Pedestrian Safety Countermeasures Deployment and Evaluation: Las Vegas Case Study

Shashi Nambisan
Director, InTrans & Professor of Civil Engineering
Iowa State University (shashi@iastate.edu)

Srinivas Pulugurtha, The University of North Carolina at Charlotte
Mukund Dangeti, University of Nevada, Las Vegas
Vinod Vasudevan, University of Nevada, Las Vegas

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Goals

• Improve pedestrian safety, minimize risk
• Identify, develop, deploy, and evaluate countermeasures
• Case Study: Las Vegas metro area, Nevada
Introduction

• Significant growth for 20+ years
• Wide, fast street grid network
  ➢ High posted & operational vehicle speeds
• Widely used transit system
• High risk conditions for pedestrians
• Demographics
  ➢ Population ~ 1.8 million
  ➢ Diversity: age, race
• 85 percent of the crashes involved locals
Methodology

• Identify candidate locations
  ➢ GIS based analysis
  ➢ Site characteristics
  ➢ Problem characteristics

• Develop, deploy, & evaluate countermeasures
  • Measures of effectiveness
Study Design

• Before and after Studies
• Comparative studies (with control group)
• Data collection ( ~18,000 pedestrians)
• Statistical analyses
  ➢ Parametric
  ➢ Non-parametric
Study Locations

- Top priority / high risk locations
  - Crash index and crash rank
- Site selection: 18 locations
  - Includes 4 control locations
  - Excluded the resort Corridor (The “Strip” and its proximity)
- Different jurisdictions
  - City of Las Vegas
  - City of North Las Vegas
  - Clark County
  - Nevada Dept of Transportation (State)
Study Locations

Major Streets
High Pedestrian Risk Locations
Control Points
Selection of Countermeasures

• Site characteristics
  ➢ Geometric conditions
  ➢ Operating conditions
  ➢ Light conditions
  ➢ Demographics
  ➢ Land-use

• Costs
Countermeasures

- Engineering based countermeasures
- ITS based countermeasures
- Others
Advanced Warning Signs / Yield Markings
High Visibility Crosswalk Treatment
In-Roadway Knockdown Signs
Portable Speed Trailer
Turning Vehicles Yield to Pedestrians
Danish Offset and Median Refuge
Pedestrian Activated Flashers
Pedestrian Buttons that Confirm “Call”

“Call”
Pedestrian Channelization
ITS No-Turn on Red Blank out Signs
Pedestrian Countdown Timers with Animated Eyes
Measures of Effectiveness / Statistical Tests

- Pedestrian
  - Using the crosswalk
  - Captured / diverted
  - Looking for cars before crossing
  - Trapped in the middle of the street
  - Pedestrian-vehicle Conflicts
  - Pedestrian waiting for signal to cross
  - Delay

- Driver
  - Yielding behavior, distance
  - Blocking crosswalk
  - Speed
Speed Trailer and Vehicle Speeds

Average Speed (mph)

Direction of Traffic

Before
After
54.6 kph 31.5
35.0 50.7 kph
64.3 kph
31.9 51.3 kph
### Speed Trailer: Vehicle Speeds Analysis

<table>
<thead>
<tr>
<th>MOE</th>
<th>Baseline vs. Stage 1</th>
<th>Baseline vs. Stage 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Delta Mean Speed</td>
<td>P-value</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eastbound</td>
<td>5.5 (8.9)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>mph (kmph)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Westbound</td>
<td>6.5 (10.5)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>mph (kmph)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

H₀ : \( V_{\text{before}} = V_{\text{after}} \) vs. \( H_a : V_{\text{after}} < V_{\text{before}} \)
### Speed Trailer: Analysis of Pedestrians

<table>
<thead>
<tr>
<th>(Safety) Measures of Effectiveness</th>
<th>Baseline (Sample = 165)</th>
<th>Stage 1 (Sample = 47)</th>
<th>Stage 2 (Sample = 156)</th>
</tr>
</thead>
<tbody>
<tr>
<td>% pedestrians who look for vehicles before beginning to cross</td>
<td>80</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>% pedestrians who look for vehicles before crossing 2(^{nd}) half of street</td>
<td>85</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>% pedestrians trapped in the roadway</td>
<td>41</td>
<td>34</td>
<td>37</td>
</tr>
</tbody>
</table>
## Highly Effective Countermeasures

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced Yield Markings for Motorists</td>
<td>Low</td>
</tr>
<tr>
<td>In-roadway Knockdown Signs</td>
<td>Low</td>
</tr>
<tr>
<td>Pedestrian Countdown Signals with Animated Eyes</td>
<td>Medium</td>
</tr>
<tr>
<td>Danish Offset</td>
<td>High</td>
</tr>
<tr>
<td>Median Refuge</td>
<td>High</td>
</tr>
<tr>
<td>Portable Speed Trailer</td>
<td>High</td>
</tr>
<tr>
<td>Pedestrian Activated Flashing Yellow</td>
<td>High</td>
</tr>
</tbody>
</table>
## Moderately Effective Countermeasures

<table>
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<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedestrian Call buttons that Confirm Call (Visible/Audible confirmation)</td>
<td>Low</td>
</tr>
<tr>
<td>Turning Vehicles Yield to Pedestrians</td>
<td>Low</td>
</tr>
<tr>
<td>ITS No-Turn on Red Signs</td>
<td>Medium</td>
</tr>
<tr>
<td>ITS Automatic Pedestrian Detection Devices</td>
<td>High</td>
</tr>
</tbody>
</table>
# Countermeasures with Low Effectiveness

## Effectiveness

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warning Signs for Motorists</td>
<td>Low</td>
</tr>
<tr>
<td>High Visibility Crosswalk Treatment</td>
<td>Medium</td>
</tr>
<tr>
<td>Pedestrian Channelization</td>
<td>High</td>
</tr>
<tr>
<td>Smart Lighting</td>
<td>High</td>
</tr>
</tbody>
</table>


Summary

• Significant overall benefits
  ➢ Pedestrian
  ➢ Driver
• Permitting & deployment considerations
• Administrative / jurisdictional hurdles
• Vendor / procurement difficulties
• Education needs: pedestrians, motorists
Acknowledgments

• US Dept of Transp., Federal Highway Admin
• Nevada Dept of Transportation
• Nevada Office of Traffic Safety
• Regional Transp Commission of So. Nevada
• Clark County, Nevada
• City of Las Vegas
• UNLV TRC: students, staff