Pedestrian Safety on Arterial Streets

Dan Goodman  Toole Design
Thomas Hillman  Toole Design
Carey McAndrews  University of Wisconsin
Housekeeping

⇒ Submit your questions

⇒ Webinar archive: www.pedbikeinfo.org/webinars

⇒ Live transcript: https://link.ai.media/session?plink=HSRC

⇒ Certificates and professional development hours

⇒ Follow-up email later today

⇒ Review previous episodes and sign up for upcoming sessions
Today’s Panel

Dan Goodman
Toole Design

Thomas Hillman
Toole Design

Carey McAndrews
University of Wisconsin
Pedestrian Safety on Arterial Streets

June 15, 2021
Webinar Agenda

1. Introduction and overview
2. Health, pedestrian safety, and equity in the context of arterial roads
3. Systemic safety approaches and treatments
4. Q & A + Discussion
5. Where do we go from here?

Photo source: Toole Design Group
Dan Goodman: Piney Branch Road

1. Name an arterial street that is part of your everyday life?
2. Why do you spend time there?
3. What is challenging and what could be done better?

Piney Branch Road, Takoma Park, MD
1. Introduction and Overview

Photo source: Toole Design Group
Pedestrian Safety is an Urgent Problem in the US

US pedestrian deaths have increased by 53% in the past decade

From 2009 to 2018, pedestrian fatalities increased

- 70 percent on principal arterials
- 76 percent on minor arterials

Source: National Highway Traffic Safety Administration, 2019
Arterials are Disproportionately Dangerous for Pedestrians

**US Roadway Miles**
- 13% Non-Interstate Arterial
- 87% Other Roads

**Pedestrian Deaths**
- 41% Non-Interstate Arterial
- 59% Other Roads

Source: Bureau of Transportation Statistics, 2019

Source: Governor’s Highway Safety Administration, 2019
# FHWA Statewide Planning Process Highway Functional Classifications

<table>
<thead>
<tr>
<th>Functional Classification</th>
<th>Distance Served (and Length of Route)</th>
<th>Access Points</th>
<th>Speed Limit</th>
<th>Distance between Routes</th>
<th>Usage (AADT and DVMT)</th>
<th>Significance</th>
<th>Number of Travel Lanes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial</td>
<td>Longest</td>
<td>Few</td>
<td>Highest</td>
<td>Longest</td>
<td>Highest</td>
<td>Statewide</td>
<td>More</td>
</tr>
<tr>
<td>Collector</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Local</td>
<td>Shortest</td>
<td>Many</td>
<td>Lowest</td>
<td>Shortest</td>
<td>Lowest</td>
<td>Local</td>
<td>Fewer</td>
</tr>
</tbody>
</table>

• Assumption is moving many cars quickly
• Creates pedestrian safety problems, especially in areas with many destinations and jobs
Conventional Concept of the Role of Arterials

• The hierarchy of the functional systems consists of principal arterials, minor arterials, collectors, and local roads and streets.

• Roads making up the functional system differ for urban and rural areas.

Graphic source: FHWA
Research Shows Arterial Safety Issues for Pedestrians

In a recent study of the top 34 pedestrian fatality hot spot corridors in the US:

- **Almost all** (97%) are multilane roadways
- 70% require pedestrians to cross five or more lanes
- Over **three quarters** have speed limits of 30 mph or higher
- 62% have traffic volumes over 25,000 vehicles per day
- **Nearly all** had adjacent commercial land uses
- **Three quarters** were bordered by low-income neighborhoods

Common Unsafe Conditions on Arterials

• Lack of sidewalks

• Lack of pedestrian signals and marked crossings

• Intersections with fewer than all crosswalks marked

• Bus stops without sidewalks or marked crossings

• Schools on high-speed arterials

Photos source: Toole Design Group
Lighting and Pedestrian Safety on Arterials

Source: PBIC Toward a Shared Understanding of Pedestrian Safety, 2020
Land Use and Pedestrian Safety

• Land use planning and roadway design are often siloed from each other
• Land use can complicate arterial safety
• Enhanced coordination between transportation and land use decision-making can improve outcomes
• Safer road systems for pedestrians provide appropriate safety designs in all land use contexts
Pedestrian Safety Inequities

- Greater reliance on walking and public transit:
  - People with lower-incomes
  - Older people
  - Youth
  - People with disabilities

- Essential services often located on arterials lacking pedestrian safety infrastructure:
  - Grocery stores
  - Pharmacies
  - Daycares
  - Multifamily housing
  - Senior centers
  - Bus Stops

Photos source: Toole Design Group
Pedestrian Safety Inequities

- Black and Indigenous people have higher pedestrian death rates
- Lower-income neighborhoods have higher pedestrian death rates
- Older pedestrians have higher death rates

Source: National Complete Streets Coalition, Dangerous by Design 2019
Webinar Agenda

1. Introduction and overview
2. Health, pedestrian safety, and equity in the context of arterial roads
3. Systemic safety approaches and treatments
4. Q & A + Discussion
5. Where do we go from here?

Photo source: Toole Design Group
Carey McAndrews: San Pablo Avenue

1. Name an arterial street that is part of your everyday life?
2. Why do you spend time there?
3. What is challenging and what could be done better?

San Pablo Avenue, East Bay, CA
Webinar Agenda

1. Introduction and overview
2. Health, pedestrian safety, and equity in the context of arterial roads
3. Systemic safety approaches and treatments
4. Q & A + Discussion
5. Where do we go from here?
Thomas Hillman: 14th Street NW

1. Name an arterial street that is part of your everyday life?
2. Why do you spend time there?
3. What is challenging and what could be done better?

14th Street NW, Washington, DC
Health, Pedestrian Safety, and Equity in the Context of Arterial Roads

Carey McAndrews, UW–Madison
June 15, 2021 / PBIC Webinar
cmcandrews@wisc.edu

Song of Unity, 1978 [2008].
3105 Shattuck Ave., Berkeley, CA
Artstor
Outline

• Argument: Arterials are high-impact locations to address health, safety, equity

• Highlight two perspectives: 1) mobility-health and 2) place-health

• Share TRB and NCHRP resources about arterials and public health
Premises

• Diversity of arterials across the urban–rural continuum, context matters

• Arterials attract multimodal trips

• Complex and challenging nearly everywhere → significant reach

• High-impact opportunity to have a positive influence on health and equity
Mobility-focused research & practice

High impact 1
Exposure to air pollution and arterials

- Extensive health literature on exposure to vehicle-produced emissions (1–3)
- Not only on freeways but also fresh emissions on arterials (4)
- Smart growth policies (infill) may exacerbate exposure along arterial corridors (5)
- Between 4–19% of the U.S. population lives close to a high-traffic road, more likely to be lower income and minoritized groups

"It's only emission is water vapor."
• To improve health and reduce health disparities

• Manage traffic volume, traffic speed, mix, etc.

• Research seeks to understand these complex relationships, support decision making

Arterials seen through a health lens

Adapted from Human Impact Partners. 2011. I-710 Corridor Project Health Impact Assessment.
Challenge: conflicting goals

- Communities already use traffic operations, ITS, and geometric design → reduce emissions

- Integrated corridor management (NCHRP, 2020), access management, eco driving, eco routing, parking management

- Recommended speeds (45 mph) still too high for pedestrians

- Conflicting goals, need for innovative practice, health impact assessment

Place making research & practice

High impact 2
Livable arterials and networks

Research about living on or near arterials (6–7):

• High traffic roads can be livable places (around 25,000 AADT)

• Can support safe, multimodal access by implementing known strategies

• Amenities—street trees, commercial nodes

• High-traffic neighborhoods need more stewardship, maintenance—pick up trash, deal with vacant storefronts
Social and physical environments of arterials

- Research about arterials finds that pedestrian safety is not limited to injury prevention

- Safety + personal security, and basic services such as keeping streets free of litter, graffiti, drug and alcohol use, prostitution (8)

- Incivilities in industrial areas have been linked to stigma and chronic stress (9)

- An equity issue for women, gender minorities, and minoritized groups
Resources
TRB and NCHRP
Arterials & Health E-Circular 239

- Prepared by TRB Task Force on Arterials and Public Health 2015–2018

- Applies a multi-disciplinary health lens to arterials, contains over 250 research questions

- Cases: metrics, Vision Zero, proximity, retrofitting, land use, technology, models

Research Products

- Communications Guidebook and Tools
- Recorded Overview Presentation
- Presentation Slides with Speaker Notes
- Summary Brochure
- Project Summary Report

Closing thoughts
Arterials and health

- Direct exposure to hazards, pollution, noise
  - Injury
  - Cancer
  - Poor birth outcomes
  - Respiratory disease
  - Cardiovascular disease
  - Chronic stress

- Social aspects of arterials also cause chronic stress and diminish physical activity
  - Community severance, lack of connectivity
  - Litter, graffiti
  - Harassment
  - Perceived as insecure

- 4–19% of the US population lives close to high-traffic road, disproportionately people of color and lower income
Agenda for health, safety, equity on arterials

- **Tradeoffs.** Manage traffic and networks with health, safety, and equity tradeoffs in mind.

- **Livability is possible.** Arterials are multimodal, neighborhood resources and can host amenities that make them more livable (up to a point).

- **Reduce litter, physical decay →** support pride in place and stewardship.

- **Disaggregate data.** Collect and analyze data by gender, race, ethnicity, income, age to the greatest extent possible (surveys, crash data, etc.).
Thank you

Contact:
Carey McAndrews
cmcandrews@wisc.edu
References


3. Systemic Safety Approaches and Treatments

Photo source: Toole Design Group
The Safe System

- People make mistakes
- Bodies are vulnerable
- Deaths or serious injuries not acceptable
- Redundant safety measures create layers of safety
- Infrastructure is key
  - Influences user behavior
  - Alters crash dynamics

Graphic source: FHWA, 2020
Systemic Pedestrian Safety Infrastructure

A systemic approach to pedestrian safety infrastructure implementation identifies many locations for rapid application of safety measures designed to avert severe and fatal crashes—throughout the roadway system.

According to the Federal Highway Administration

“The systemic approach to safety involves widely implemented improvements based on high-risk roadway features correlated with specific severe crash types. The approach provides a more comprehensive method for safety planning and implementation that supplements and complements traditional site analysis. The approach also helps agencies broaden their traffic safety efforts and consider risk as well as crash history when identifying where to make low-cost safety improvements.”

Source: FHWA Systemic Safety Project Selection Tool, 2013

Photo source: Toole Design Group
Vision Zero

Vision Zero Ethical Platform

System Designers
Responsible for safety level in entire system

If road users fail to comply
System designers take new steps to counteract people being killed or seriously injured

Road Users
Responsible for following rules

Graphics source: Vision Zero Network
Complete Streets and Equity on Arterials

• Equity Imperatives:

  • Streets should not pose disproportionate safety burdens
  
  • Pedestrians should be able to reach their destination safely and comfortably
  
  • Income or racial distribution should not influence how likely a person is to die while walking along or crossing a road

Photo source: Toole Design Group
Planning and Design Considerations

• Motor vehicle volumes, speeds, and turning movements

• Roadway crossing width

• Driveway and intersection frequencies

• Transit considerations

• Pedestrian generators and desire lines

• Vulnerable populations

• Pedestrian network characteristics and connectivity gaps

Photo source: Toole Design Group
Which Treatments are Effective?

• Research supports evidence of crash reduction by implementing roadway safety treatments

• Crash reduction estimates do not exist for all treatments, but other research and prior use can indicate safety benefits

• Multiple treatments at the same location often have complementary benefits
## Implementation Options

<table>
<thead>
<tr>
<th></th>
<th>Low-Cost Rapid Treatments</th>
<th>Corridor (Re)construction</th>
<th>Network (Re)design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>Implementation Timeline</td>
<td>Fast</td>
<td>Medium</td>
<td>Slow</td>
</tr>
<tr>
<td>Implementation Effort</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>Safety Benefits</td>
<td>Low to Moderate</td>
<td>Moderate to High</td>
<td>High</td>
</tr>
<tr>
<td>Livability Benefits</td>
<td>Low</td>
<td>Moderate</td>
<td>High</td>
</tr>
</tbody>
</table>
Implementation Challenges

• Arterials are complex environments
  • High traffic volumes
  • Multiple lanes
  • Commercial driveways
  • Bus routes and stops
  • Traffic signals and intersections
• Corridor or network redesigns are required to meet agencies’ pedestrian safety goals
• Transformative safety improvements are high-cost and have long-term implementation timelines
Implementation Solutions

• Interim safety improvements through rapid-implementation projects
  • Quick and less costly
  • Designed to save lives
  • Often help refine capital projects based on real-world use

• Coordination among safety, engineering, asset management, capital program, and other staff to deliver quality facilities

• Systemic safety analysis – improvements throughout the road network at locations most likely to result in a fatality or serious injury

• Agency leadership that prioritizes safety above all other goals
Common Pedestrian Crash Types

Left Turn
Right Turn
Going Straight

Graphics source: NCHRP Research Report 926 Guidance to Improve Pedestrian and Bicyclist Safety at Intersections, 2020
Examples of Left-Turn Pedestrian Safety Treatments

Left-Turn Wedge

Hardened Centerline

Photo source: Toole Design Group

Photo source: NYC DOT
Examples of Right-Turn Pedestrian Safety Treatments

Leading Pedestrian Interval

Corner Radius Reduction

Photo source: Toole Design Group

June 15, 2021
Going Straight Pedestrian Safety Treatments

Rectangular Rapid Flashing Beacon (RRFB)

Pedestrian Hybrid Beacon (PHB)

Crossing Island

Photos source: Toole Design Group
Key Additional Pedestrian Safety Treatments

• Pedestrian Pathways (Sidewalks or Sidepaths)
• Curb Extensions
• High-Visibility Crosswalks
• Lighting
• Pedestrian Signals and Signal Timing (e.g. Protected Phases)
• Pedestrian Hybrid Beacons (PHB)
• Posted Speed Limit (e.g. Target Speeds and School Speed Zones)
• Roundabouts
## Safety Benefits of Common Safety Treatments

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Reduce Speeds</th>
<th>Safer Crossings</th>
<th>Increase Visibility</th>
<th>Reduce Conflicts</th>
<th>Mode Separation</th>
<th>Rural Road Safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicanes / Roadway Curvature</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corner Radius Reduction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crossing Islands</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Curb Extensions / Bulb Outs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gateway Treatments</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hardened Centerlines and Turn Wedges</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High-Visibility Crosswalks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leading Pedestrian Intervals</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lighting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parking Restrictions at Crossing Locations / Daylighting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pedestrian Hybrid Beacons (PHB)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pedestrian Pathways (Sidewalks and Sidepaths)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pedestrian Signals and Signal Timing (e.g. Protected Phases)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posted Speed Limit (Target Speeds and School Speed Zones)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protected Crossing Spacing for Managing Conflicts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protected Phases</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raised Crossings / Raised Intersections</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rectangular Rapid Flashing Beacons (RRFB)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Road Diets and Lane Width Reductions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roundabouts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

June 15, 2021
STEP Studio: Pedestrian Safety Treatment Selection and Application

Includes guidance on:
• Data collection
• Analysis
• Countermeasure selection
• Design and installation considerations
• Implementation
• Monitoring outcomes

Featured Transformative Treatment: Road Diets

- Road diets reduce the number or width of travel lanes
- Multiple pedestrian safety benefits:
  - Shorter crossing distances
  - Speed management
- Create space for pedestrian facilities:
  - Crossing islands
  - Curb extensions
  - Sidewalks - with physical buffers

Graphic source: FHWA, 2008
Case Study: Protected Intersections

• Protected intersections use floating curbs to improve safety for all road users

• Multiple pedestrian safety benefits:
  • Slow through and turn speeds
  • Channelize turns
  • Shorten crossing distance
  • Can be used with crossing islands

Graphic source: NHTSA, 2020
4. Questions & Answers + Discussion

Photo source: Toole Design Group
5. Where do we go from here?
Key Resources

- USDOT Equity Information and Resources
- FHWA Zero Deaths and Safe Systems Resources
- FHWA Office of Safety: Pedestrian and Bicycle Safety
- FHWA Safe Transportation for Every Pedestrian (STEP)
- NCHRP Research Report 926: Guidance to Improve Pedestrian and Bicyclist Safety at Intersections
- FHWA Toolbox of Pedestrian Safety Countermeasures and Their Potential Effectiveness

Photo source: Toole Design Group
Thank You!

Photo source: Toole Design Group
Discussion

➔ Send us your questions

➔ Follow up with us:
  ➔ Dan Goodman  dgoodman@tooledesign.com
  ➔ Thomas Hillman  thillman@tooledesign.com
  ➔ Carey McAndrews  cmcandrews@wisc.edu
  ➔ General Inquiries  pbic@pedbikeinfo.org

➔ Archive at www.pedbikeinfo.org/webinars