



**Pedestrian and Bicycle
Information Center**

Pedestrian Safety on Arterial Streets

Dan Goodman Toole Design

Thomas Hillman Toole Design

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Today's Panel



Dan Goodman
Toole Design



Thomas Hillman
Toole Design



Carey McAndrews
University of
Wisconsin



**Pedestrian and Bicycle
Information Center**

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?



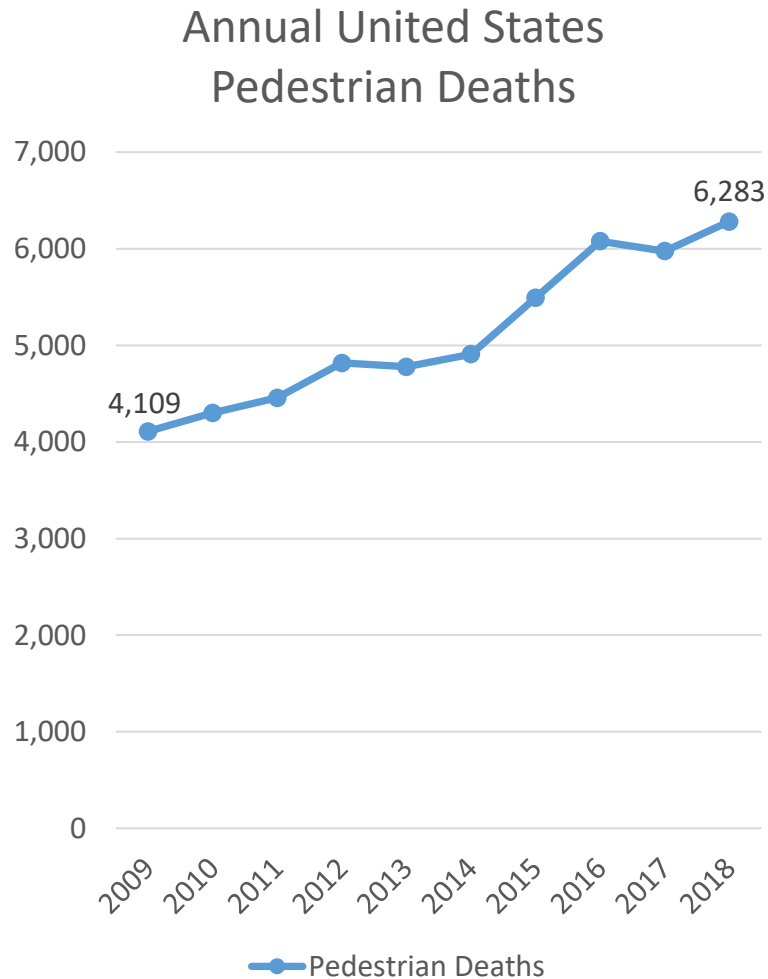
Piney Branch Road, Takoma Park, MD

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

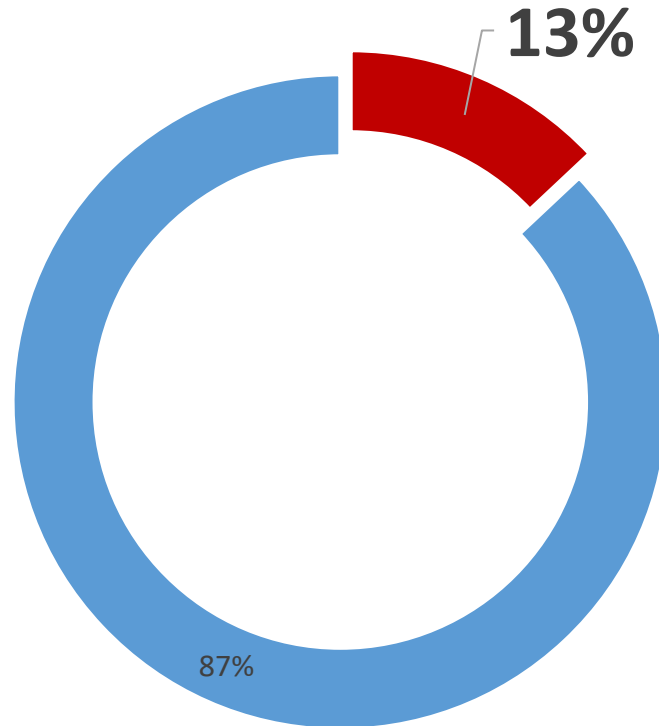
From 2009 to 2018, pedestrian fatalities **increased**

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

Source: National Highway Traffic Safety Administration, 2019

Arterials are Disproportionately Dangerous for Pedestrians

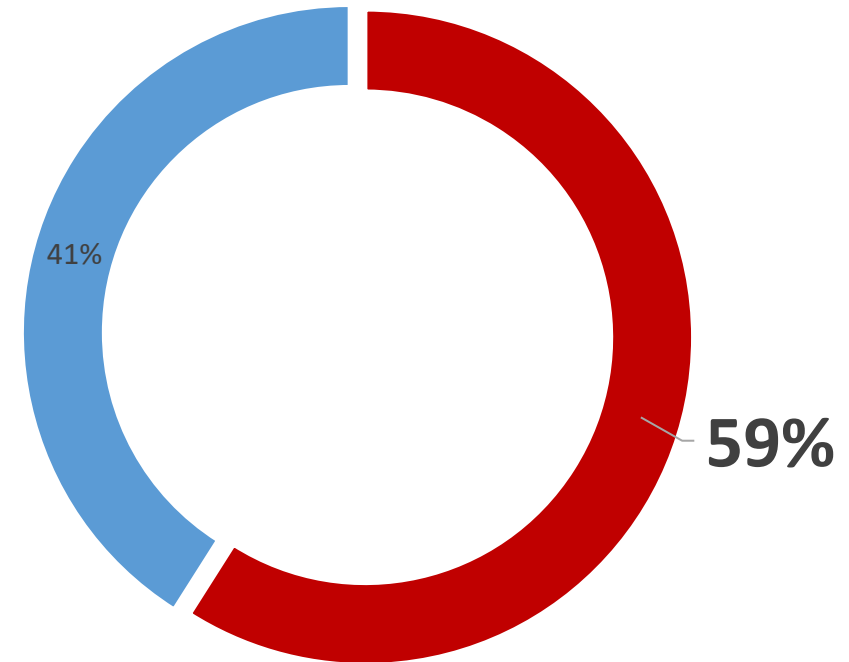
US Roadway Miles



■ Non-Interstate Arterial ■ Other Roads

Source: Bureau of Transportation Statistics, 2019

Pedestrian Deaths



■ Non-Interstate Arterial ■ Other Roads

Source: Governor's Highway Safety Administration, 2019

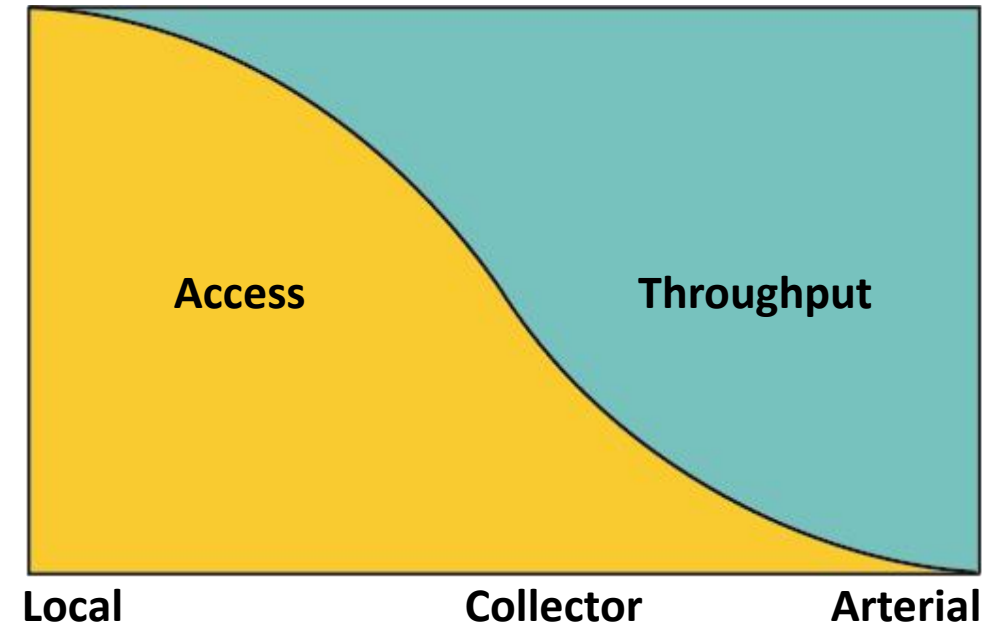
FHWA Statewide Planning Process Highway Functional Classifications

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

- 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**

Source: Schneider, Sanders, and Proulx. 2020. *United States Fatal Pedestrian Crash Hot Spot Locations and Characteristics*. Transportation Research Board Annual Meeting, 2020. Manuscript Number: 20-02402

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

No marked crossing opportunity



No sidewalk near bus stop



No crosswalk near bus stop

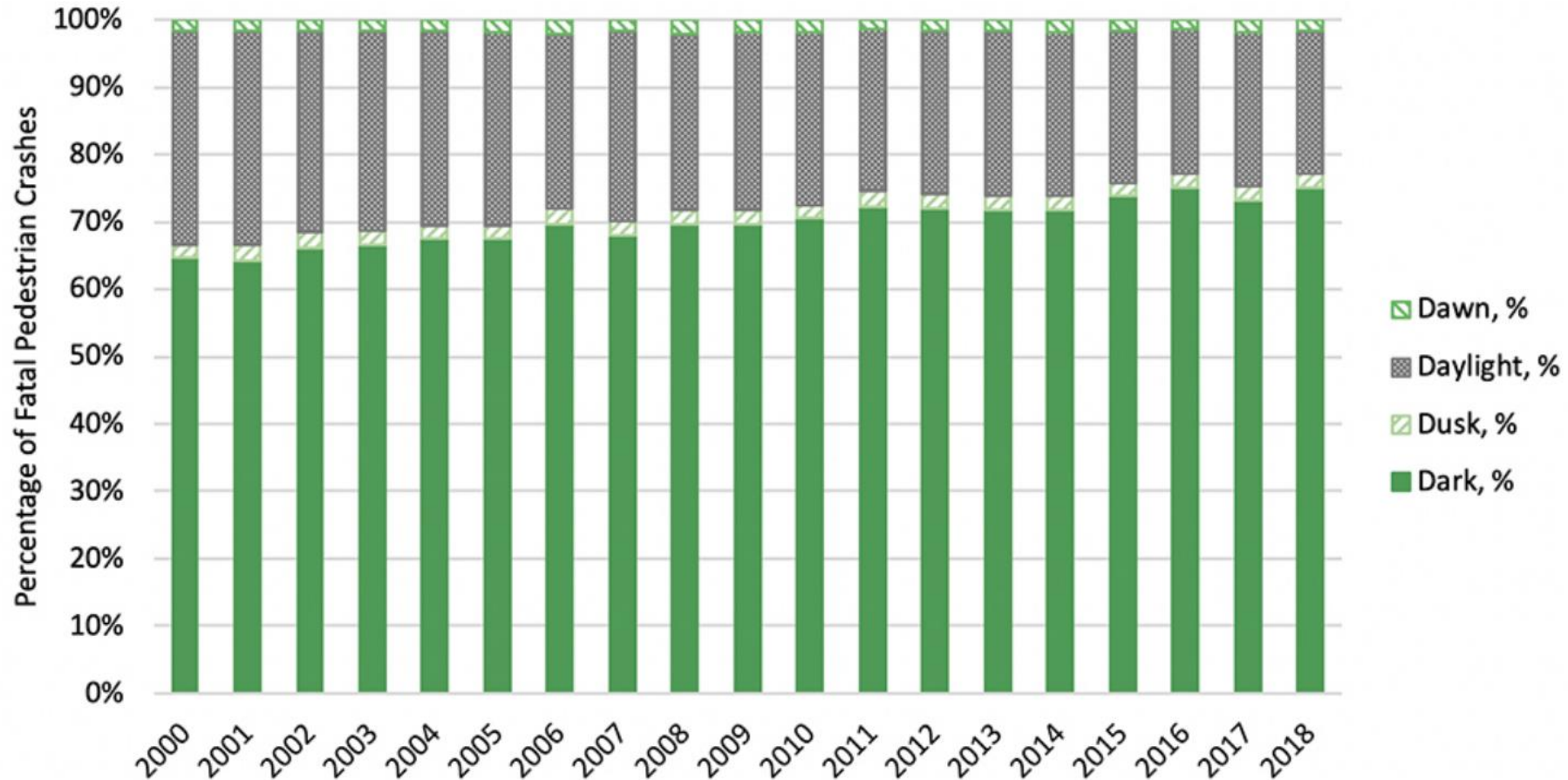


No pedestrian facilities near school



Photos source : Toole Design Group

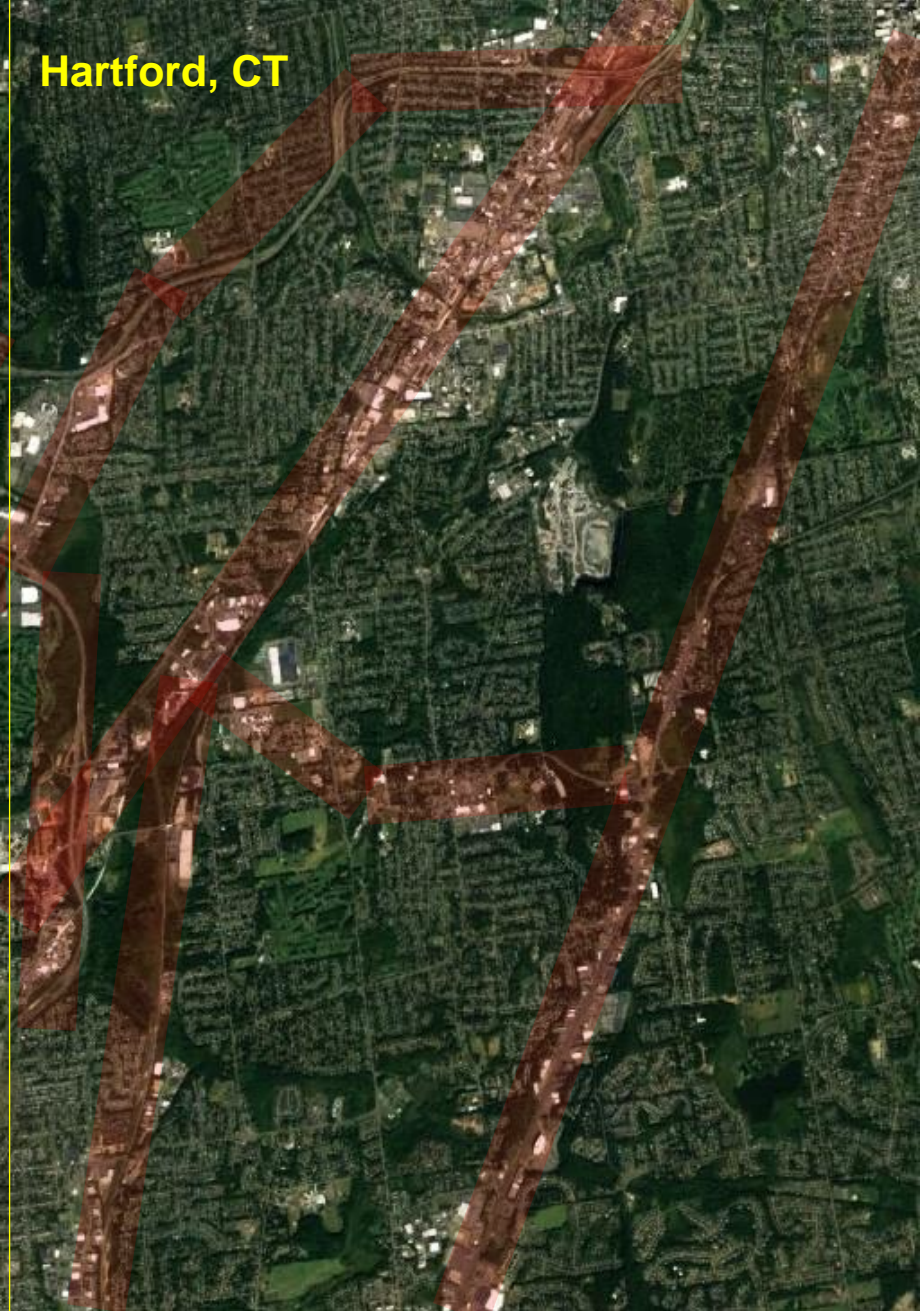
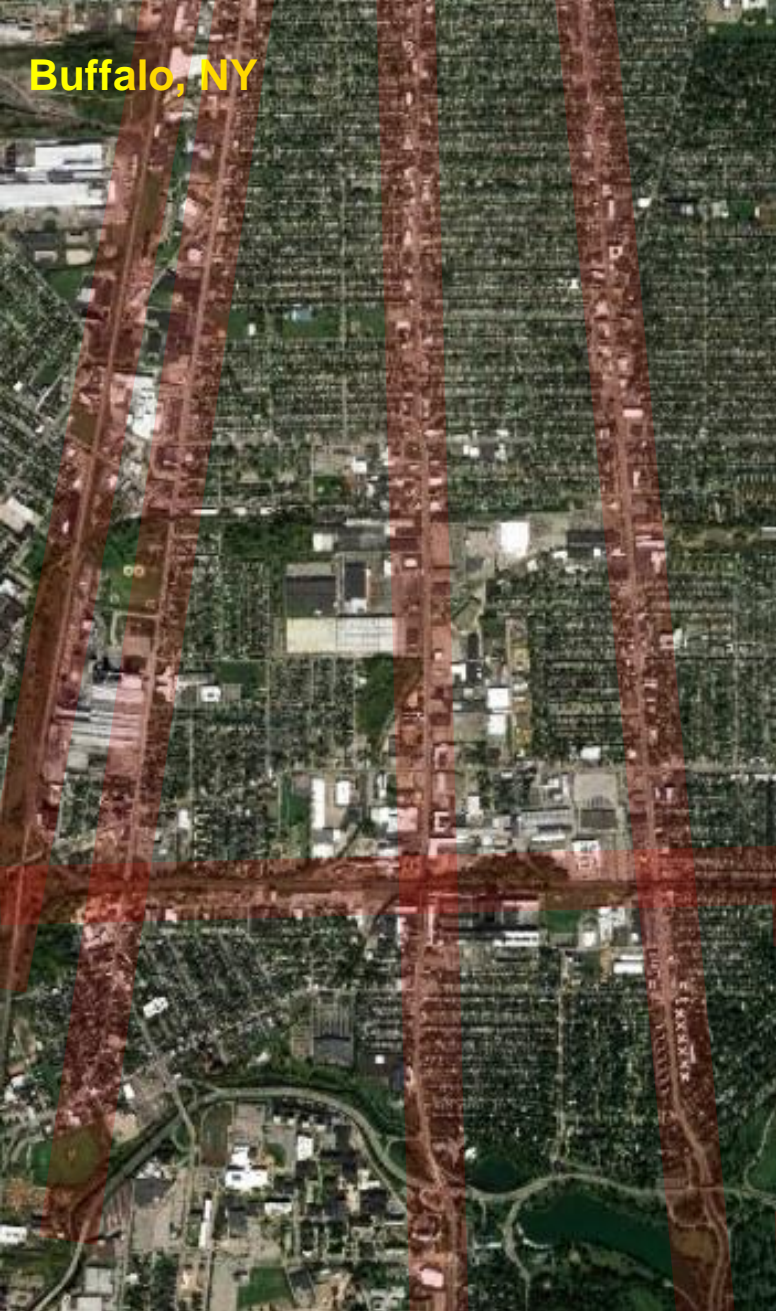
Lighting and Pedestrian Safety on Arterials



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

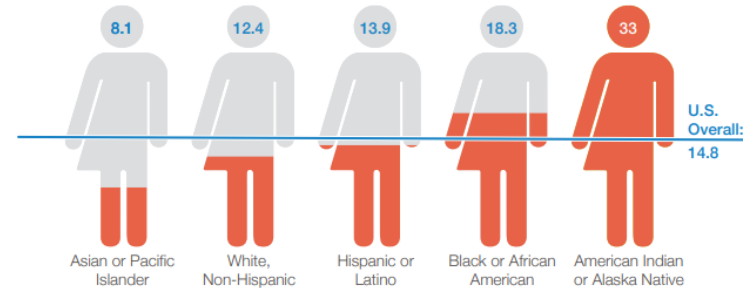


Photos source: Toole Design Group

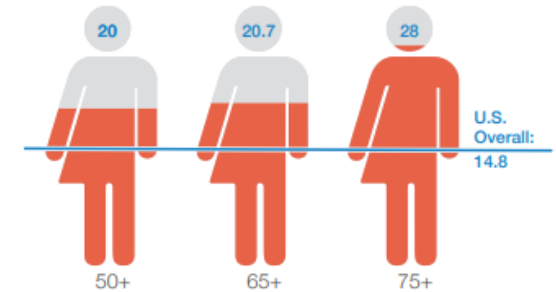
Pedestrian Safety Inequities

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

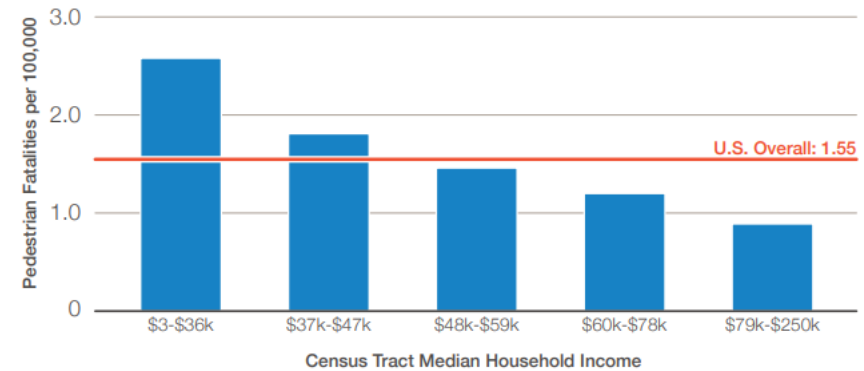
Relative Pedestrian Danger by Race and Ethnicity (2008-2017)



Relative Pedestrian Danger by Age (2008-2017)



Location of Pedestrian Fatalities by Neighborhood Income



Source: National Complete Streets Coalition, Dangerous by Design 2019

Webinar Agenda

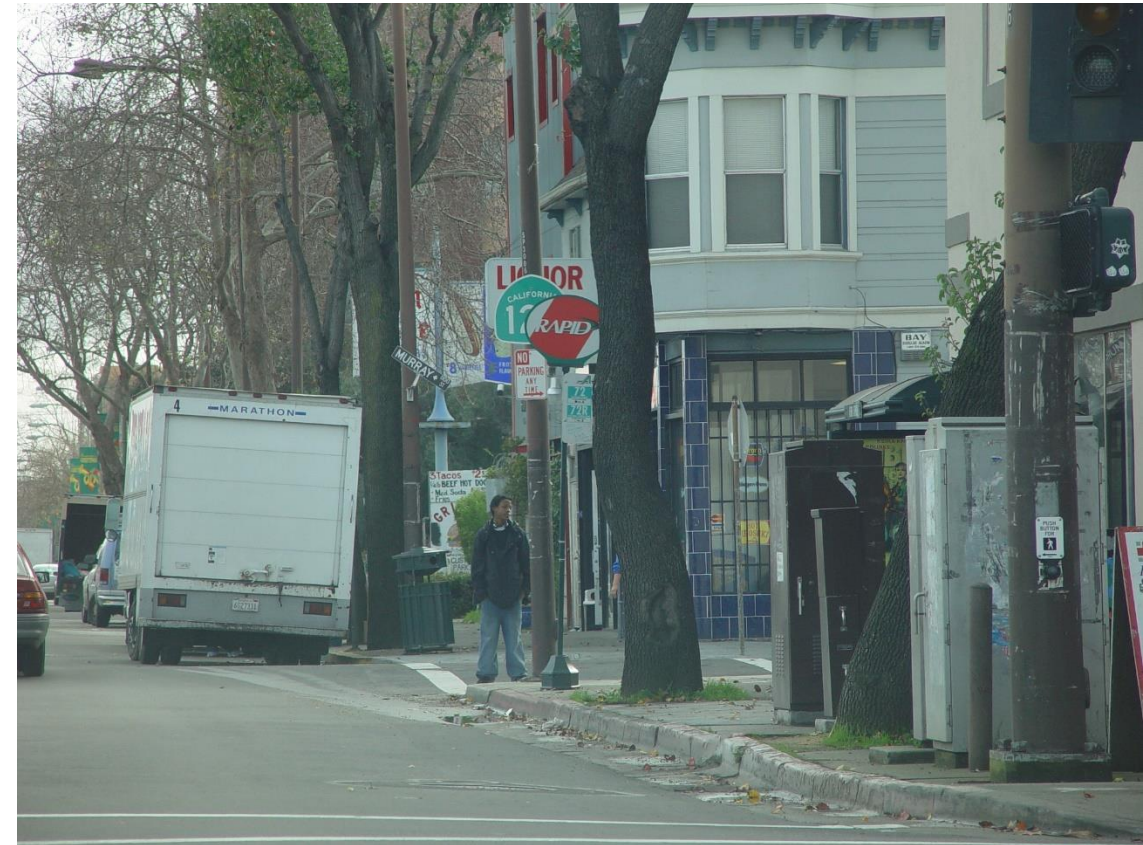
1. Introduction and overview
2. **Health, pedestrian safety, and equity in the context of arterial roads**
3. Systemic safety approaches and treatments
4. Q & A + Discussion
5. Where do we go from here?



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

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Photo source: Toole Design Group

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

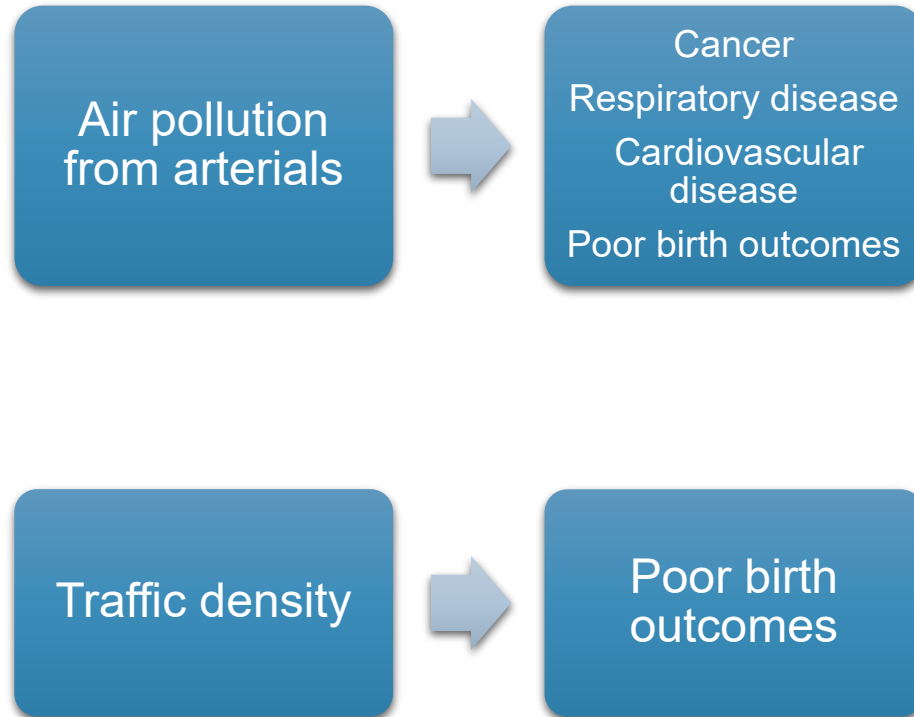


Colfax Avenue, Denver, CO, 2013.

Mobility-focused research & practice

High impact 1

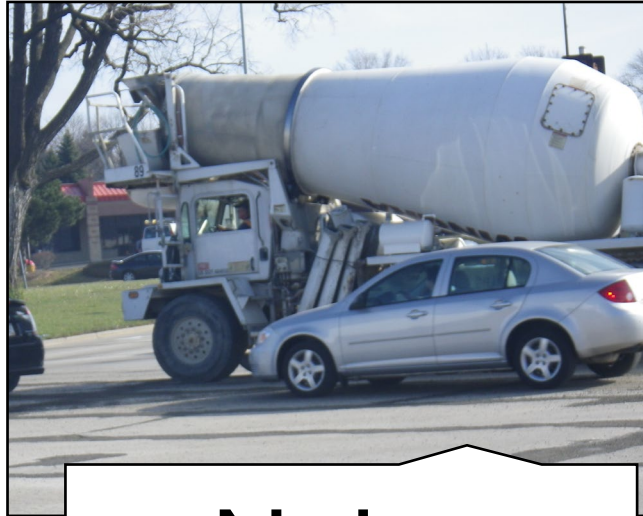
Exposure to air pollution and arterials



- 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."



Noise



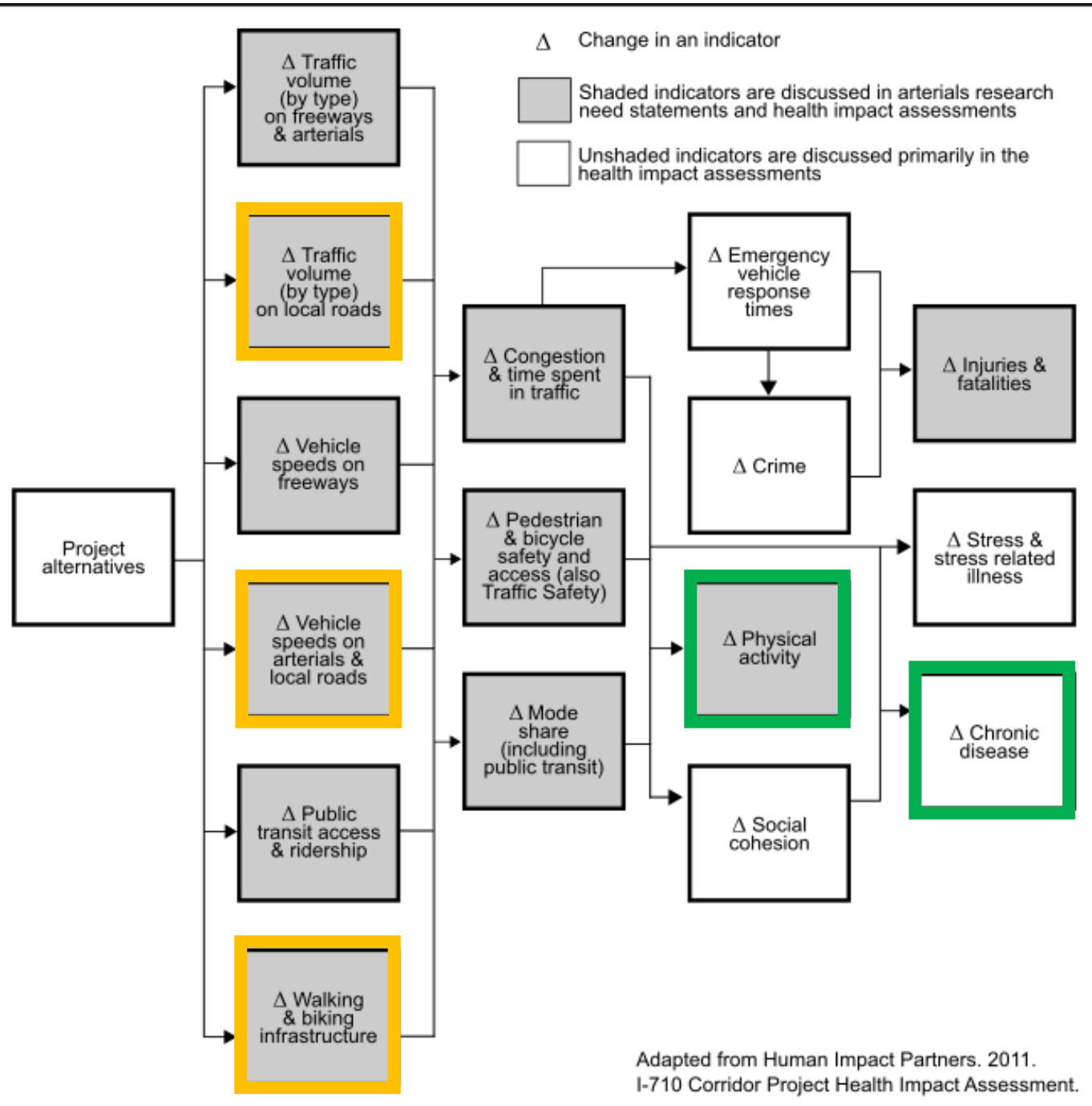
Safety



Barriers

Source: McAndrews et al. "Understanding and improving arterial roads to support public health and transportation goals." *American journal of public health* 107, no. 8 (2017): 1278–1282. <https://doi.org/10.2105/AJPH.2017.303898>

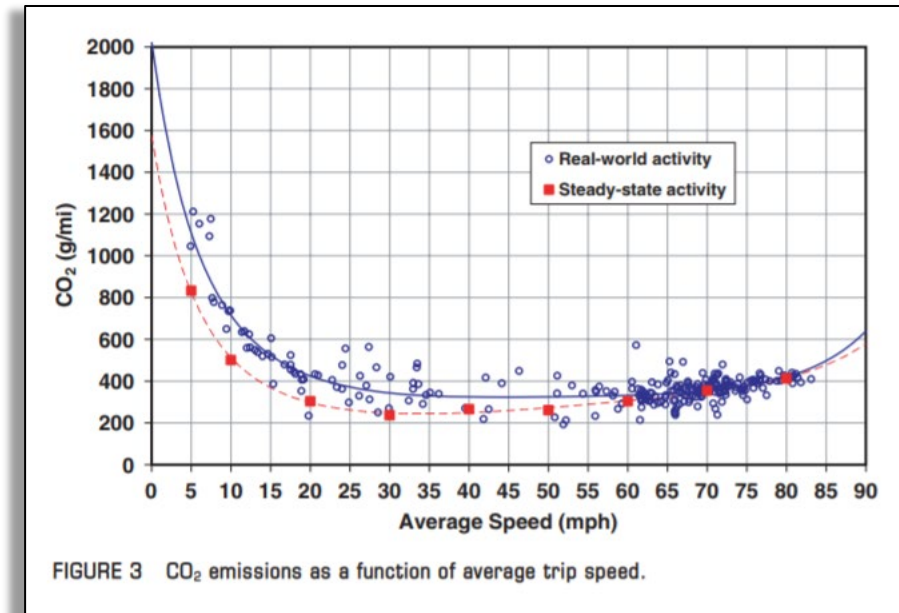
Arterials seen through a health lens



- Manage traffic volume, traffic speed, mix, etc.
- To improve health and reduce health disparities
- Research seeks to understand these complex relationships, support decision making

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



Barth, M., & Boriboonsomsin, K. 2008. Real-world carbon dioxide impacts of traffic congestion. *Transportation Research Record: Journal of the Transportation Research Board*, 2058, 163-171.

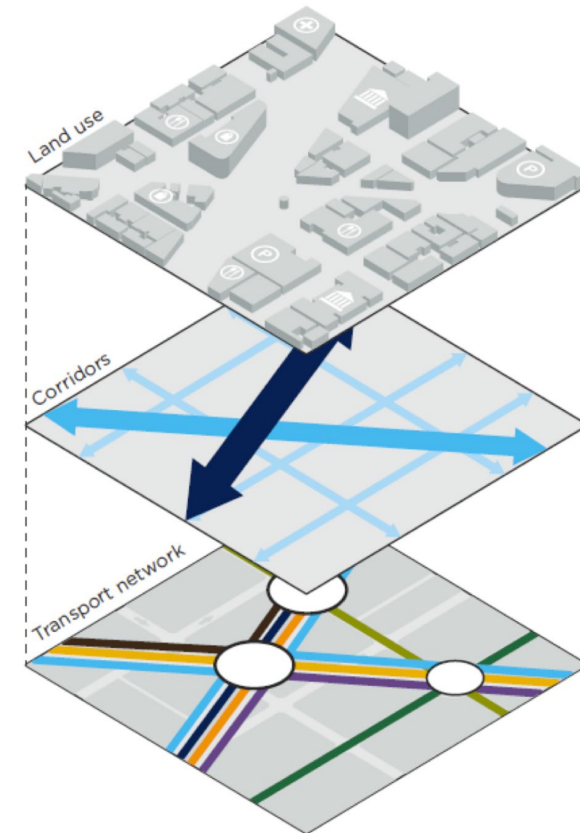
Place making research & practice

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



Transport for New South Wales.



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

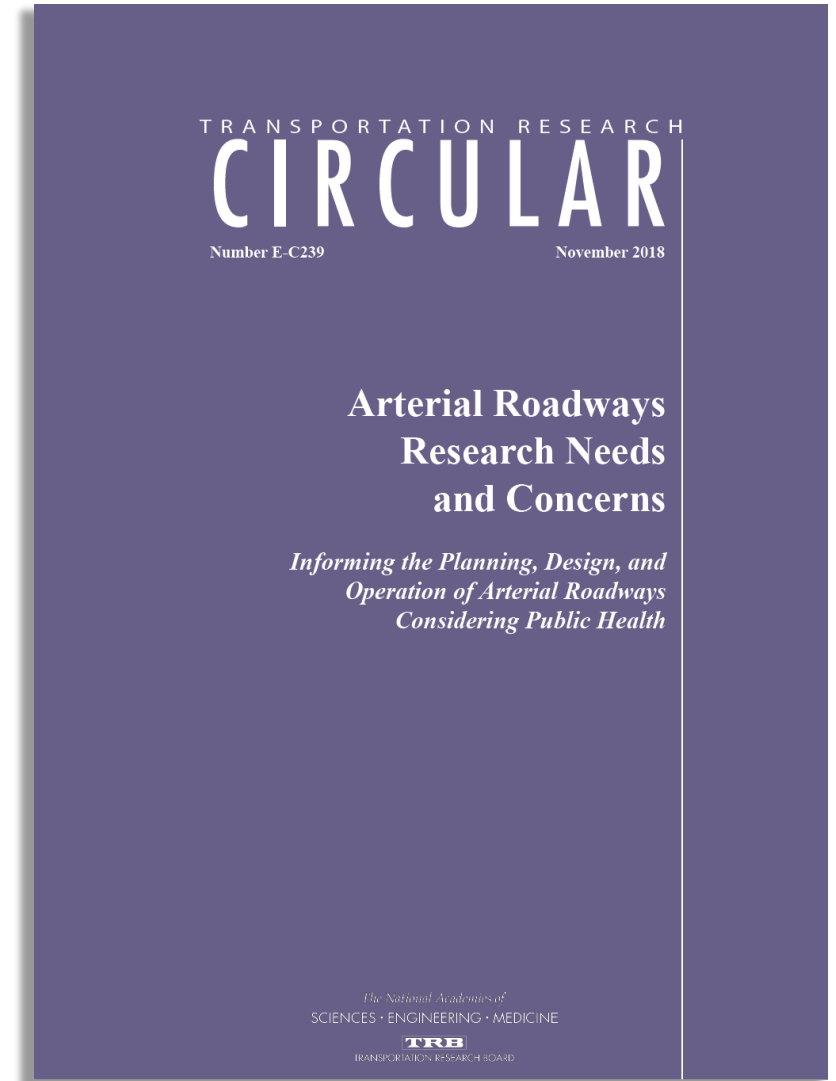


Resources

TRB and NCHRP

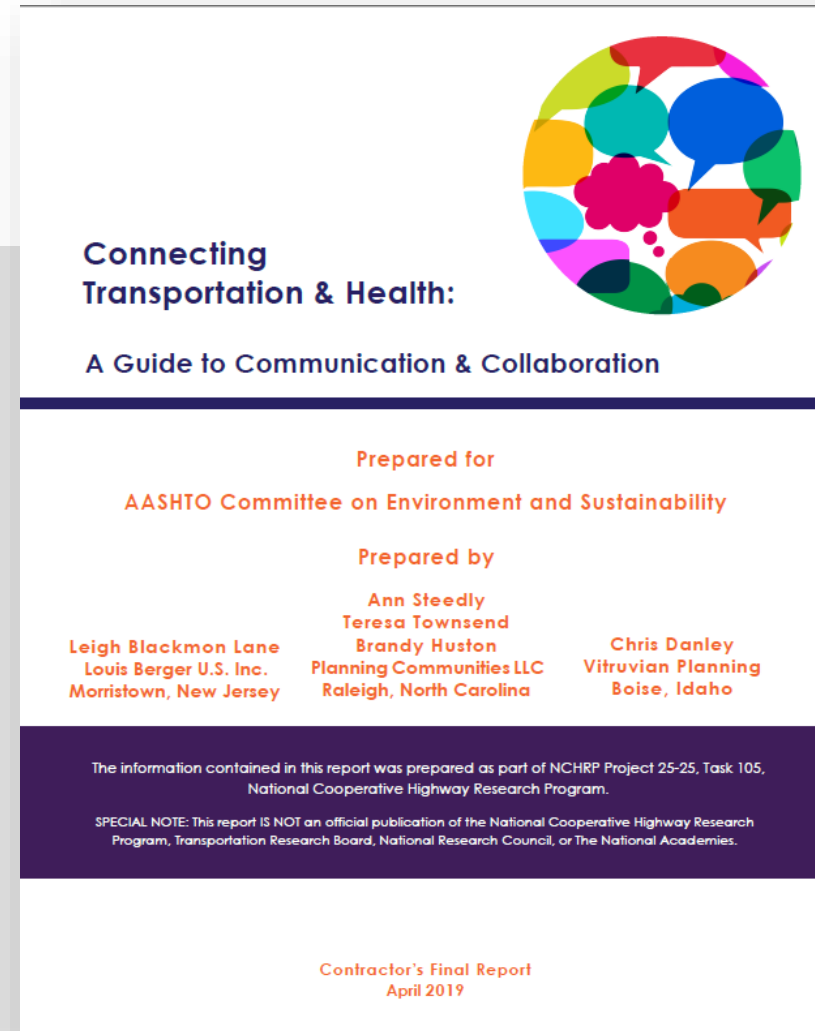
Arterials & Health E-Circular 239

- 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
- <http://onlinepubs.trb.org/onlinepubs/circulars/ec239.pdf>



Research Products

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



<http://bit.ly/TransportationHealthCommunicationsGuidebook>

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

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1. Landrigan PJ. Air pollution and health. *Lancet Public Health*. 2017;2(1):e4–e5.
2. Wilhelm M, Ghosh JK, Su J, et al. Traffic-related air toxics and term low birth weight in Los Angeles County, California. *Environ Health Perspect*. 2012; 120(1):132–138.
3. Pedersen M, Giorgis-Allemand L, Bernard C, et al. Ambient air pollution and low birthweight: a European cohort study (ESCAPE). *Lancet Respir Med*. 2013; 1(9):695–704.
4. Baldauf, R., Watkins, N., Heist, D. et al. Near-road air quality monitoring: Factors affecting network design and interpretation of data. *Air Qual Atmos Health* 2, 1–9 (2009).
5. Garzón C, Dominie W, Gordon M. Pollution-free housing for all: coalition-based research, education, and advocacy for healthier housing in transportation and land use planning in the San Francisco Bay Area. *Environ Justice*. 2014;7(6):186–190.
6. McAndrews, C., Marshall, WE. Livable Streets, Livable Arterials? Characteristics of Commercial Arterials Associated with Neighborhood Livability. *Journal of the American Planning Association*, 2018, 84(1), 33–44.
7. Marshall, Wesley E., Carolyn McAndrews. Understanding Livable Streets in the Context of the Arterials that Surround Them, *Transportation Research Record*, 2017, 2605, 1–17.
8. Loukaitou-Sideris A. Inner-city commercial strips: evolution, decay—retrofit? *Town Plan Rev*. 1997;68(1):1–29.
9. Kondo MC, Gross-Davis CA, May K, et al. Place-based stressors associated with industry and air pollution. *Health Place*. 2014;28:31–37.

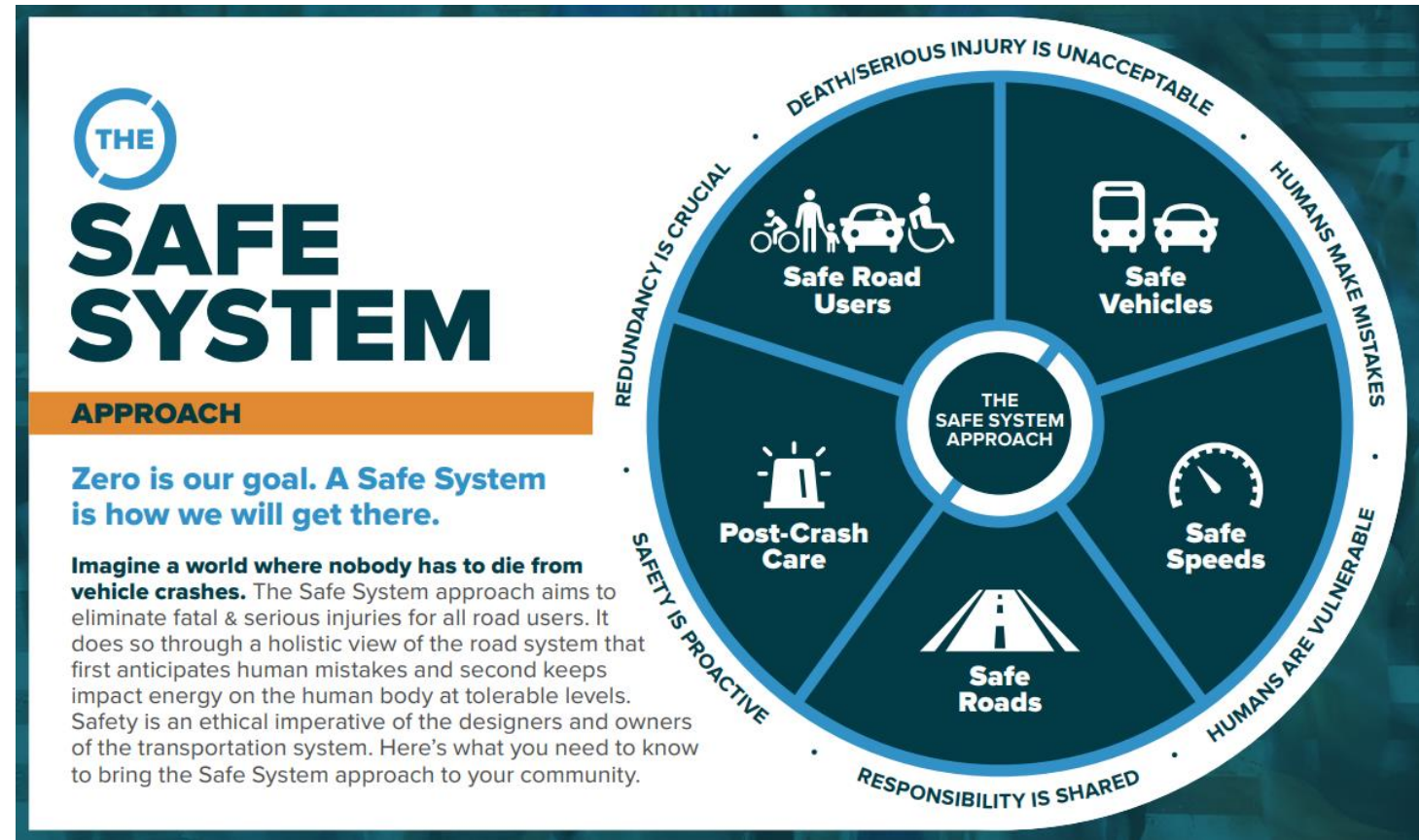
3. Systemic Safety Approaches and Treatments



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

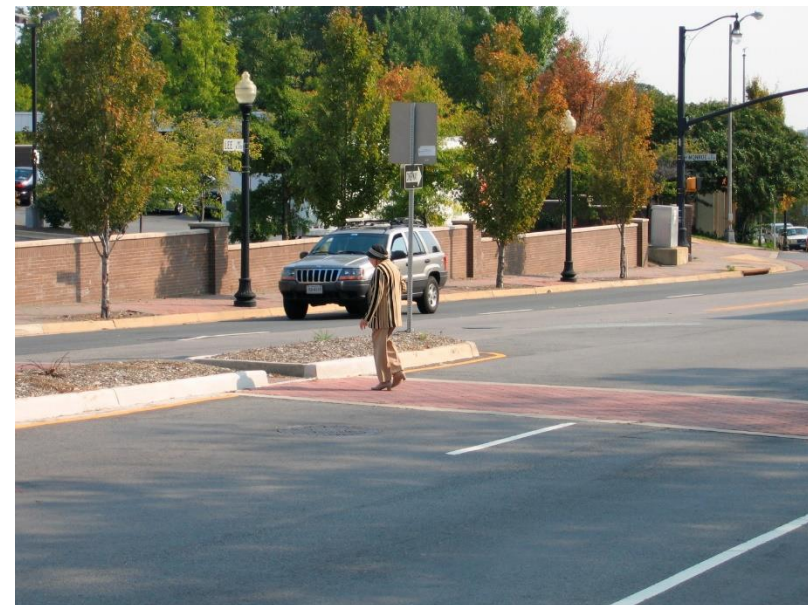


Photo source: Toole Design Group

Vision Zero



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

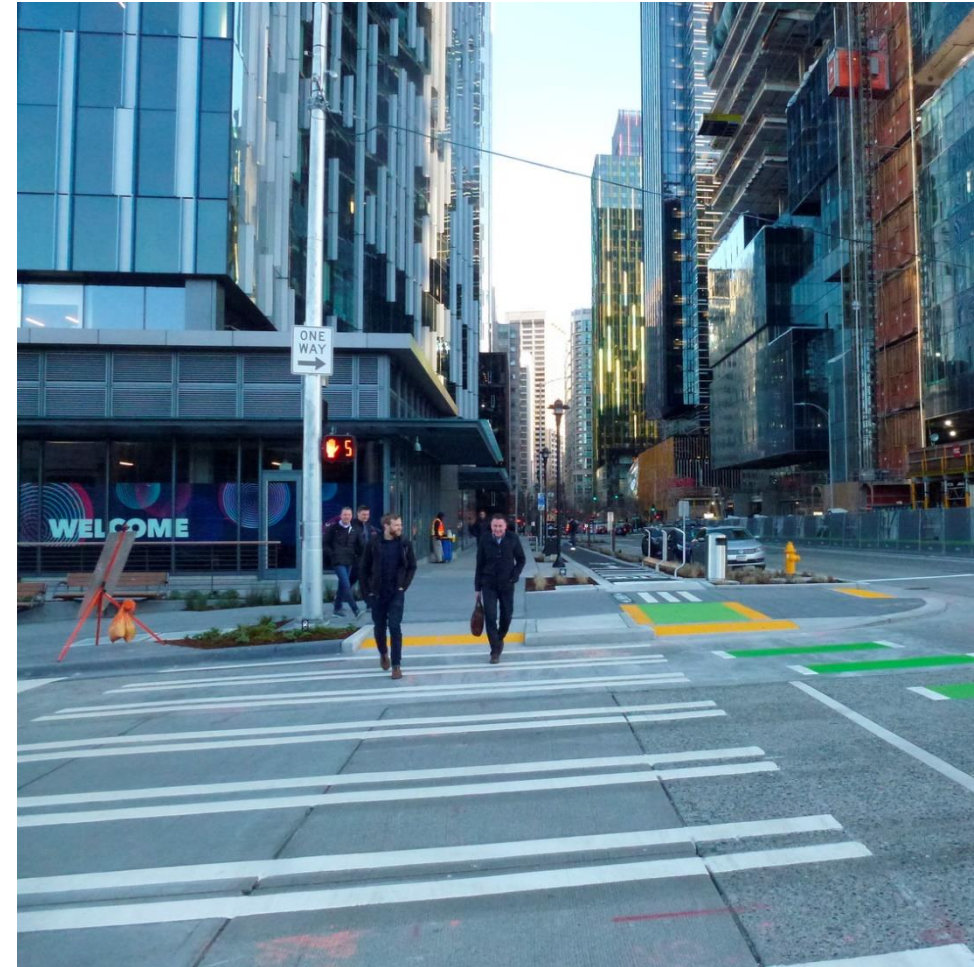


Photo source: Toole Design Group

Implementation Options

Low-Cost
Rapid
Treatments

Corridor
(Re)construction

Network
(Re)design



Cost	Low	Medium	High
Implementation Timeline	Fast	Medium	Slow
Implementation Effort	Low	Medium	High
Safety Benefits	Low to Moderate	Moderate to High	High
Livability Benefits	Low	Moderate	High

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

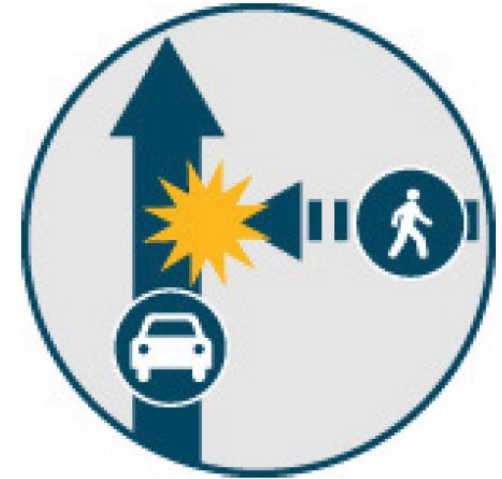
Common Pedestrian Crash Types



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



Photo source: Toole Design Group

Left-Turn Wedge



Photo source: NYC DOT

Hardened Centerline



Examples of Right-Turn Pedestrian Safety Treatments



Photo source: Toole Design Group

Leading Pedestrian Interval



Photo source: Toole Design Group

Corner Radius Reduction



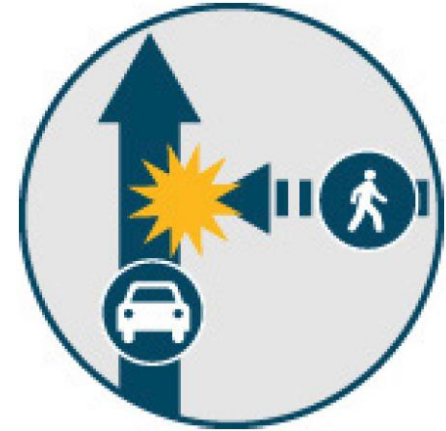
Going Straight Pedestrian Safety Treatments



Rectangular Rapid Flashing Beacon (RRFB)



Pedestrian Hybrid Beacon (PHB)



Photos source: Toole Design Group

Crossing Island

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

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

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?



Photo source: Toole Design Group

Resources



The Crash Modification Factors Clearinghouse provides a searchable database of CMFs along with guidance and resources on using CMFs in road safety practice.

ENTER SEARCH TERMS...

Countermeasure Name SEARCH

FREQUENT SEARCHES: ROUNDABOUT | SIGNAL | PEDESTRIAN | SHOULDER | TSMO | BROWSE ALL

WHAT ARE CMFs?

A crash modification factor (CMF) is used to compute the expected number of crashes after implementing a countermeasure on a road intersection.

[LEARN MORE](#)

GETTING STARTED

Learn more about how to use this site in our User Guidebook.

STATE CMF LISTS

See the CMFs that various states have decided to use as a starting point to improve their communities.

PEDSAFE Pedestrian Safety Guide and Countermeasure Selection System

Guide: Background | Statistics | Analysis | Implementation | Countermeasures: List | Tool | Matrices | Case Studies | Resources

The Pedestrian Safety Guide and Countermeasure Selection System is intended to provide practitioners with the latest information available for improving the safety and mobility of those who walk. The online tools provide the user with a list of possible engineering, education, or enforcement treatments to improve pedestrian safety and/or mobility based on user input about a specific location.

GUIDE

Background
Understand what is needed to create a viable pedestrian system.

Analysis
How crash typing can lead to the most appropriate countermeasures.

Implementation
Needed components for treatments.

Statistics
Learn about the factors related to the pedestrian crash problem.

COUNTERMEASURES

Selection Tool
Find countermeasures based on desired objectives.

Selection Matrices
Find countermeasures based on crash types and performance objectives.

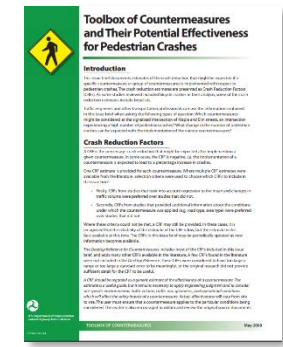
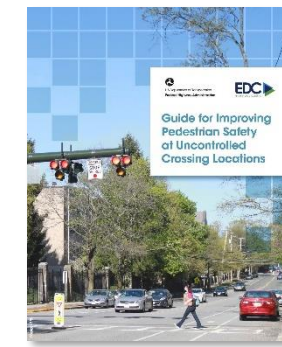
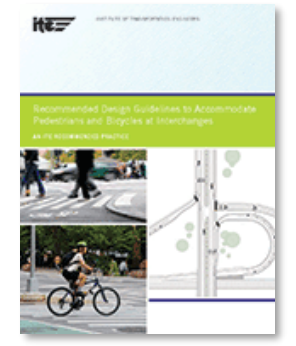
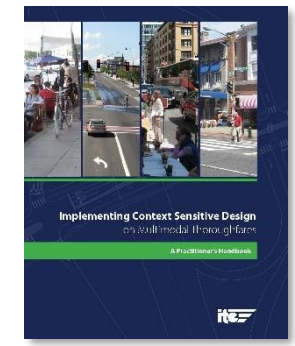
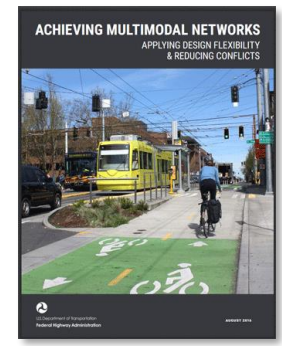
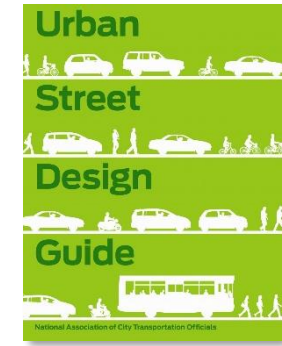
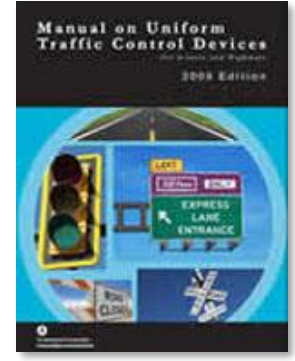
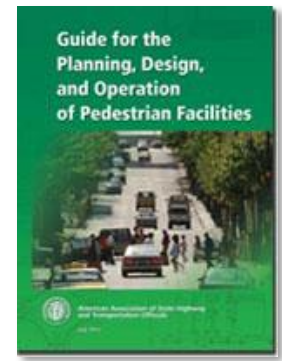
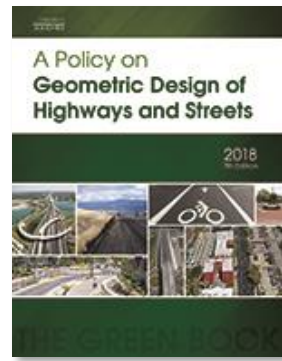
Countermeasure List
A comprehensive list of all countermeasures.

CASE STUDIES

RESOURCES & GUIDELINES

Authors and Acknowledgements

U.S. Department of Transportation
Federal Highway Administration



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**

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