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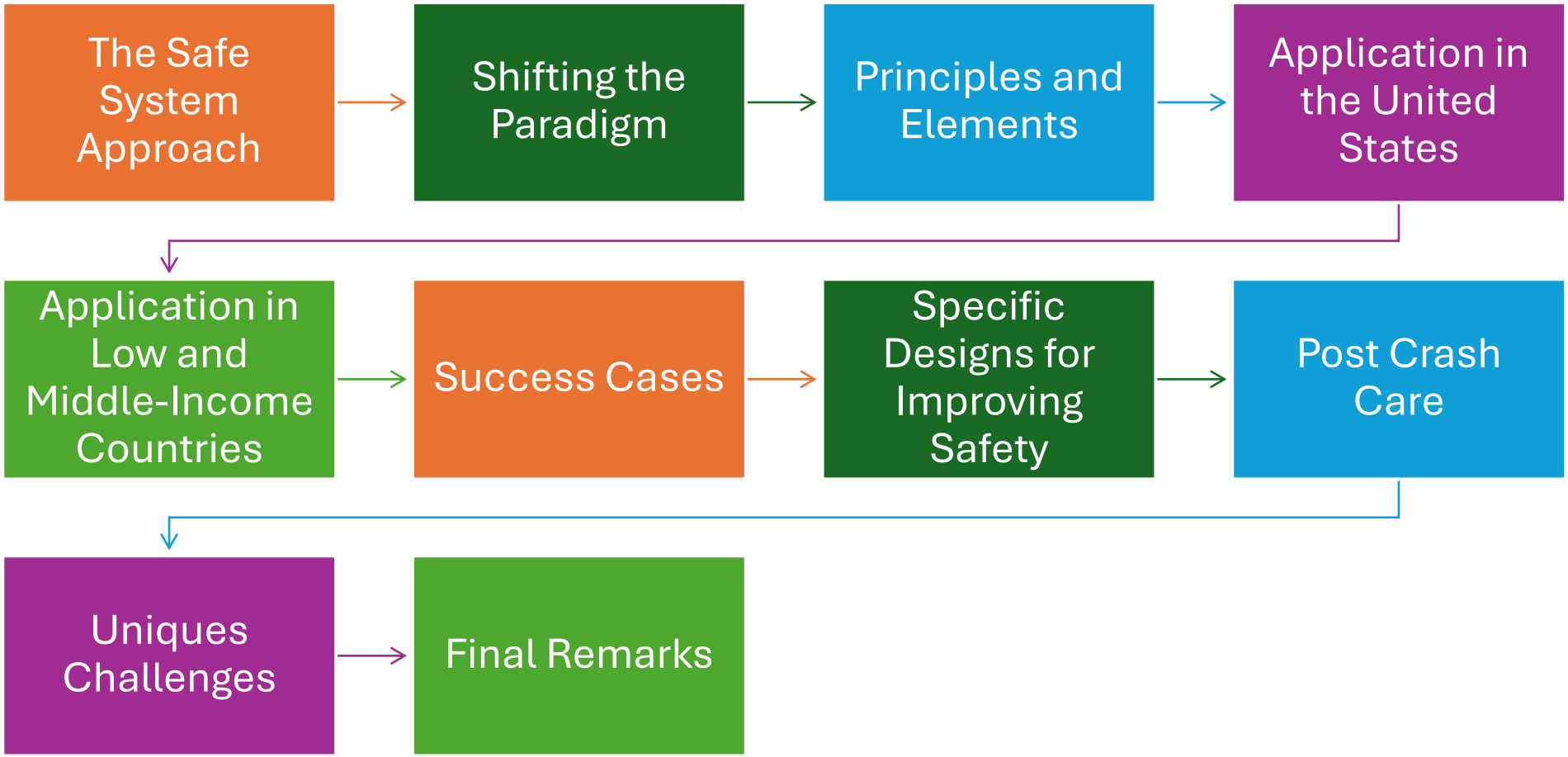
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The Safe System Approach

Envisioning a world where road crashes claim zero lives.

- The Safe System approach aims to eliminate fatal and serious injuries for **all road users** by creating a transportation system that:

- **Anticipates and accommodates human mistakes**

- Keeps **impacts on the human body** at **tolerable levels**

- Traffic safety has traditionally focused on promoting adherence to the rules of the road through *education*, *training, regulation,* and *enforcement*.

- *However, these initiatives leave out a set of design, infrastructure, and systemic issues that impact safety on the road.*

Shifting the Paradigm

The Safe System approach represents a paradigm shift away from the traditional approach to road safety.

	Traditional	Safe System
What is the problem?	Accident risk	Fatalities and Serious injuries
What causes the problem?	Human factors	Humans make mistakes. Humans are fragile
Who is responsible?	Individual road users	Responsibility is shared; starts with system designers
What is the appropriate goal?	Optimize the number of fatalities and serious injuries	Eliminate fatalities and serious injuries
What is the approach?	Reactive approach to change road user behavior through education	Proactive systemic approach to build safer roads

Principles and Elements

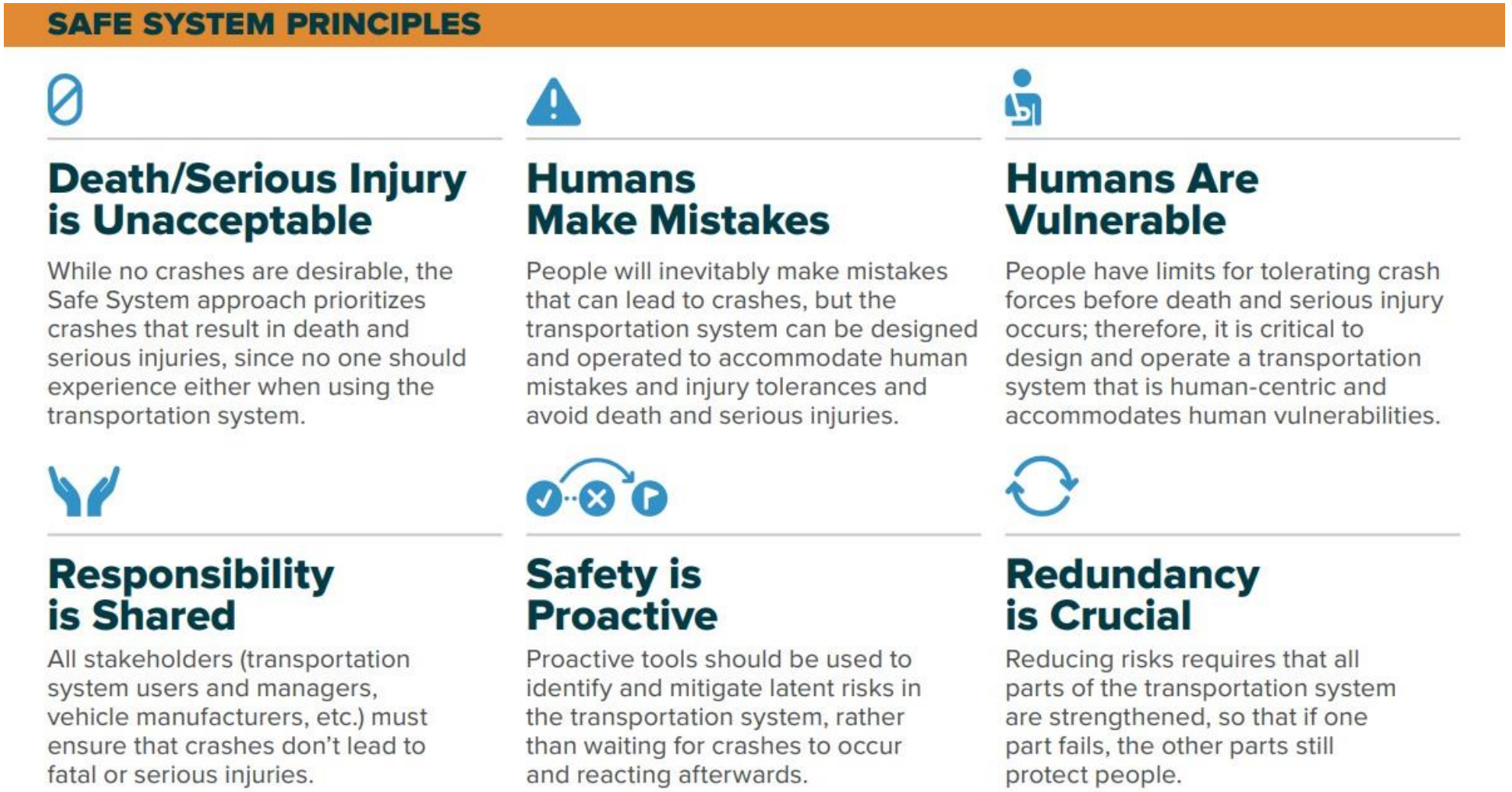
Principles

- Humans make errors
- Humans are vulnerable to injury
- Responsibility is shared
- No Death or Serious injury is acceptable
- Proactive vs Reactive

Elements

- Safe Road Users
- Safe Vehicles
- Safe Speeds
- Safe Roads
- Post-Crash Care

Principles and Elements (cont.)



Source: FHWA, https://safety.fhwa.dot.gov/zerodeaths/docs/FHWA_SafeSystem_Brochure_V9_508_200717.pdf

Principles and Elements (cont.)

SAFE SYSTEM ELEMENTS

Making a commitment to zero deaths means addressing every aspect of crash risks through the five elements of a Safe System, shown below. These layers of protection and shared responsibility promote a holistic approach to safety across the entire transportation system. The key focus of the Safe System approach is to reduce death and serious injuries through design that accommodates human mistakes and injury tolerances.

Safe Road Users

The Safe System approach addresses the safety of all road users, including those who walk, bike, drive, ride transit, and travel by other modes.

Safe Vehicles

Vehicles are designed and regulated to minimize the occurrence and severity of collisions using safety measures that incorporate the latest technology.

Safe Speeds

Humans are unlikely to survive high-speed crashes. Reducing speeds can accommodate human injury tolerances in three ways: reducing impact forces, providing additional time for drivers to stop, and improving visibility.

Safe Roads

Designing to accommodate human mistakes and injury tolerances can greatly reduce the severity of crashes that do occur. Examples include physically separating people traveling at different speeds, providing dedicated times for different users to move through a space, and alerting users to hazards and other road users.

Post-Crash Care

When a person is injured in a collision, they rely on emergency first responders to quickly locate them, stabilize their injury, and transport them to medical facilities. Post-crash care also includes forensic analysis at the crash site, traffic incident management, and other activities.

Source: FHWA, https://safety.fhwa.dot.gov/zerodeaths/docs/FHWA_SafeSystem_Brochure_V9_508_200717.pdf

Application in the United States

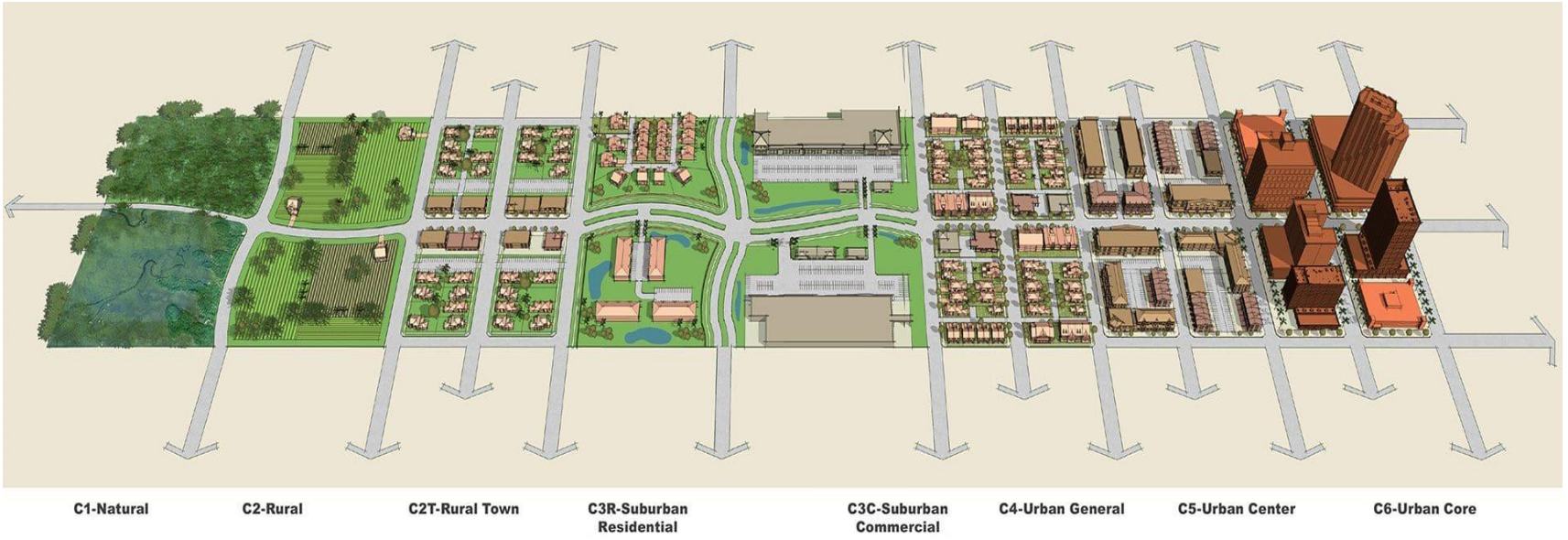
Target Zero Initiative in Florida

- **Goal** - to reduce the **number of serious injuries** and **deaths** from road crashes to **ZERO.**
- The initiative helps to address all elements of a safe transportation system in an **integrated manner.**
- Florida's Strategic Highway Safety Plan provides a framework for reducing fatalities and serious injuries identifying strategies that address the **4 "E"s** of traffic safety and additional **4 "I"s**

Application in the United States (cont.)

Florida’s context-based street design

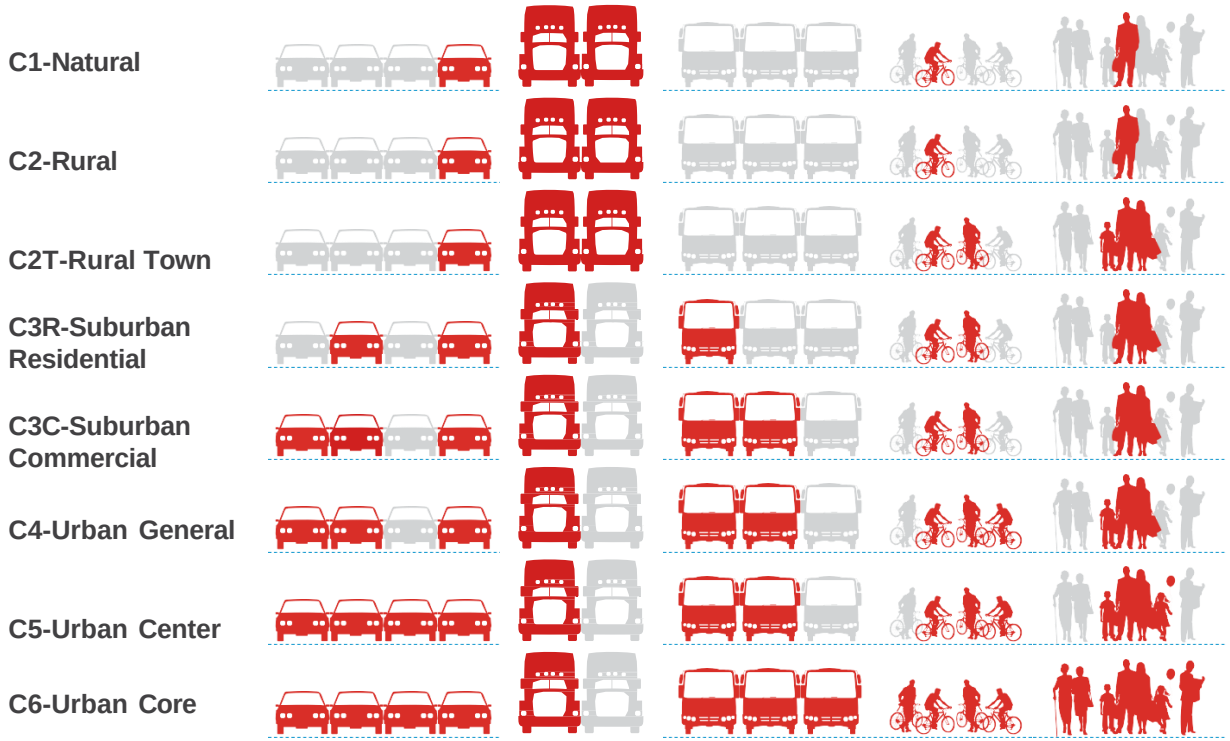
- Florida is among the first states to adopt **context-based street design** to complement the existing functional classification.
- **Concept**: Streets serve various purposes and therefore design must be sensitive to the context in which the road will operate.



Application in the United States (cont.)

Florida DOT's context-based street design

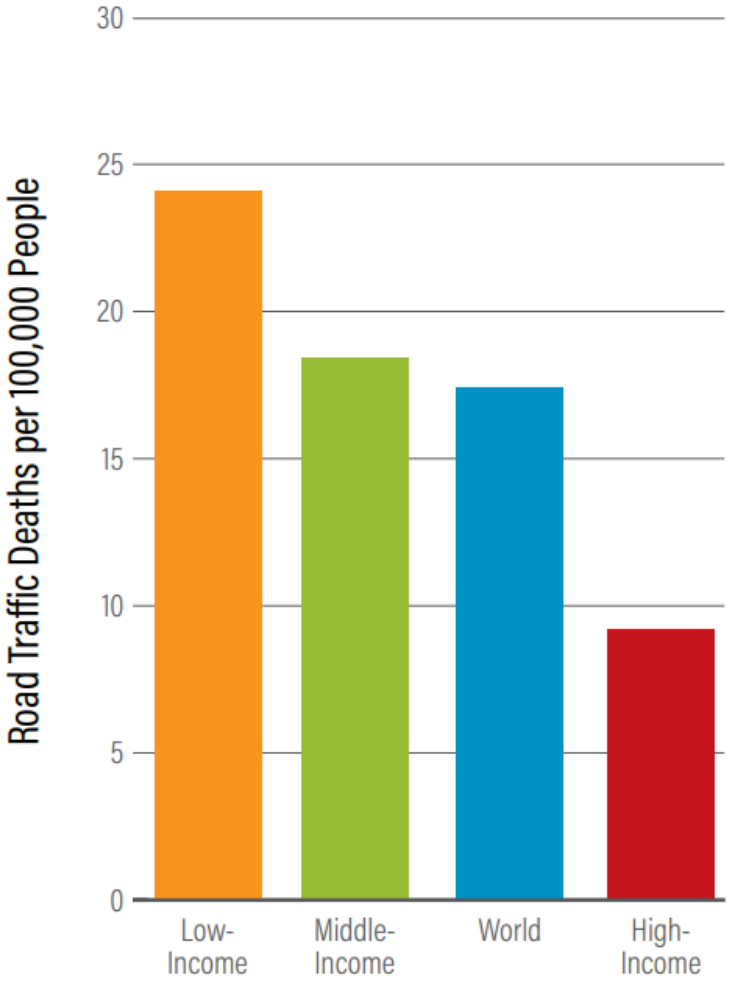
- Involves considering existing and future characteristics to ensure that roads are designed for the **right vehicle speeds**, **road users**, and **trip types**.
- Outcomes:
  - Reduced design speeds in walkable context zone that improve safety.
  - Wider sidewalks on state roads and reduced travel lane widths that slow traffic and create space for bike lanes.
  - Connected street networks that improve safety and capacity.



Expected user types in the different context classifications
Source: FDOT Context Classification Guide

Application in Low and Middle-Income Countries

- **Most** of the world's **traffic deaths** occur **in low- and middle-income countries (LMICs).**
- LMICs also experience **higher** traffic **deaths** among **pedestrians**, **bicyclists** and **motorcyclists**.
- Most of these deaths result from **unsafe speeds** and **infrastructure problems**, such as the lack of separation among road users.
- The safe systems approach would address these issues.



Source: WHO 2015.

Success Cases

Countries that have adopted the Safe System approach have both the lowest rates of fatalities per 100,000 inhabitants and the fastest rate of reduction in fatality levels.

NORWAY

68.5%

Reduction in fatalities
2000-2019

FRANCE

57.6%

Reduction in fatalities
2000-2019

SWEDEN

47.3%

Reduction in fatalities
2000-2019

NETHERLANDS

43.3%

Reduction in fatalities
2000-2019

AUSTRALIA

33.5%

Reduction in fatalities
2000-2019

UNITED STATES OF AMERICA

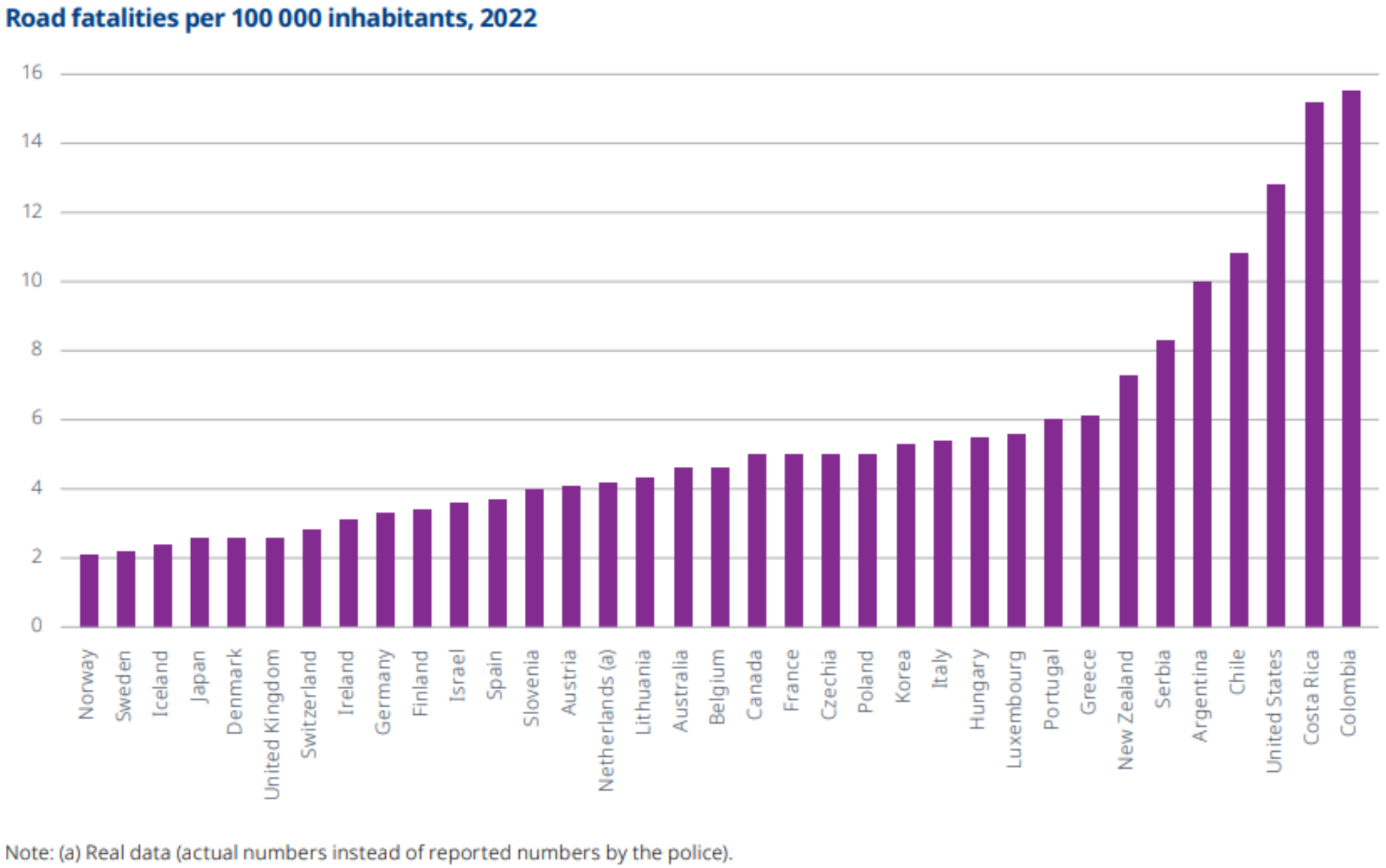
5.6%

Reduction in fatalities
2000-2019

Source: FHWA with data from World Health Organization Global Health Observatory Repository

Success Cases (cont.)

Source: ITF (2023), Road Safety Annual Report 2023, OECD



Note: (a) Real data (actual numbers instead of reported numbers by the police).

Discussion

What initiatives is the government taking to reduce road deaths and serious injuries, and what else can they do to improve road safety?

Specific Designs for improving safety

Safe Speeds

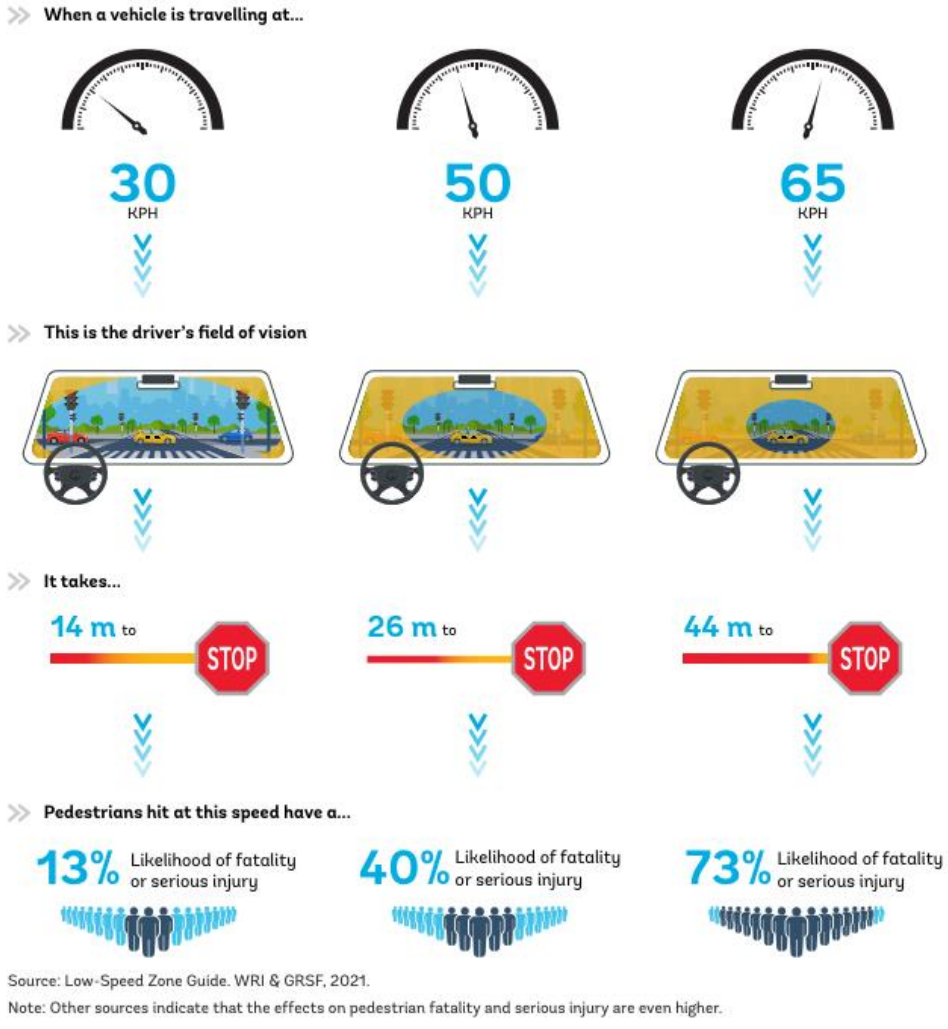
Impacts of high speeds

1% increase in average speed can lead to:

Increase in injury crash frequency

Increase in severe crash frequency

Increase in fatal crash frequency



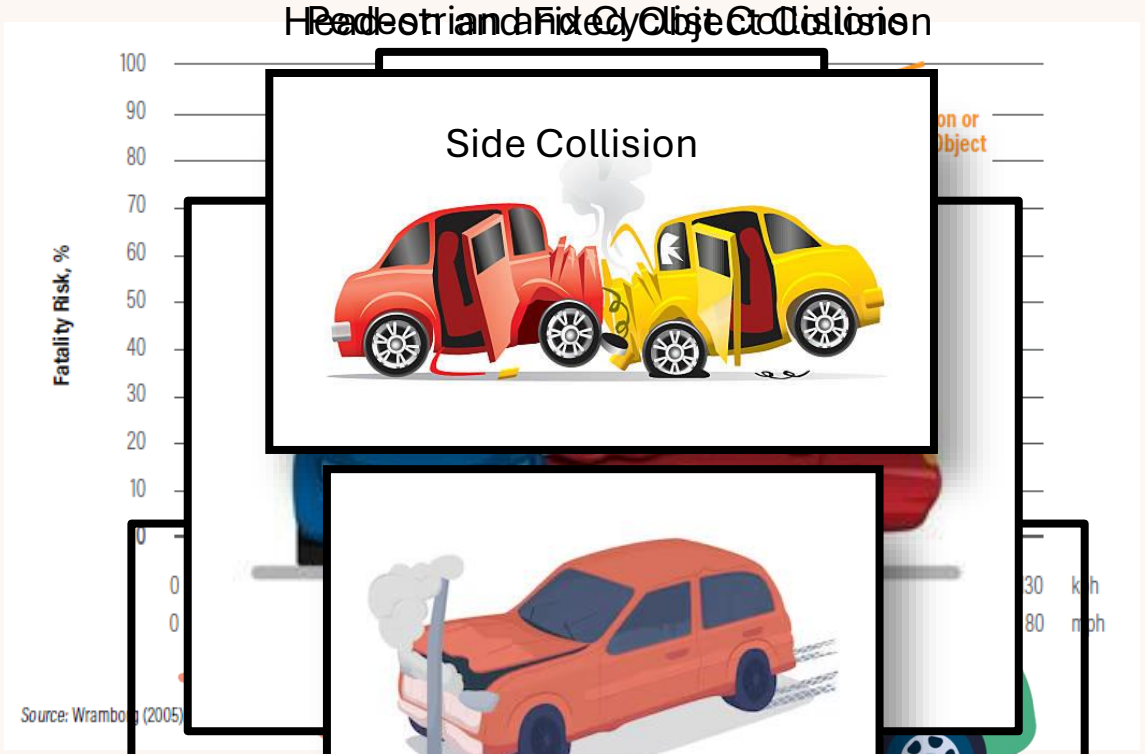
Specific Designs for improving safety

Kinetic energy

- Death and serious injury occur when collision forces transferred onto the human body exceed tolerable thresholds.
- Designing safer roads involves managing **kinetic energy.**

  $$k = \frac{1}{2}\, mv^2$$

  where v = velocity i.e., **speed** in combination with **direction** (**angle of impact**)

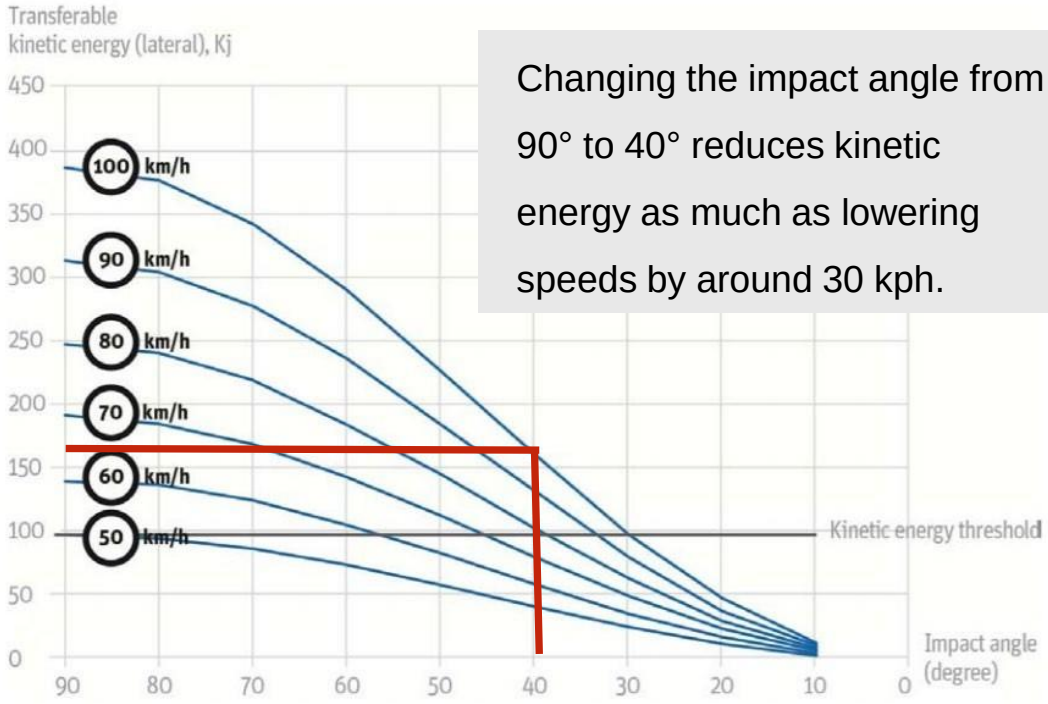


Relationship b… **speed** for pedestrians, cyclists and motorists

Specific Designs for improving safety

Kinetic energy

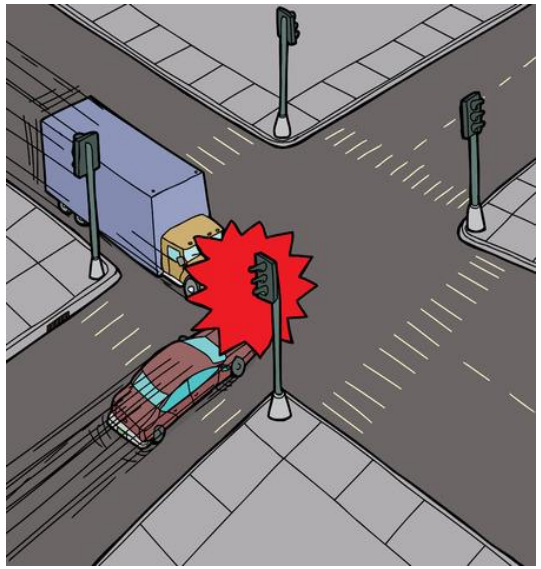
Figure 5.11. **Influenced impact angle on transferable kinetic energy**



Changing the impact angle from 90° to 40° reduces kinetic energy as much as lowering speeds by around 30 kph.

Transferable **kinetic energy** vs **impact angle** and travel **speed**

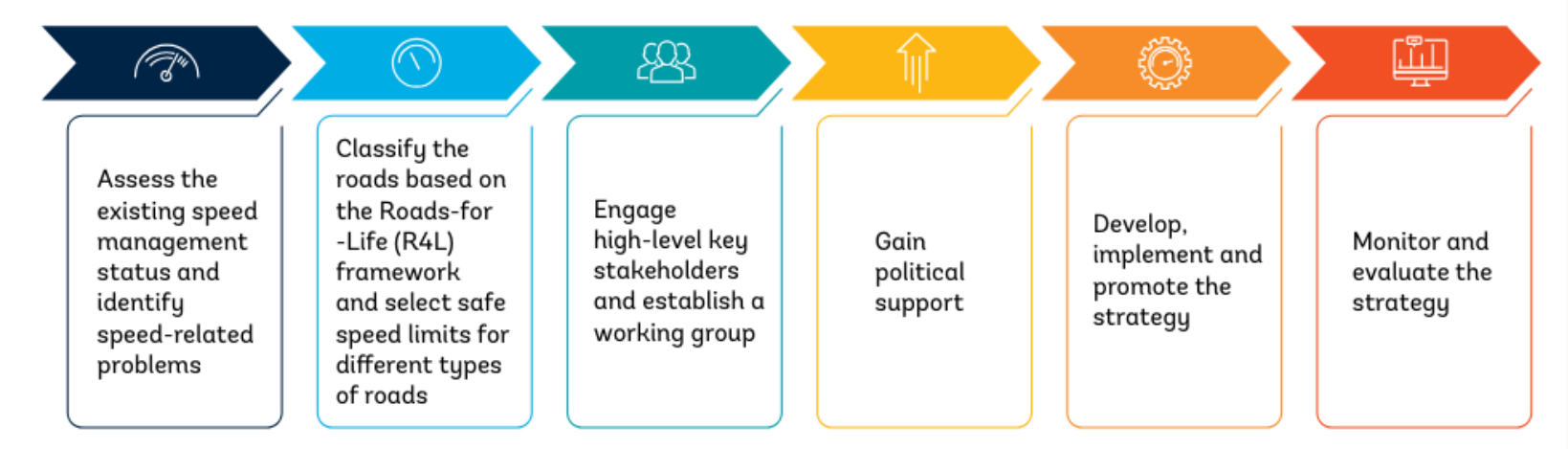
Source: International Transport Forum (2016)



Roundabouts provide **lower impact angles** compared to intersections, making them **effective in reducing severe crashes.**

Safe Speed Management

Implementation



Benefits

Provides protection from fatal and severe injuries

Provides space to recover from human errors

Provides positive guidance to safely navigate the mobility system

Discussion

What examples of speed management strategies are you aware of? Provide answers in rural vs urban context.

Specific Designs for Improving Safety (cont.)

Chicanes

- Artificial turns created to slow traffic.
- Application:
  - Arterials passing through more residential or mixed land use areas that require safer speeds.

Specific Designs for Improving Safety (cont.)

Raised pedestrian crossings

- At-grade raised pedestrian crossings can improve safety by slowing down vehicles, while increasing pedestrian visibility due to the increased height.
- Should be accompanied by appropriate warning signs and roadway markings

Specific Designs for Improving Safety (cont.)

Rumble Strips

- Textured road markings, which may be placed:
  - Near the edge of the travel lane to **alert drivers** when they are **leaving the roadway** or
  - Perpendicular to the direction of travel to **alert drivers of a need to slow down or stop**.
- These significantly **reduce roadway departure crashes** due to inattention, distraction, and fatigue.

Specific Designs for Improving Safety (cont.)

Lane markings

Lane markings ensure the safe, smooth and harmonious flow of traffic.

Traffic lanes lacking delineation

Clear delineation of travel lanes using lane markings

Specific Designs for Improving Safety (cont.)

Raised pavement markings

- Used to provide delineation of the road.
- They may also alert drivers who drift out of their lanes by creating a thumping sound.
- They include a lens or sheeting that reflects automotive headlights, enhancing visibility and improving guidance during daytime and nighttime driving.

Specific Designs for Improving Safety (cont.)

Safe roads

Dangerous open channels in several roads in Tanzania

Specific Designs for Improving Safety (cont.)

Separating road users in time and space reduces the risk of crashes.

Vulnerable road users exposed to vehicular traffic

Vulnerable road users separated from vehicular traffic

Specific Designs for Improving Safety (cont.)

Separating road users in time and space reduces the risk of crashes

Pedestrians separated from vehicular traffic using grade-separated crossings

Specific Designs for Improving Safety (cont.)

Safe Sidewalks

Provide space for pedestrian traffic, free of vehicle conflicts

Sidewalk commandeered by vendors

Safe Sidewalk with adequate space and barriers to protect pedestrians

Specific Designs for Improving Safety (cont.)

Safe Sidewalks

Provide space for pedestrian traffic, free of vehicle conflicts

Presence of a sidewalk encourages walking and outdoor physical activity

Absence of a sidewalk discourages walking despite the attractiveness of the street

Specific Designs for Improving Safety (cont.)

Bicycle infrastructure

Separated bike lanes enable bicyclists to ride comfortably away from moving vehicles, providing a sense of safety that increases bicycling rates

Protected lanes place bicyclists farther away from vehicle exhaust.

Specific Designs for Improving Safety (cont.)

Integrated public transport

Studies suggest that well designed public transit is the safest mode of urban travel.

BRT – Safer mass transit

Well designed BRT/Busway Stations can prevent dangerous traffic movements and improve accessibility and operations.

Specific Designs for Improving Safety (cont.)

Transition Zones

In rural areas, creating land use plans that encourage safe access management along highways, consider town bypasses, and provide for high-speed to low-speed transition zones through towns improves safety.

Transition zone into residential area

Post Crash Care

Road Rangers

Provides traffic incident management response services and highway assistance to motorists to improve highway safety.

Emergency Care

Effective and efficient post-crash care to enhance survivability of crashes by promoting access to emergency medical care.

Discussion

List other road safety best practices that have not been highlighted.

Unique Challenges

Unique mix of vehicular traffic

Unique Challenges (cont.)

Overloaded two-wheelers occupying a large amount of space on the road.

Unique Challenges (cont.)

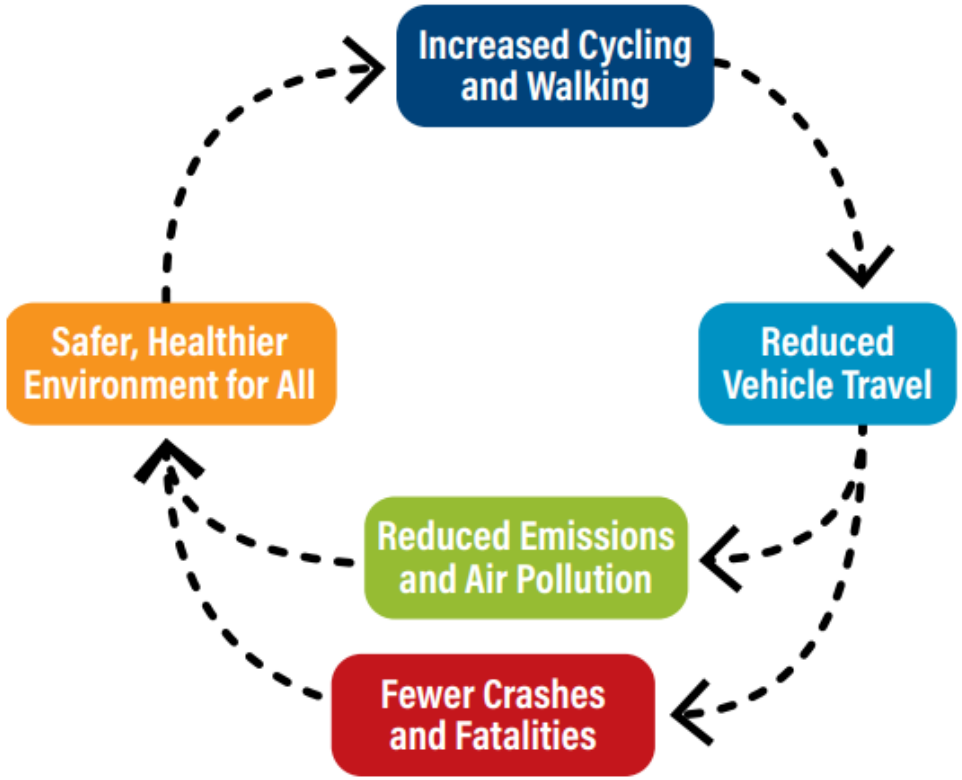
Overwhelming rate of urbanization and growth of informal settlements makes it challenging to implement safe road designs.

Discussion

Given the unique challenges faced by the country, what specific strategies and initiatives have been or could be successful in addressing these challenges, and how can we ensure their sustainability and scalability?

Final Remarks

- A well-designed Safe System can help improve public safety.
- It can help reduce vehicle travel, and green house gas emissions, and increase physical activity, and quality of life.



Environmental and Health Benefits of a Safe Systems Approach

Source: World Resource Institute