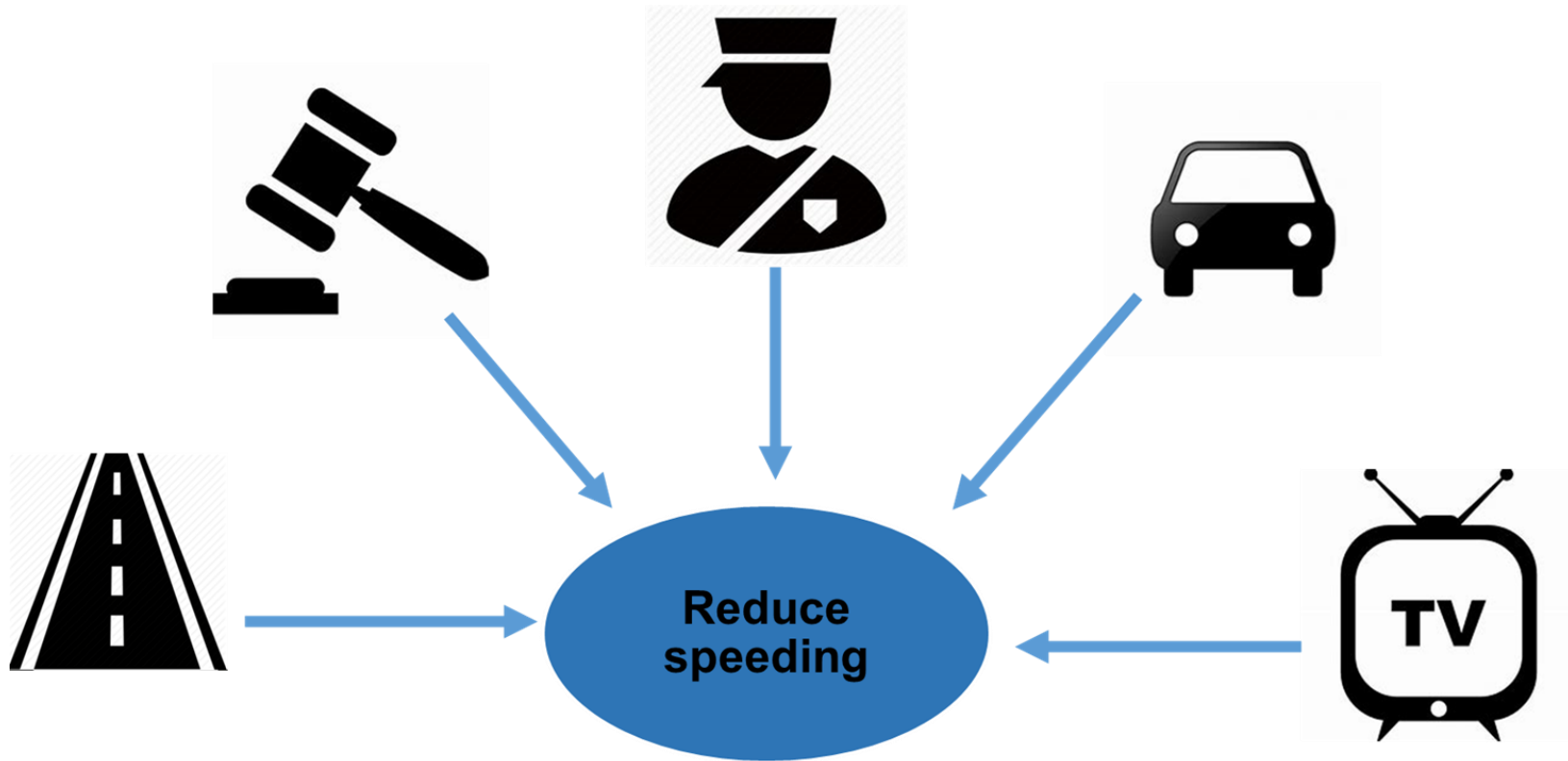
Building or Modifying Roads

Speed Management Through Infrastructure

Traffic calming is the use of infrastructure designed and installed to slow down traffic and to reduce unnecessary through traffic.

- Vertical displacement
- Horizontal displacement (e.g. lane narrowing)
- Signs and markings
- Gateway treatments
- Surface changes
- All of these…..

Good traffic calming should make drivers feel like they are sharing road space, including with vulnerable road users.
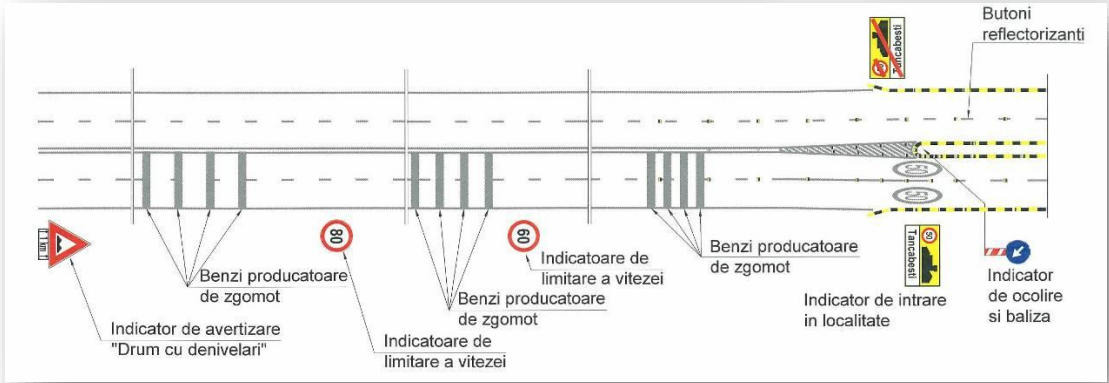
Speed Reduction Outside Built-Up Areas
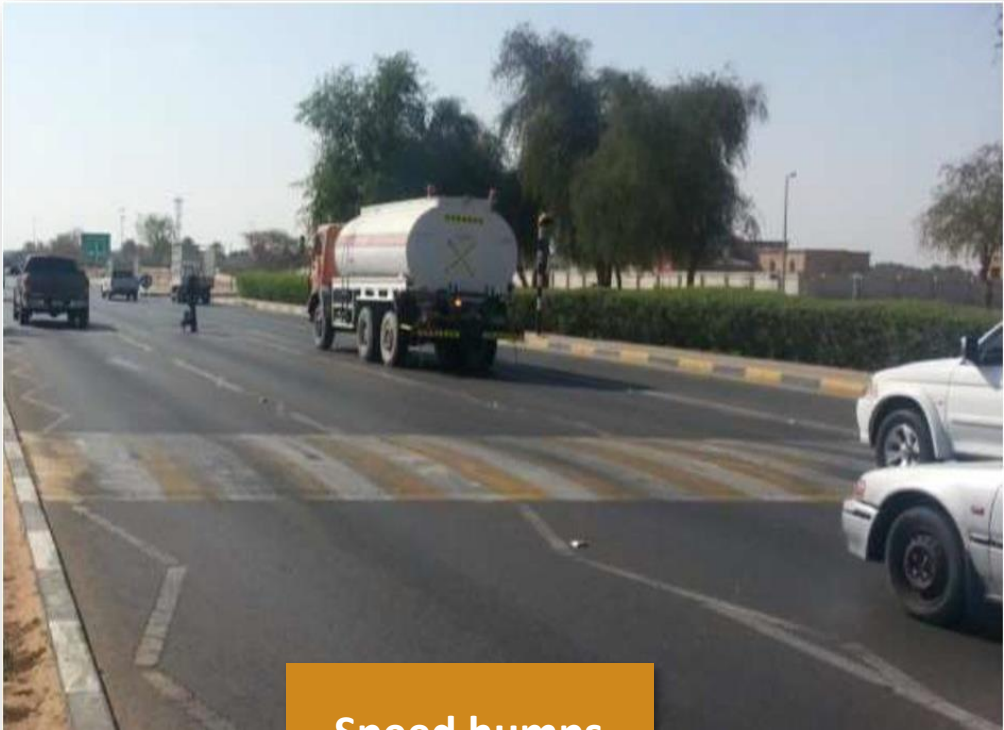

Gateways

Carriageway narrowing at pedestrian crossing

Transition Zone

Speed Reduction Outside Built-Up Areas

Speed humps

Speed cushions

Speed table

Public

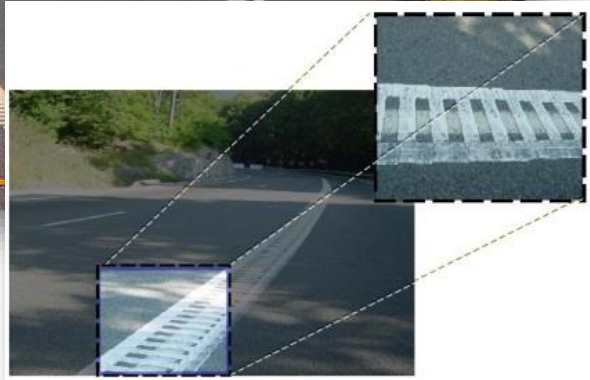# Speed Reduction Outside Built-Up Areas

Roundabouts

Speed Reduction Outside Built-Up Areas

Wide central line marking

Risk Factors on Roads in Built-Up Areas
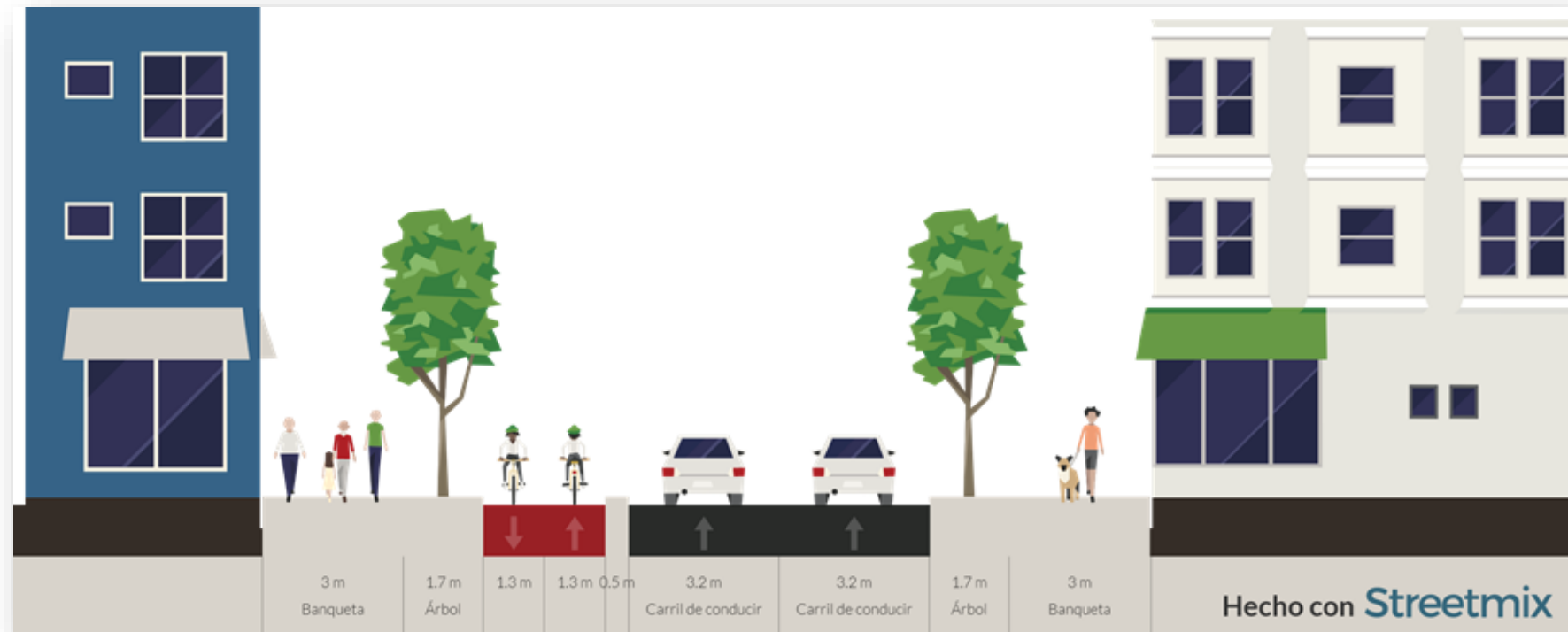
Source: Alcaldía Bucaramanga - Streetmix

Speed Reduction in Built-Up Areas

Vertical displacement

Source: Revista Motor

Speed Reduction in Built-Up Areas

Horizontal displacement – lane narrowing

Speed Reduction in Built-Up Areas

Roundabouts

Source: NACTO

Speed Reduction in Built-Up Areas

Raised zebra crossing

Chevron marking

Chicane

Gateway treatment

Raised junction

Safe System Speed Limits – Limiting Speeds to Survivable Levels
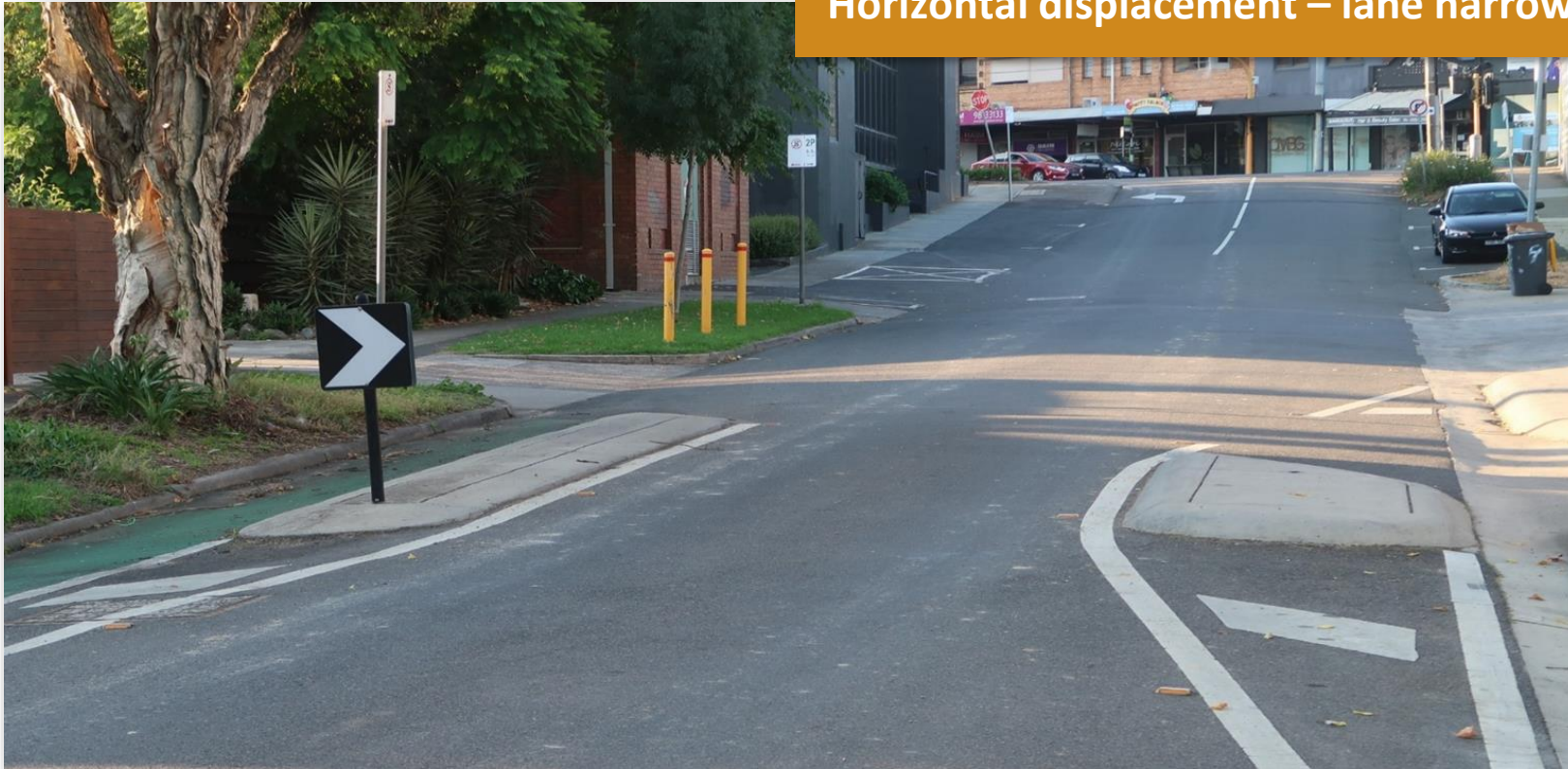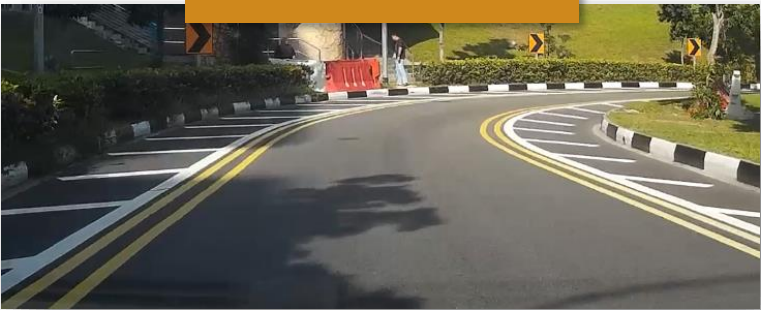
"Countries with a significantly lower road mortality rate than the European Union average of 5 deaths per 100,000 population apply a 70 or 80 km/h standard speed limit on rural, non-motorway roads."

(European Traffic Safety Council, 2019)

Type of Infrastructure and traffic	Possible travel speed (km/hour)
Locations with possible conflicts between pedestrians/cyclists and cars	30
Intersections with possible side impacts between cars	50
Roads with possible frontal impacts between cars	**70**
Road with no possibility of a side impact or frontal impact (only impact with the infrastructure)	100

Mooren, Grzebieta & Job, 2014

Across Europe, rural roads are the most dangerous in terms of design

Posted Speed Limits

A road without speed limit

Posted Speed Limits

The same road with speed limit
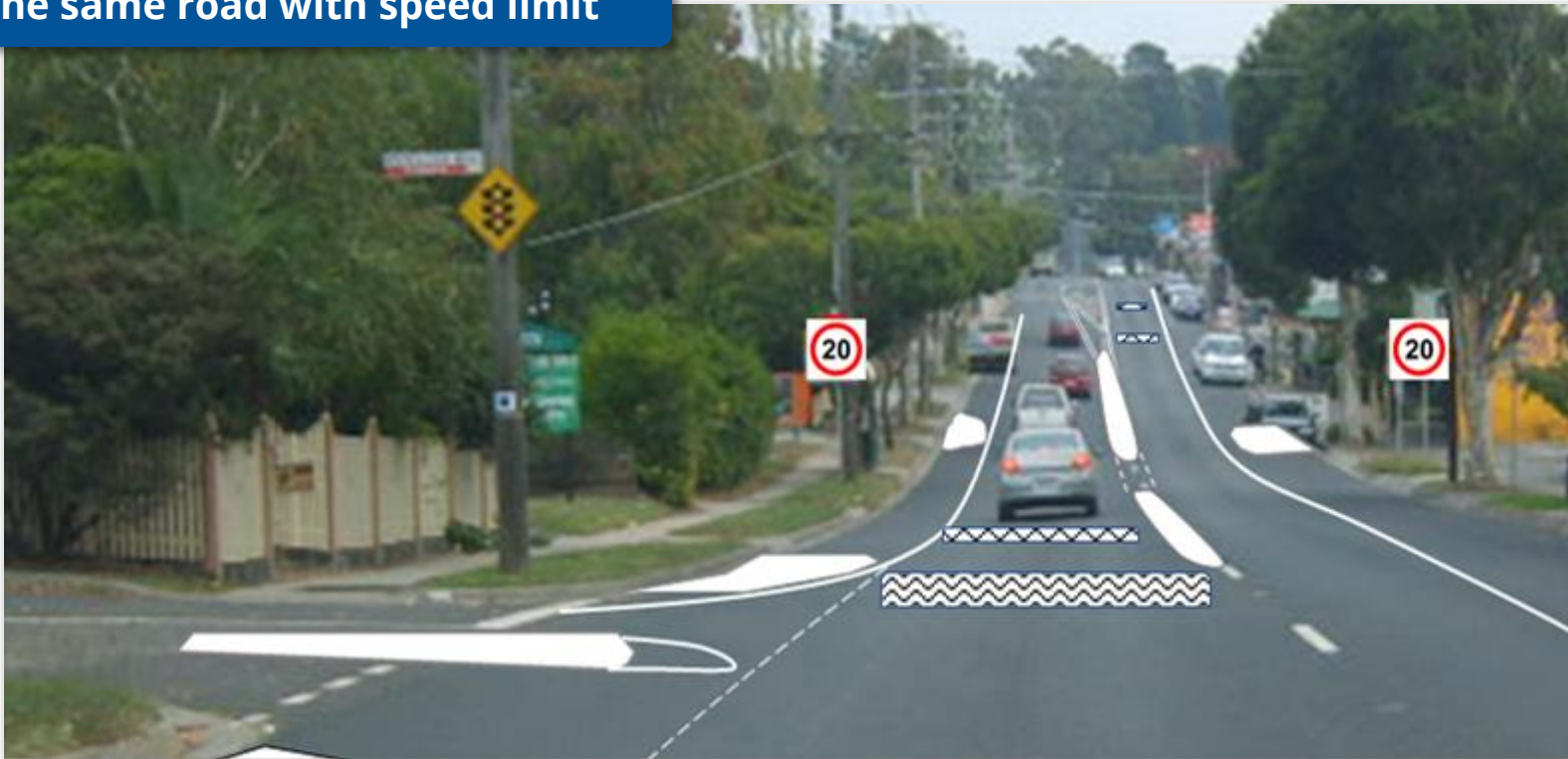
- Provides information to drivers

- Sets expectations

- Should match driver's perception

- And other issues such as the type of road, land use etc.

In-Vehicle Technologies

WHAT IS INTELLIGENT SPEED ASSISTANCE?

1. Car receives position information via GPS and current speed limit from a digital map. Can also be combined with video camera sign recognition.

2. Speed limit is displayed on the dashboard.
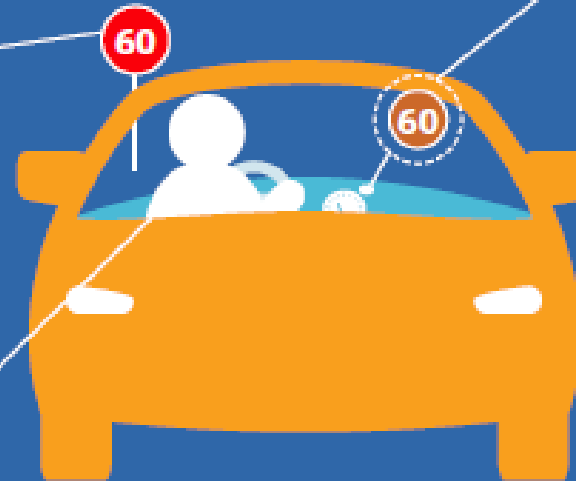
Driver can override system by pushing harder on accelerator.

3. Car helps driver not to speed when speed limit is reached.

© European Transport Safety Council (ETSC), www.etsc.eu

Policing as Part of the Safe System

- Effectively conduced enforcement is a key component of the 'Safe System' approach to improving road safety.
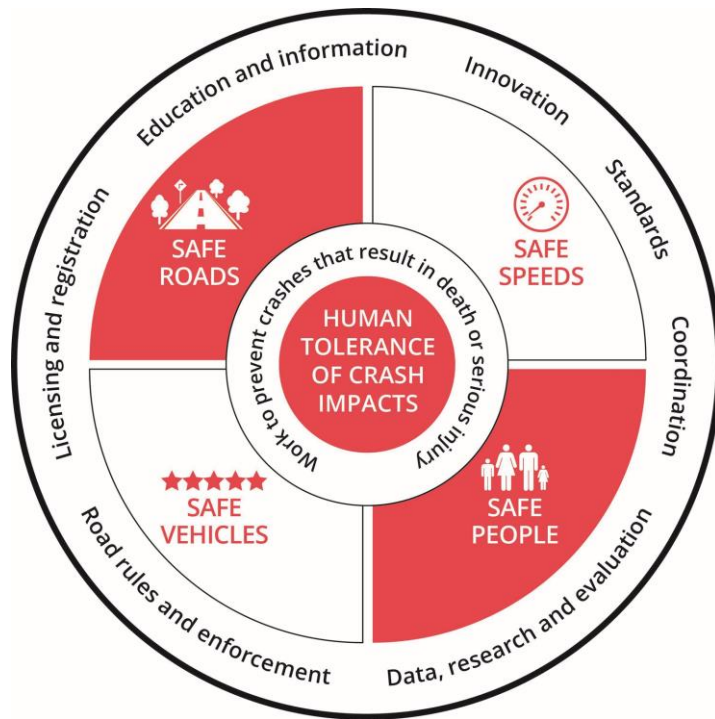
Numerous studies have shown the positive impact of enforcement on reducing road trauma

The lesson in all this is clear: when we think we'll get caught, we're far less likely to break the rules

What Effect Can Policing Have?

- Enforcement of speed has a direct impact on reducing road trauma.

Do We Need Enforcement?

"Strong and sustained enforcement of road safety laws, accompanied by public education, has positive effects on road user behaviour and thus has the potential to save millions of lives."
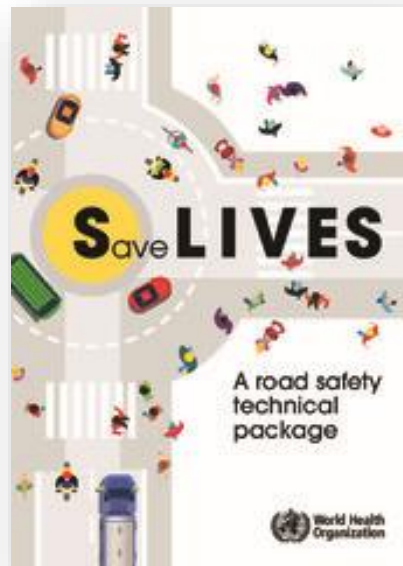
World Health Organization (WHO), 2017

Road Policing Impact

Traffic-law enforcement and risk of death from motor-vehicle crashes: case-crossover study *(The Lancet, 2003).*

Findings:
Risk of a fatal crash in the month after a notice (traffic fine) was issued was 35% lower than in a comparable month with no notice.

Lesson:
Enforcement reduces the chances of being involved in a fatal crash but the effect wears off requiring enforcement to be ongoing.

What Should Policing Focus on?

Reduce speeding – Globally, the number one problem!

Increase the perception of enforcement:

- Alcohol-impaired driving

- Safety belts and child restraints

- Motorcycle helmets

There are other behaviours that require enforcement, but the 'fatal four' require the most focus.

What is Required for Road Policing to Work Effectively?

Laws and regulations

Combinations of tiered penalties

Supporting judicial system and fines enforcement

Combined forces create deterrence
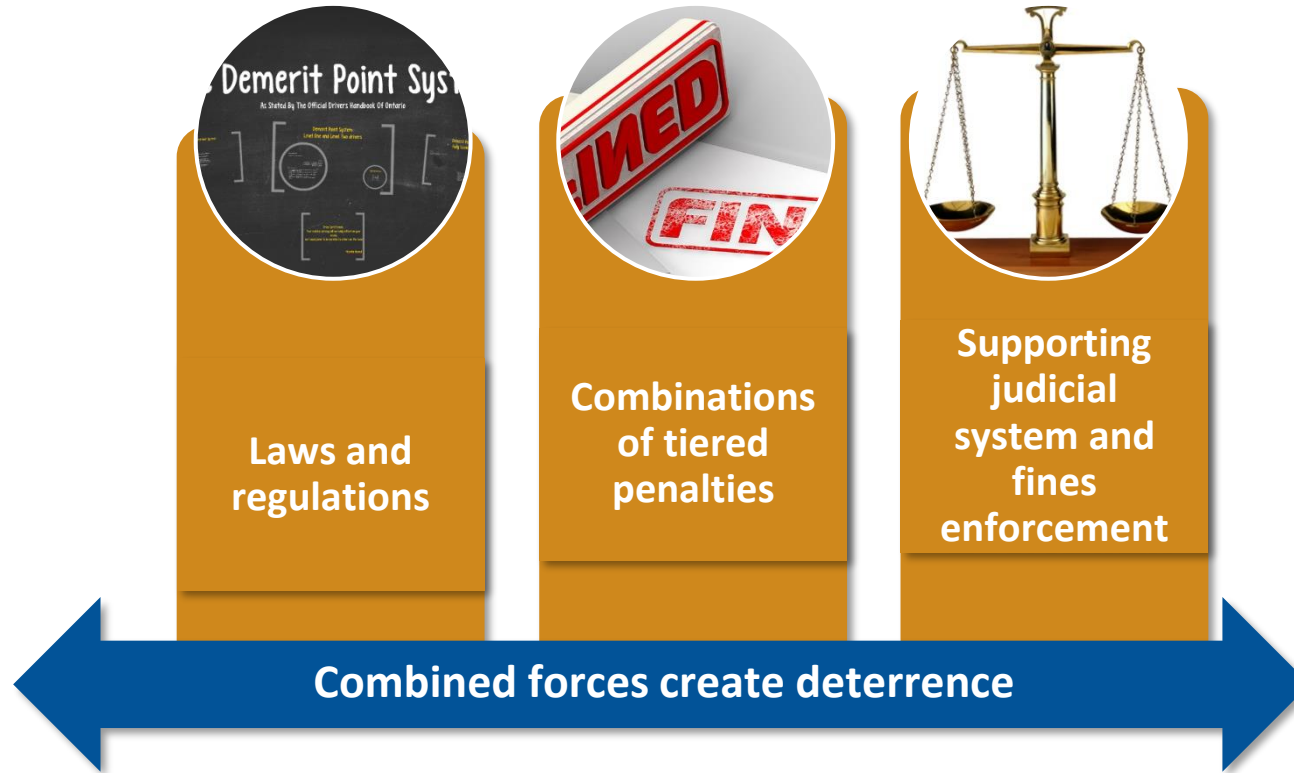
Legislation and Maximizing Effectiveness

Excessive Speed

- Clearly sign posted and 'Safe System' compliant speed limits.

- Clear and enforceable speed enforcement procedures and speed detection instrument certification.

- Legislation to enable automated speed enforcement.

Effective Penalties

- Graduated fines *(e.g., the higher the speed, the higher the fine)* set at deterrent levels.

- Demerit point system.

- Driver license disqualification or suspension.

- Roadside vehicle impoundment and license suspension for high speeds (over 25 km/h).

- Imprisonment for serious offending.

A Guide to the Use of
Penalties to Improve Road Safety

GLOBAL ROAD SAFETY PARTNERSHIP

Deterrence Theory

General deterrence

Impact of the threat of legal punishment on the public at large

(Highly-visible enforcement and public awareness programmes such as breath testing large numbers of drivers.)

Specific deterrence

Impact of the actual legal punishment on those who are apprehended

(Intensive enforcement operations penalising large numbers of speeding drivers.)

We're stopping speeders this summer

Public

Changing the Perceived Risk of Speeding

Perceived risk of apprehension is one of the main factors determining the level of speeding behavior.

To deter speeding it is essential that:

- A high proportion of speeding motorists are apprehended *(specific deterrence)*.

- All motorists are made aware that apprehension is likely if they decide to speed *(general deterrence)*.

Changing the Perceived Risk of Speeding

Impact of insufficient enforcement:

- If the risk of apprehension is low, then speeding behaviour can actually be encouraged because motorists learn that such behaviour is unlikely to be detected *(Ostvik & Elvik, 1990).*

- Low apprehension risk can also compromise other aspects of the deterrence process and increased penalty severity has been shown to be a relatively ineffective deterrent if motorists perceive the risk of receiving such a penalty as being low *(Ross, 1988).*

Drivers must believe that if they speed, apprehension is inevitable.

What Makes Enforcement Effective?

- Dosage – Delivered in sufficient quantity to mean it is likely that offending results in detection - **Persistent offending must result in regular detection and increasing penalties.**
- Unpredictable and regular – **Speeders should not be able to guess where enforcement will be, but know it is regular.**
- Swift Sanction – Penalties are swift and meaningful - **Fines and other sanctions cannot be avoided.**
- Network Wide – **But, focused on high-risk times and locations.**

Relying on a targeted approach with a small number of selected enforcement sites is not desirable. It leads to predictability and a lack of general deterrence. (European Commission, 2018)

Level of Enforcement Intensity Required 'Dosage'

"There is a positive relationship between the amount of enforcement (the size of the dose) and the effect on crashes. The more enforcement, the larger the crash reduction."

(Elvik, 2011)

Country/state	Netherlands (2017)	Luxemburg (2017)	Belgium (2017)	France (2016)	Jamaica (2020)
Speed infringements per 1000 inhabitants	457	428	299	253	**11**

Level of Enforcement Intensity Required

- Scandinavian studies reported that increases in the level of enforcement activity are often underestimated by motorists.

- Increased enforcement efforts which were less than three times the previous level, appeared to have only a minimal effect on the perceived probability of detection and little or no impact on speeding behaviour.

HOW FAST ARE YOU GOING?

Tripling speed enforcement creates deterrence!

Automated Enforcement - Options

The following are the main automated enforcement options:

- Mobile speed cameras (operated from vehicles parked on the roadside).

- Fixed speed cameras (permanently mounted, generally at high fatal and serious injury crash locations).

- Point to Point or Time over Distance Cameras – (generally used to suppress speeds over longer distances on motorway networks).


Significant penalties for failing to display or obscured registration plates

Automated Enforcement

The following are the key process requirements:

- Speeding vehicle is photographed *(image includes vehicle registration plate, time, date and speed detected)*.

- Image and data sent to processing centre *(wireless encrypted transmission preferred)*.

- Infringement validated and sent to registered owner *(requires enabling legislation, processing capacity, maintenance and calibration processes, robust vehicle and driver licence registries)*.
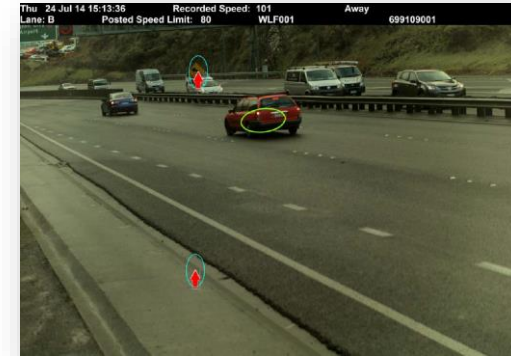
GRSP's guide sets out the requirements to operate automated enforcement

Automated Enforcement – Overt vs Covert

- Overview of Australasian enforcement indicates effects of hidden mobile cameras spread over larger areas than effects of fixed cameras. *(Delaney, Diamantoppulou & Cameron, 2003)*

- Visible cameras more effective where speed needs to be lowered at specific location *(e.g., intersection, school, pedestrian crossings, etc.)*.
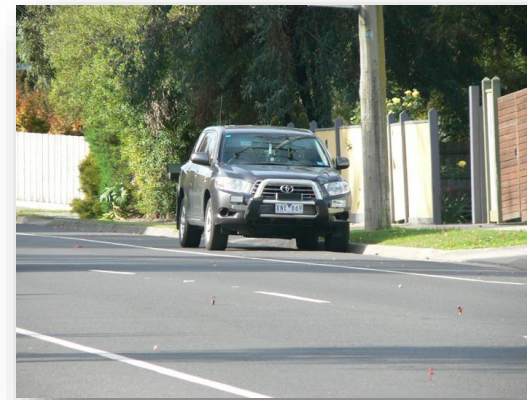
Automated Enforcement – Overt vs Covert

- Hidden cameras result in lower mean speeds, less speed variance and less 'kangaroo effects'.

- Comparison of speed cameras in Sweden and Victoria (Australia) – both deliver substantial benefits- Victoria model capable of delivering greater road safety benefits at less cost than Sweden *(Belin, Tillgren, Vedung, Cameron & Tingvall, 2010).*

- Overt cameras are less optimal than covert cameras *(European Commission, 2018).*

Speed cameras in Switzerland – No signage, painted grey, difficult to see and everywhere. HIGHLY EFFECTIVE

Generating Public, Political and Partner Support

- Educating the public, politicians and partners.

- Cultivating the support of non-government organizations and partners.

- Developing a public awareness programme.

Public Awareness – Supporting Enforcement

"The effect of speed enforcement and traffic enforcement in general is substantially increased if it is supported by information targeted at the road user." *(Williams, 1994: Erke, 2009)*

Communication with road users should:
- Emphasize safety is the goal of enforcement.
- Explain how and why speeding causes more crashes and makes them more severe.
- Explain enforcement method and procedures.
- Preferably illustrate that fines revenue is used to benefit local road safety.
- Provide feedback on interim and final results *(i.e., traffic behaviors or safety).*
- Focus on at risk groups *(i.e., message content and medium).*

Characteristics of a Robust Road Policing Programme

- Undertaken in a strategic and targeted manner, based on crash data and other intelligence *(intelligence led policing)*.
- Underpinned by a broad road safety strategy and specific enforcement plans.
- Delivered by professional, knowledgeable and skilled police *(not just how, but **WHY!**)*.
- Supported by a comprehensive offender management system and widespread public awareness programmes.
- Involves strong partnership between police and other road safety agencies *(strong political, partner and public awareness support)*.
- Enabled by sufficient funding and resource allocation.
- Clear and unambiguous targets *(e.g., independently monitored outcome measures)*.

Characteristics of a Robust Road Policing Programme

- **Balanced approach** – optimal emphasis between:

    -Automated Enforcement - Fixed, Point to Point & Mobile Speed Cameras.

    -Officer based enforcement.

- **Consider the best mix between overt and covert operations** (situationally dependent).

- **Dedicated police as far as possible** – minimal deployment to non-crash prevention activities – line control to a Road Policing Command.

- **Minimal enforcement tolerance** – enforce as close to the speed limit as possible to avoid de facto speed limits.

Identifying High-Risk Locations
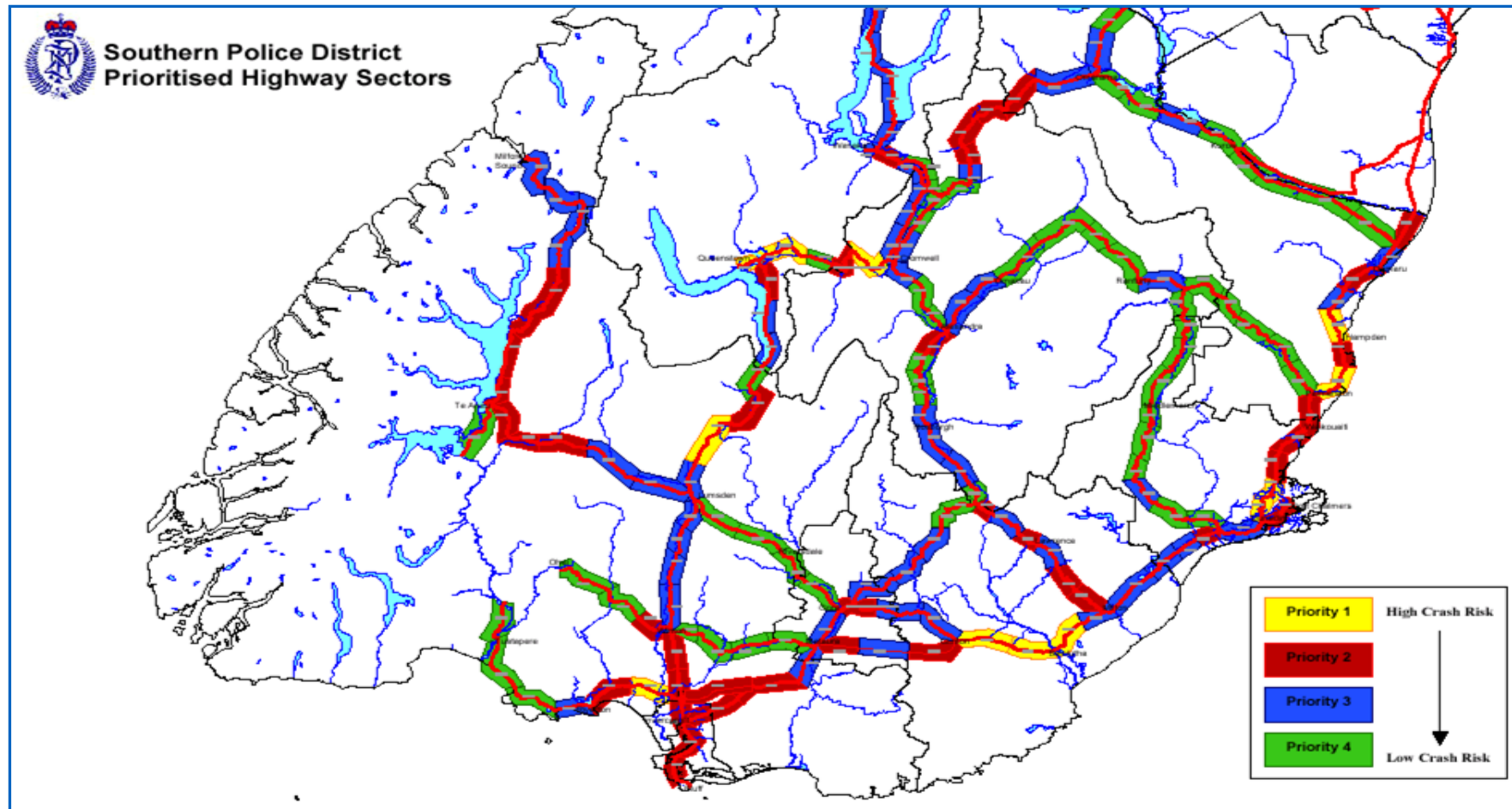
# High-Risk Speed Times – Time and Days of the Week When Speed-Related Crashed Peak

Table 2 - Speed related fatal/injury crashes by hour band (New Zealand Crash Data)							n	Greater than average (91)	
2009-13	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Total
00:00-01:59	56	38	58	**86**	**97**	**216**	**175**	726
02:00-03:59	24	29	46	44	63	116	**137**	459
04:00-05:59	26	20	26	**40**	41	91	**91**	335
06:00-07:59	51	54	55	70	83	77	55	445
08:00-09:59	72	88	90	73	71	84	71	549
10:00-11:59	85	82	61	71	63	**98**	**97**	557
12:00-13:59	**75**	76	75	**98**	77	138	**123**	662
14:00-15:59	95	80	101	107	134	**148**	**137**	802
16:00-17:59	116	137	**134**	**129**	**136**	**136**	**149**	937
18:00-19:59	72	96	100	**102**	**135**	**136**	**107**	748
20:00-21:59	**69**	**79**	108	112	**172**	**174**	**80**	794
22:00-23:59	56	66	**86**	99	**152**	**167**	65	691
Total	797	845	940	1031	1224	1581	1287	7705

Setting Enforcement Targets

- Network wide coverage / Risk Targeted Patrol Plans *(e.g., enforcement is network wide and focused on risk times/days of week/seasonal risk).*
- Percentage reduction in mean and 85th percentile free travel speeds by region, district or area.
- Changes in public perceptions *(based on public attitude surveys).*
- Enforcement hours/offences detected/location/temporal distribution.
- Monitoring offences detected relative to known levels of offending.
- Unbiased population based impartial enforcement.

Locations with high proportions of road trauma should be the subject of a major proportion of enforcement.

Setting Enforcement Targets

New Zealand Open Road Speeds
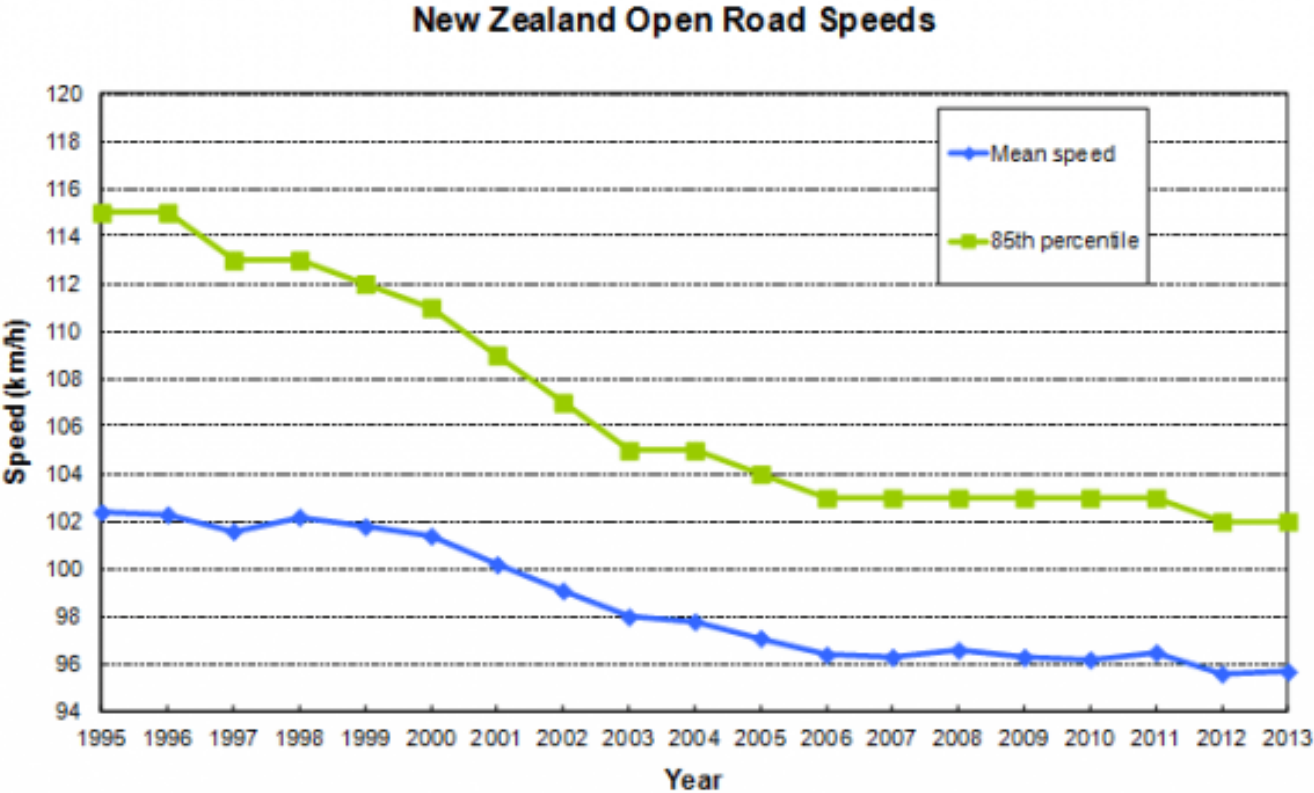
Declining mean and 85th percentile speeds equates with reducing road trauma

Public

Good Practice Enforcement Guidelines

- Road policing is most effective when it is unpredictable, unavoidable and appears to operate 'everywhere'.

- **Road policing operations need to be:**
  - Intensive and sustained *(increase perceived risk of detection).*
  - Random as possible *(maintain unpredictability).*
  - Utilize both highly visible operations <u>(general deterrence)</u> and targeted covert operations <u>(specific deterrence)</u> to reduce punishment avoidance
  - Well supported by mass media *(reinforce general deterrence, anywhere, any time and any body).*
  - Time saving operational guidelines.
  - Minimal enforcement tolerance and judicious use of warnings *(e.g., infringements issued as close to the speed limit as possible to avoid higher de-facto speed limits).*
  - Optimize effectiveness through research *(e.g., optimal presence, dosage, deployment patterns, tactics, overt vs covert, technology, etc.)*

Questions?

Thank You!