

THE SAFE SYSTEM APPROACH:

“WHAT IS IT AND WHY IS IT GETTING SO MUCH ATTENTION?”

PRESENTED BY MARK DOCTOR, PE, SENIOR SAFETY & DESIGN ENGINEER, FHWA RESOURCE CENTER, MARCH 28TH



SAFE SYSTEM APPROACH

Zero is our goal. A Safe System is how we get there.

BRIEF HISTORY AND PURPOSE OF THE SAFE SYSTEMS APPROACH

- Began from the ethical standpoint that no one should be killed or suffer a life long injury on our transportation system
- This idea first adopted by Sweden in 1997 as “Vision Zero”
- Reaching zero deaths or serious injuries requires the implementation of the Safe System Approach
- Acknowledgment that humans make mistakes and that human bodies have limited ability to tolerate crash impacts



TOP 3 TAKEAWAYS

- The Safe System Approach is “Principles Based” (6 Principles)
- Achieving a Safe System requires all elements to be strengthened (5 elements)
 - Cannot be achieved just through infrastructure
- Safe Roads is a continuum, not an absolute
 - There is not a perfect catch-all transportation system, but we can reduce risks
 - What is covered: What is it? Who is involved? Why is it different?
 - What is not covered: Implementation, Design, Case Studies

“IN ROAD INJURY EPIDEMIOLOGY, KINETIC ENERGY IS THE PATHOGEN” — ROBERTSON LS, INJURY EPIDEMIOLOGY

Why are people killed and seriously injured on the roads?



IMPAIRED DRIVING



SPEEDING AND AGGRESSIVE DRIVING



DISTRACTED DRIVING



OCCUPANT PROTECTION



PEDESTRIANS AND BICYCLISTS



MOTORCYCLISTS AND MOTOR SCOOTER RIDERS



COMMERCIAL MOTOR VEHICLE OPERATORS



TEEN DRIVERS



AGING ROAD USERS

People are killed and seriously injured on the roads when the collision forces transferred onto the human body exceed tolerable thresholds.

There has been a steady increase nationally of ped/bike/total fatalities since 2011

WHAT IS THE SAFE SYSTEM APPROACH?

A different way of thinking about the road safety problem ...



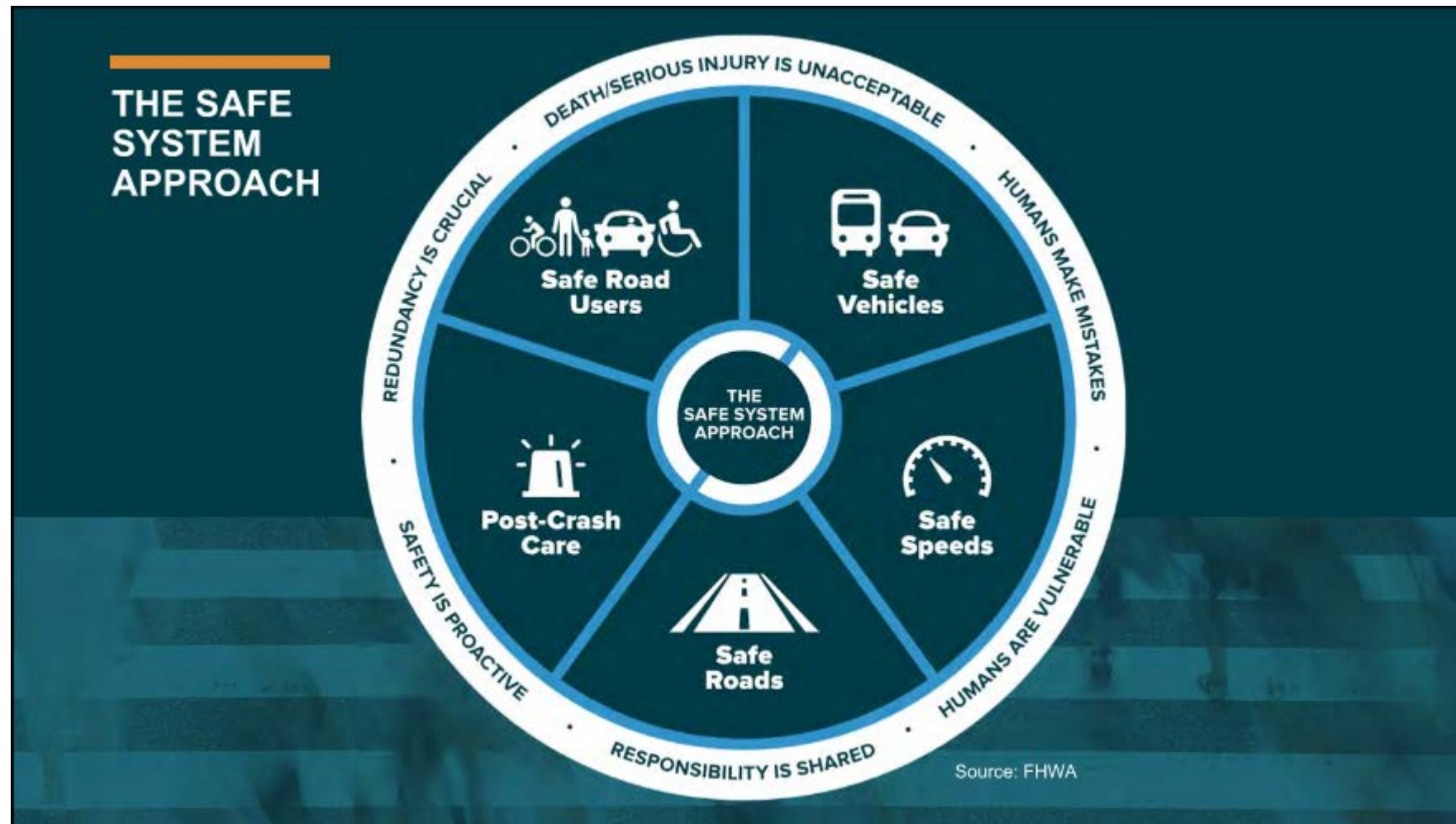
**Accommodating
human mistakes**

PARADIGM SHIFT



**Keeping impacts on the human
body at tolerable levels**

PRINCIPLES AND ELEMENTS



I. DEATH/SERIOUS INJURY IS UNACCEPTABLE

PARADIGM SHIFT



Focus on Fatalities and Serious Injuries



Death/serious injury is unacceptable

National Efforts

ROAD TO ZERO

Toward Zero Deaths
National Strategy on Highway Safety

VISION ZERO NETWORK

ite
A Community of Transportation Professionals



U.S. Department of Transportation

ABOUT DOT ▾

PRIORITIES ▾

National Roadway Safety Strategy

The United States Department of Transportation National Roadway Safety Strategy (NRSS) outlines the Department's comprehensive approach to significantly reducing serious injuries and deaths on our Nation's highways, roads, and streets. This is the first step in working toward an ambitious long-term goal of reaching zero roadway fatalities. Safety is U.S. DOT's top priority, and the NRSS represents a Department-wide approach to working with stakeholders across the country to achieve this goal.

2. HUMAN MAKE MISTAKES



As road users, people will inevitably make mistakes and those mistakes may lead to crashes

In a Safe System approach, owners and operators of the system strive to make it easy for humans to not make mistakes by designing roads and vehicles to be in tune with human competences.



3. HUMANS ARE VULNERABLE

- The human body has a limited physical ability to tolerate crash forces before harm occurs
- Designing safer roads is an exercise of managing kinetic energy
- Speed
- Impact Angle (Changing an impact angle from 90° to 40° reduces energy to about a 20 mph speed reduction)



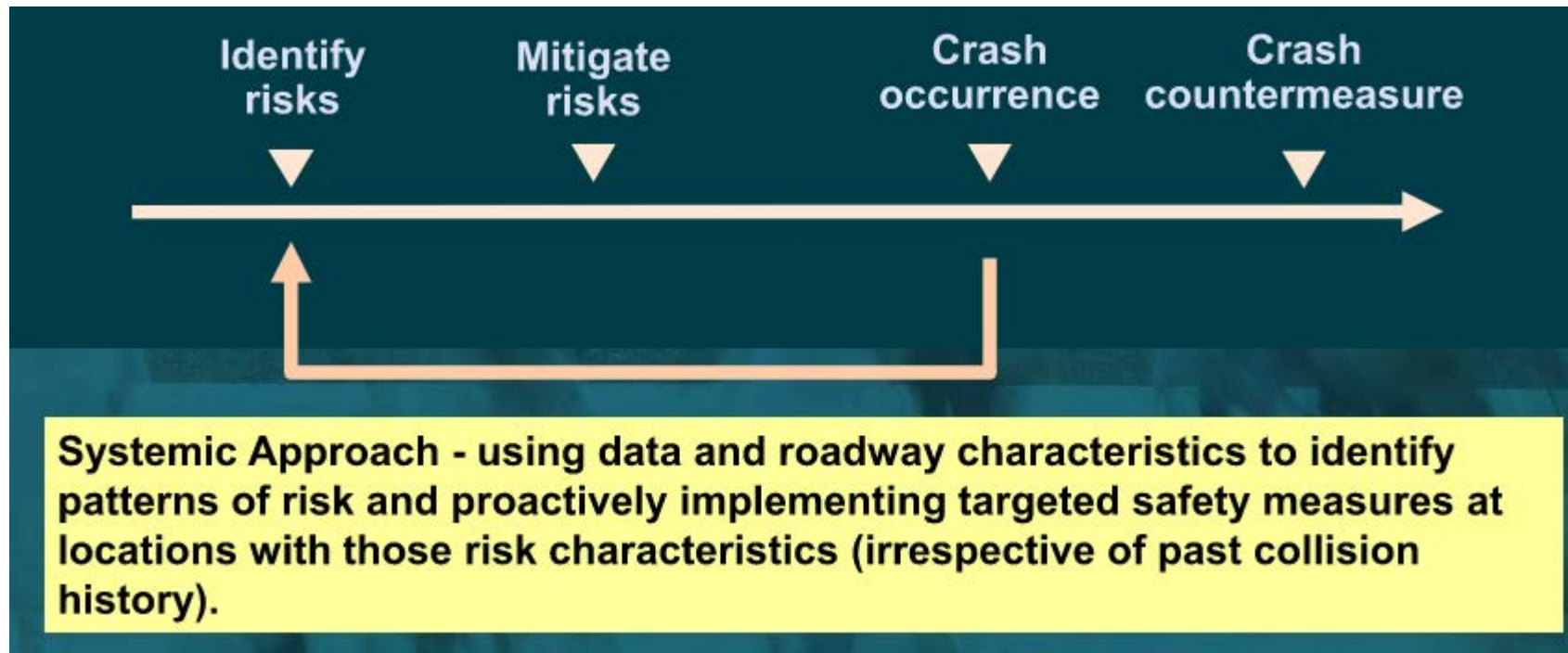
4. RESPONSIBILITY IS SHARED

- A Safe System cannot be achieved by engineering alone



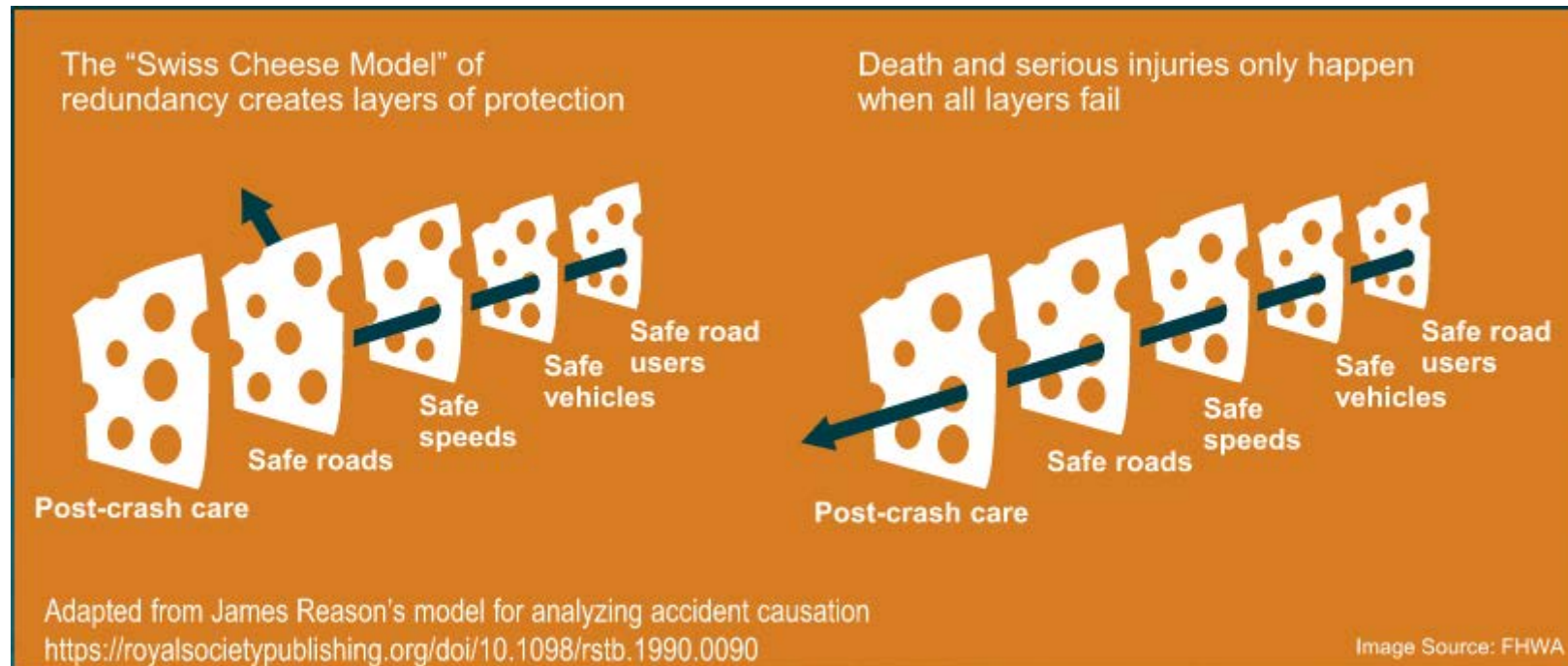
- Also, the road user shares responsibility

5. SAFETY IS PROACTIVE



...Involves widely implemented improvements based on high-risk roadway features correlated with specific severe crash types

6. REDUNDANCY IS CRUCIAL



What's Different?

PARADIGM SHIFT



Traditional Approach

Reduce Crashes

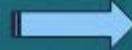
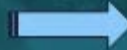
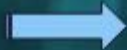
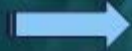
Speed Management

Safety "Four E's"

Apply Countermeasures at High Crash Locations

Examine crash records to identify causes or "deficiencies"

"Balance" Safety vs. Mobility



Safe System Approach

Eliminate Fatalities & Serious Injuries

Kinetic Energy Management

Five Safe System Elements

Proactively Apply Countermeasures in a "Systemic" Approach

Strengthen all elements to reduce "system failures"

Only "Safe Mobility"



Five Safe System Elements



Source: FHWA

I. SAFE ROAD USERS

Safe Road Users

Walk Bike Drive Transit Other

Source for all images: Fehr & Peers

Not distracted or impaired

Follow rules

Act within the limits of the road design

- There is an integral role of behavioral safety and road user responsibility in the SSA

2. SAFE VEHICLES

Active Safety	Passive Safety
Reduces the chance of a crash occurring	Protective systems for when crashes occur
<ul style="list-style-type: none">• Lane departure warnings• Lane keeping assist• Forward collision warnings• Autonomous emergency braking• Pedestrian detection• Backup camera• Antilock brakes• Electronic stability control	<ul style="list-style-type: none">• Seatbelts• Airbags• Crumple zones• Collapsible steering column



3. SAFE SPEEDS



Some roads are engineered to accommodate higher speeds ...



... and others not.

SAFE SPEEDS



The Safe System approach is not about universally reducing speeds. It's about matching speed appropriate to the road conditions that exist.

Hit by a vehicle traveling at

23 MPH

10% risk of death



Hit by a vehicle traveling at

42 MPH

50% risk of death



Hit by a vehicle traveling at

58 MPH

90% risk of death



Source: FHWA

SAFE ROADS – PART I

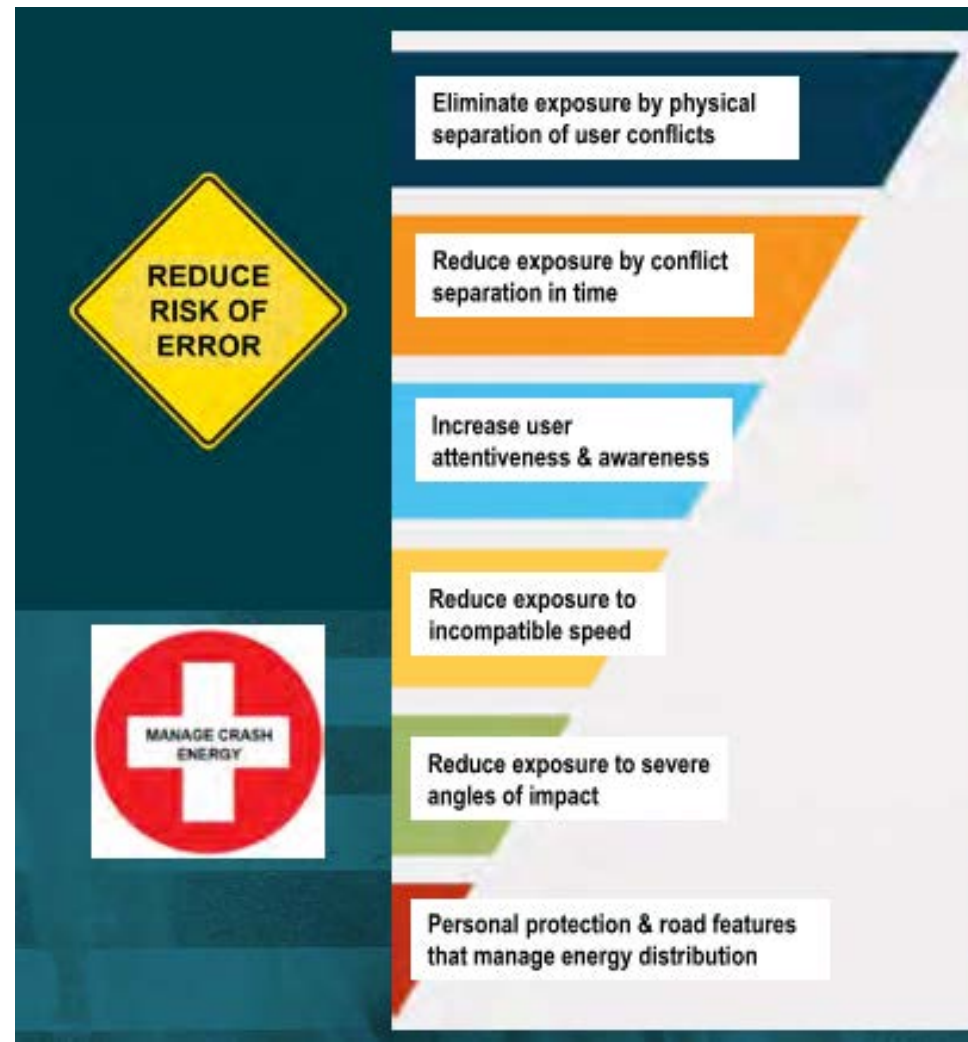
- “Safe Roads” is a continuum – not an absolute
- The aim is to design and operate roads to continually approach to a Safe System by implementing features appropriate for the intended use

- Reduce the likelihood of error
- Reduce the consequences of error



- Transportation agencies are strongly encouraged to implements “ Proven Safety Countermeasures”, where appropriate, to accelerate the achievement of safer roads in the SSA.
- https://safety.fhwa.dot.gov/provencountermeasures/pdf/FHWA-SA-21-071_PSC%20Booklet_508.pdf

SAFE ROADS - PART II



SAFE ROADS - PART II



ite
A Community of Transportation Professionals

Safe System Framework

<https://www.ite.org/technical-resources/topics/safe-systems/>

Safe Roads



Separating users in space

Separating users in time

Increasing attentiveness and awareness



Manage speed

Manage impact angles

Manage impact energy distribution

Source: Fehr & Peers

Source: City of Carmel, IN

Source: Fehr & Peers

SEPARATING USERS IN SPACE GUIDANCE

Table 14. Recommended Countermeasure Tiers Depending on Traffic Context

Roadway Type (Number of Travel Lanes and Median Type)	Vehicle ADT < 9,000			Vehicle ADT 9,000–12,000			Vehicle ADT 12,000–15,000			Vehicle ADT ≥ 15,000		
	Speed Limit (mph)											
	≤30	35	≥40*	≤30	35	≥40*	≤30	35	≥40*	≤30	35	≥40*
2 Lanes	1	1	2	1	1	2	1	1	3	1	2	3
3 Lanes	1	1	2	1	2	2	2	3	3	2	3	3
4 Lanes with raised median**	1	1	2	1	2	2	2	3	3	3	3	3
4+ Lanes without raised median	1	2	3	2	2	3	3	3	3	3	3	3

Legend:

- 1 **Tier 1:** Traffic context generally supports motorist yielding; countermeasures are generally less expensive and require less process than other two tiers to implement
- 2 **Tier 2:** Traffic context generally requires intervention to induce motorist yielding; countermeasures are generally less expensive and require less process than Tier 3 to implement
- 3 **Tier 3:** Traffic context generally requires intervention to require motorist to stop or to physically separate pedestrians and bicyclists from traffic; often the most expensive and may require extensive public process

* Where the speed limit exceeds 40 mph, Tier 3 should be considered.

** Raised medians must be at least 6 feet wide to serve pedestrians. See the AASHTO *Bicycle Guide* for lengths to serve bicyclists. Where median width is less than these values, review category of 4+ lanes without raised median.

Table adapted from AASHTO *Bicycle Guide* and the FHWA *STEP Guide*



Source: Guidance to Improve Pedestrian and Bicyclist Safety at Intersections (2020); National Cooperative Highway Research Program (NCHRP) Report 926 - <http://www.trb.org/Main/Blurbs/180624.aspx>

Separating Users in Time

Pedestrian Hybrid Beacons



Leading Pedestrian Interval



All Images
Source: FHWA

Increasing Users Attentiveness & Awareness

ROADWAY DEPARTURE



Wider Edge Lines



Longitudinal Rumble Strips and Stripes on Two-Lane Roads



Enhanced Delineation for Horizontal Curves

INTERSECTIONS



Backplates with Retroreflective Borders



Systemic Application of Multiple Low-Cost Countermeasures at Stop-Controlled Intersections

PEDESTRIANS/BICYCLES



Rectangular Rapid Flashing Beacons (RRFB)



Crosswalk Visibility Enhancements

CROSSCUTTING



Lighting

5. POST CRASH CARE

Vital post-crash actions include:



**First
responders**



Medical care



**Crash
investigation**



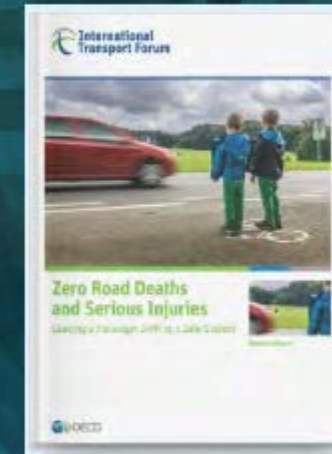
**Traffic
incident
management**



Justice

Safe System Approach – What's Next?

“There is no single pathway for the adoption, establishment and implementation of a Safe System. Moving to a Safe System is a learning-by-doing process best described as a journey which presents opportunities, hazards and challenges along the way. The experiences of the pioneering countries show that each follows its own journey, shaped by the cultural, temporal, and local context, but guided by the underlying principles.”



Source: Zero Road Deaths and Serious Injuries: Leading a Paradigm Shift to a Safe System; OECD (2016)

<http://www.oecd.org/publications/zero-road-deaths-and-serious-injuries-9789282108055-en.htm>

