

# Evidence GAP MAP

## Road Infrastructure

G.Tiwari

Transportation research and injury prevention program/Civil Engineering  
Department

Indian Institute of Technology Delhi

# Road Designs, Infrastructure and Traffic Control

Road Design & Urban Form

Protective Infrastructure

Speed Control Measures

Bicycles, PTW, Pedestrian  
Paths, Plazas

Traffic Control, Junctions

Work Zones Toll Booths

Parking Policies

Outcomes

Fatal Crashes


Non Fatal Crashes

Change in Speed

# Road Design and Infrastructure: Impact Evaluations & Systematic Reviews

| Impact Evaluations and Systematic Reviews    | Fatal Crashes |    | Non Fatal Crashes |    | Change in Speed |    |
|--|---------------|----|-------------------|----|-----------------|----|
| Road Design and Urban form                   | 11            | 83 | 10                | 83 | 0               | 12 |
| Protective Infrastructure                    | 5             | 15 | 5                 | 14 | 2               | 2  |
| Speed Control Infrastructure                 | 12            | 64 | 11                | 58 | 3               | 58 |
| Bicycle, PTW and Pedestrian Paths and Plazas | 4             | 22 | 4                 | 23 | 1               | 0  |
| Traffic Control and Junctions                | 14            | 80 | 13                | 80 | 2               | 30 |
| Work zones and tollbooths                    | 0             | 6  | 1                 | 6  | 0               | 12 |
| Parking Policies                             | 0             | 1  | 0                 | 1  | 0               | 0  |

 Impact Evaluation Studies

 Systematic Reviews

**Majority studies (SR and Evaluations) for Road design and Urban Forms, Speed Control and Traffic control.**

# Road Design and Infrastructure: LIC+LMIC and UMIC+HIC

| LIC+LMIC and UMIC+HIC                        | Fatal Crashes |   | Non Fatal Crashes |   | Change in Speed |   |
|--|---------------|---|-------------------|---|-----------------|---|
| Road Design and Urban form                   | 83            | 1 | 83                | 1 | 12              | 0 |
| Protective Infrastructure                    | 15            | 0 | 14                | 0 | 2               | 0 |
| Speed Control Infrastructure                 | 63            | 1 | 57                | 1 | 57              | 1 |
| Bicycle, PTW and Pedestrian Paths and Plazas | 22            | 0 | 23                | 0 | 0               | 0 |
| Traffic Control and Junctions                | 80            | 0 | 80                | 0 | 30              | 0 |
| Work zones and tollbooths                    | 0             | 6 | 6                 | 0 | 12              | 0 |
| Parking Policies                             | 1             | 0 | 1                 | 0 | 0               | 0 |

LIC+ LMIC
  UMIC+ HIC

**Studies in LIC+LMICs are missing**

LIC- Low Income Countries, LMIC- Lower Middle Income Countries, UMIC- Upper Middle Income Countries, HIC- High Income Countries

# Road Design and Infrastructure: SA+SAA+LAC+MENA and EAP+ECA+NA

| SA+SAA+LAC+MENA and<br>EAP+ECA+NA            | Fatal Crashes |   | Non Fatal Crashes |   | Change in Speed |   |
|--|---------------|---|-------------------|---|-----------------|---|
| Road Design and Urban form                   | 78            | 5 | 78                | 5 | 12              | 0 |
| Protective Infrastructure                    | 15            | 0 | 14                | 0 | 2               | 0 |
| Speed Control Infrastructure                 | 62            | 2 | 56                | 2 | 56              | 2 |
| Bicycle, PTW and Pedestrian Paths and Plazas | 21            | 1 | 22                | 1 | 0               | 0 |
| Traffic Control and Junctions                | 78            | 2 | 78                | 2 | 30              | 0 |
| Work zones and tollbooths                    | 6             | 0 | 6                 | 0 | 12              | 0 |
| Parking Policies                             | 1             | 0 | 1                 | 0 | 0               | 0 |

SA+SAA+LAC+MENA
  EAP+ECA+NA

**Studies in South Asia and Sub Saharan Africa are missing**

SA- South Asia, SAA- Sub Saharan Africa, LAC- Latin America and Caribbean, MENA- Middle East and North Africa, EAP- East Asia and Pacific, ECA- Europe and Central Asia, NA- North America

# Road Design and Infrastructure: NMT and MT

| NMT and MT                                   | Fatal Crashes |    | Non Fatal Crashes |    | Change in Speed |   |
|--|---------------|----|-------------------|----|-----------------|---|
| Road Design and Urban form                   | 73            | 29 | 79                | 23 | 12              | 3 |
| Protective Infrastructure                    | 15            | 3  | 14                | 3  | 2               | 0 |
| Speed Control Infrastructure                 | 61            | 16 | 55                | 17 | 58              | 5 |
| Bicycle, PTW and Pedestrian Paths and Plazas | 5             | 22 | 6                 | 23 | 0               | 0 |
| Traffic Control and Junctions                | 76            | 43 | 76                | 42 | 29              | 7 |
| Work zones and tollbooths                    | 6             | 1  | 6                 | 1  | 12              | 0 |
| Parking Policies                             | 1             | 1  | 1                 | 1  | 0               | 0 |

 NMT

 MT

NMT- Non-motorized transport, MT- Motorized transport

**More studies evaluating impacts on motorized traffic**

# Road Design and Infrastructure: Urban and Rural

| Urban and Rural                              | Fatal Crashes |    | Non Fatal Crashes |    | Change in Speed |    |
|--|---------------|----|-------------------|----|-----------------|----|
| Road Design and Urban form                   | 39            | 42 | 38                | 41 | 8               | 7  |
| Protective Infrastructure                    | 7             | 5  | 7                 | 5  | 0               | 1  |
| Speed Control Infrastructure                 | 33            | 34 | 28                | 33 | 26              | 35 |
| Bicycle, PTW and Pedestrian Paths and Plazas | 0             | 21 | 0                 | 22 | 0               | 0  |
| Traffic Control and Junctions                | 20            | 64 | 21                | 64 | 11              | 20 |
| Work zones and tollbooths                    | 3             | 2  | 3                 | 2  | 5               | 5  |
| Parking Policies                             | 0             | 1  | 0                 | 1  | 0               | 0  |


 Urban

 Rural

**Impact of Road design and urban form , Speed control measures , and Traffic control most prevalent**

# Road Design and Infrastructure: Open Access and Restricted Access

| Open Access and Restricted Access            | Fatal Crashes |    | Non Fatal Crashes |    | Change in Speed |    |
|--|---------------|----|-------------------|----|-----------------|----|
| Road Design and Urban form                   | 32            | 44 | 32                | 44 | 3               | 9  |
| Protective Infrastructure                    | 3             | 2  | 3                 | 2  | 0               | 1  |
| Speed Control Infrastructure                 | 25            | 37 | 20                | 36 | 22              | 32 |
| Bicycle, PTW and Pedestrian Paths and Plazas | 1             | 21 | 1                 | 22 | 0               | 0  |
| Traffic Control and Junctions                | 8             | 21 | 8                 | 22 | 6               | 0  |
| Work zones and tollbooths                    | 3             | 68 | 3                 | 68 | 7               | 25 |
| Parking Policies                             | 0             | 1  | 0                 | 1  | 0               | 0  |

 Open Access Roads

 Restricted Access Roads

**Studies covering Protective Infrastructure, Junction on Access control and work zones on Access control are missing**



# Transferability of results from HIC to LMICs

## Learnings for Road infrastructure 1(Safety Cube Document)

### Example: Shoulder width

Several studies have found a positive effect of increasing shoulder width on road safety. However, for some circumstances (e.g. injury and property damage only shoulder related crashes on multilane roads) significant negative estimates were found.

- Transferability is questionable since all studies identified were carried out in the United States.
- the year of the study and the evaluation method are the core predictors of the overall estimate. ....recent studies and studies adopting non EB before-after methods are likely to provide lower estimates of crash modification factors.

# Conditions prevailing in LMICs: *are different*

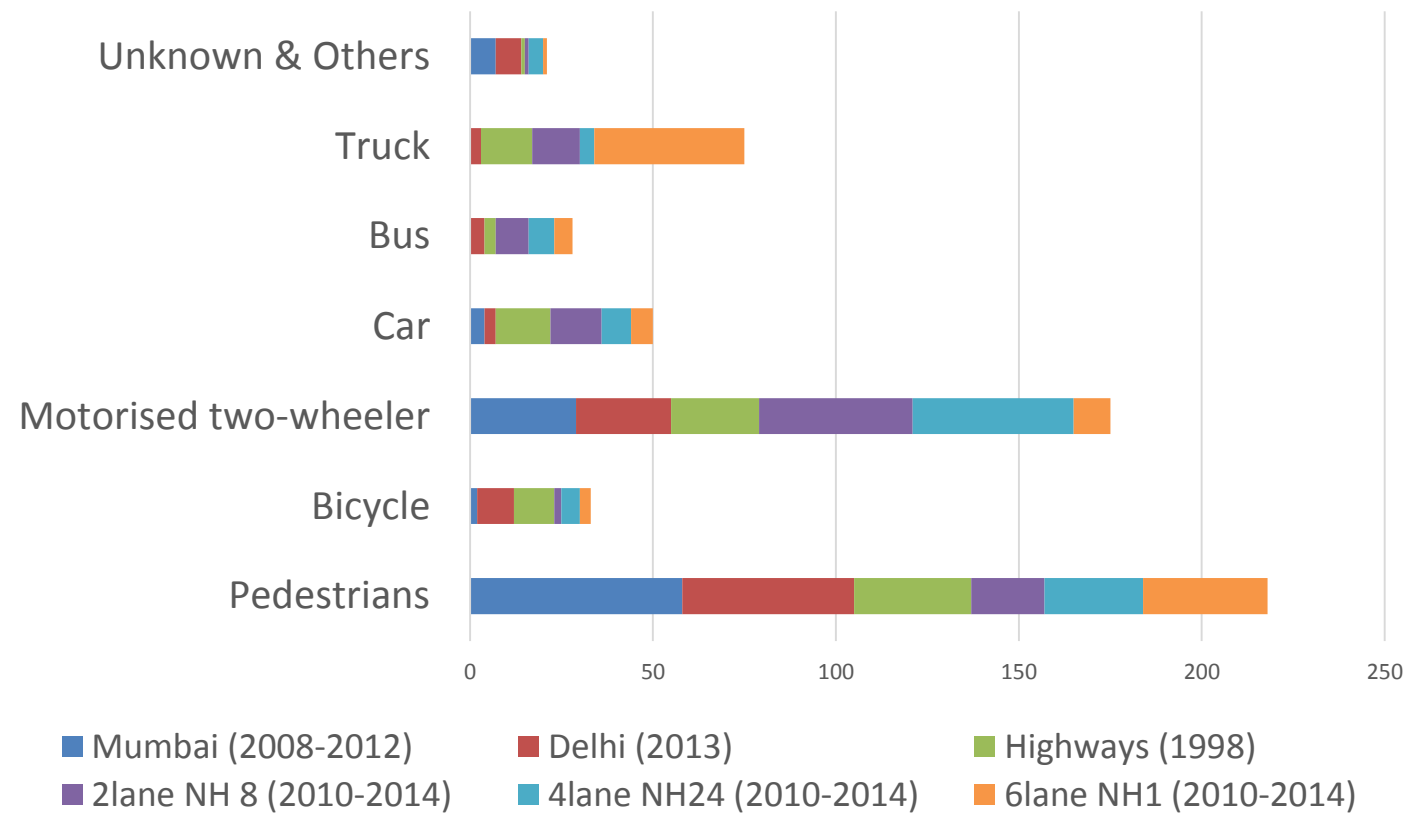
Shoulder used by Slow Vehicles



Shoulder used by non emergency activities

# Traffic movement and crash patterns

- Proportion of pedestrians and MTW in fatalities 20-40%
- Highway shoulders used by parked vehicles, slow moving vehicles(tractors, bicycles, animal carts)
- Right most lane used by heavy vehicles
- Overtaking maneuver from passenger side



# Impact of widening shoulders: LMIC context

## Road Safety Theories(Elvik, 2004)

- Engineering Effect (more space for emergency maneuvers and vehicles recovery)
- Behavioural Adaptation(Higher speed of motorized vehicles, VRU present on shoulders exposed to higher speeds)

# Transferability of results from HIC to LMICs

## Learnings for Road infrastructure 2(Safety Cube Document)

- Example: Raised median

Medians are intended to increase the distance between the driving directions ,to reduce the risk of drivers accidentally getting on the opposite lane. ...medians limit the opportunities to turn or cross the road outside of their openings.

Installation of medians has been shown to reduce the number of road accidents on road segments, with the greatest effect on the most serious accidents. The effect is greatest on control-access roads like motorways (roads without level intersections)

Transferability ?

Overall, since a meta-analysis including 29 studies was found, the topic has been studied to a sufficient extent. Most research was carried out in the United States, Australia, Denmark, Norway, Germany and Malaysia

# Median Type and Design



- Median is raised 200mm from the ground and 6m wide
- Raised medians are hazardous leading to accidents
- Trees, small structures, gantry sign poles and solar panels are on the median
- **IRC – SP-99-2013 section 2.5** does not allow for raised median

# High medians on Access control Roads(India):

responsible for tyre burst and roll over ?  
Impact not quantified



# Way Forward

- Current knowledge of impact of infrastructure designs on road safety is limited to HICs;
- Impact of shoulder designs, median type, service roads, shoulder markings with audible markers have to be studied in Africa, Asia and other LMICs.
- Impact evaluation studies should be made mandatory of all investments by international donors and development agencies.
- New infrastructure standards have to be evolved based on new knowledge production.