Safety Issues Related to e-Scooters

Takeaways from the Behavioral Traffic Safety Cooperative Research Program, BTS-10 Project, and Related Efforts

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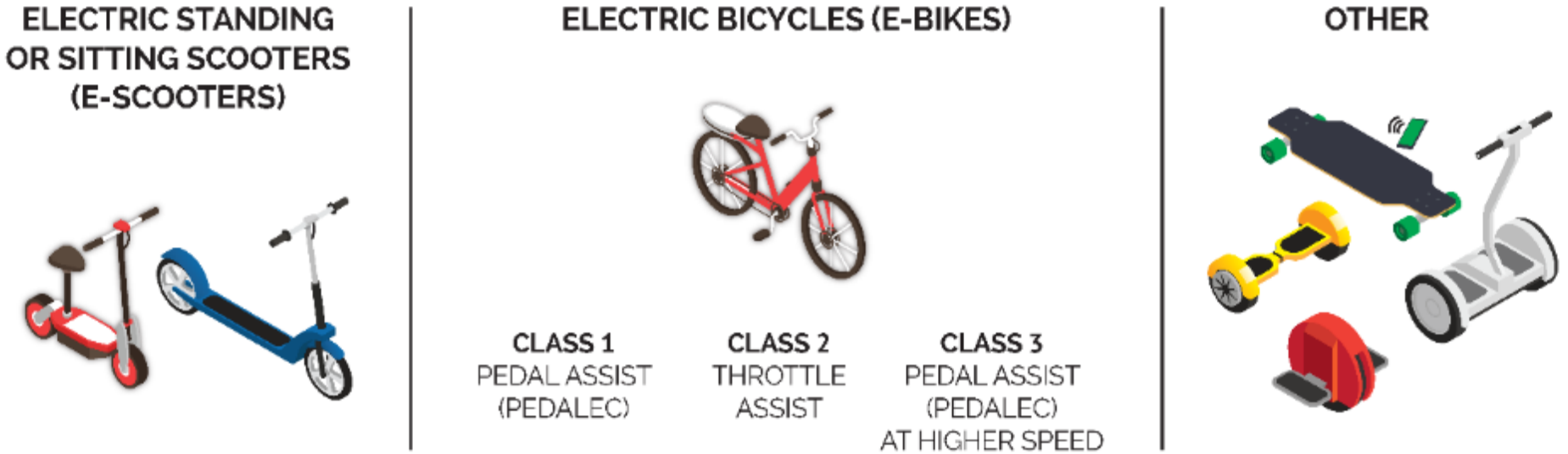
Background

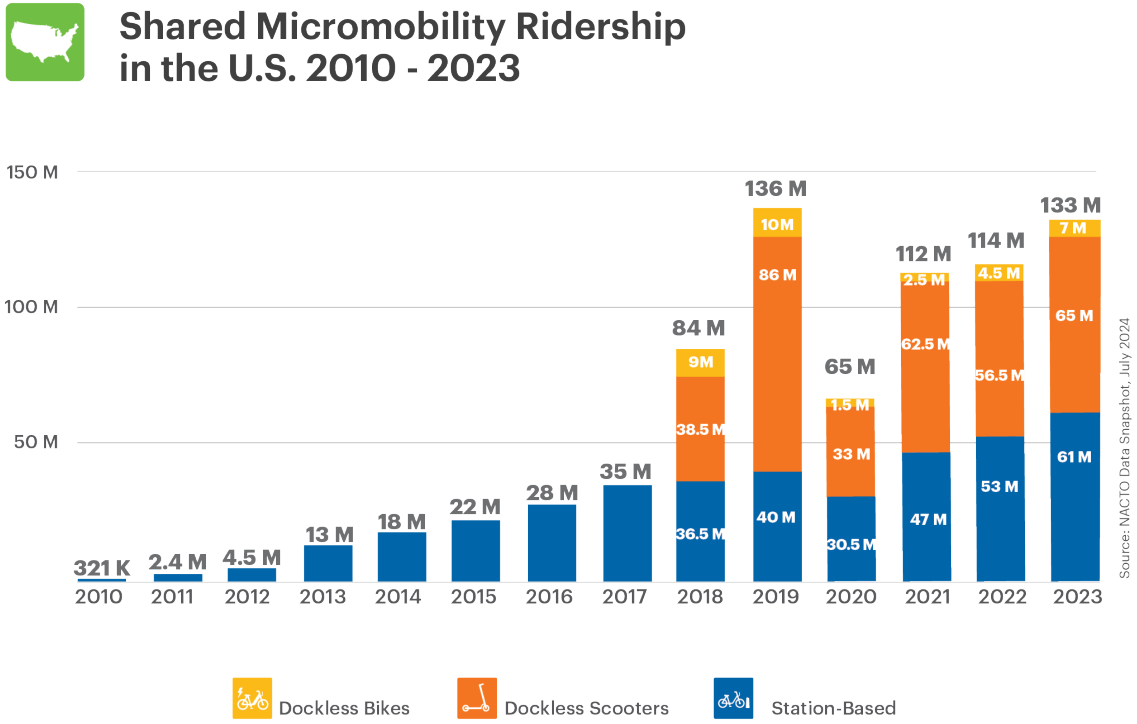
- E-scooters are a form of powered micromobility



Source: BTS-10 project team

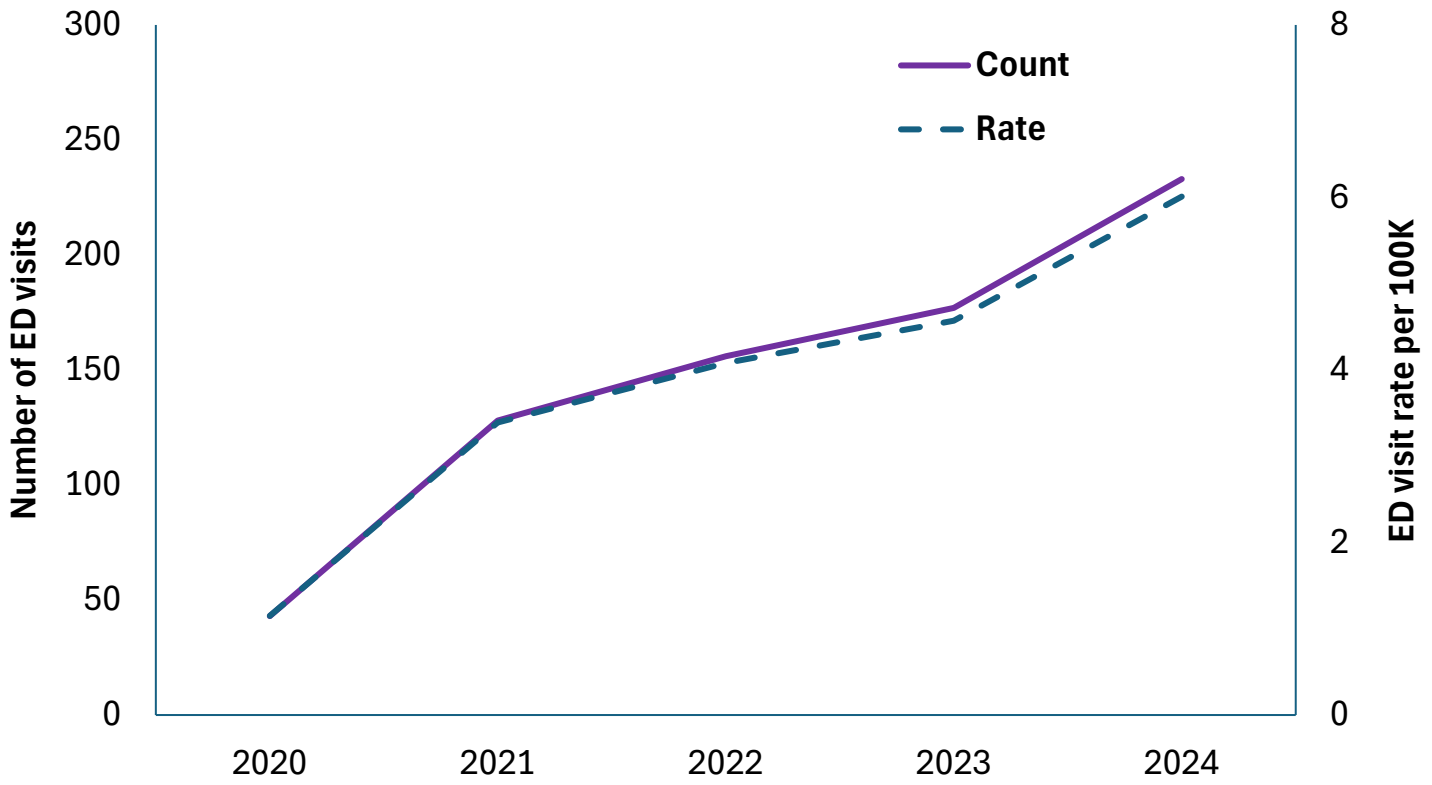
Background

- E-scooter usage continues to grow, both with personally-owned devices and shared ones
- E-scooters offer convenience, access to transit and other travel modes, and are generally considered low-cost, highly efficient, and low-impact forms of travel
- As a legitimate and growing transportation mode, e-scooter safety risks deserve attention from transportation policy makers, practitioners, and injury prevention partners



Source: National Association of City Transportation Officials, *Shared Micromobility in 2023. https://nacto.org/publication/shared-micromobility-in-2023/*

Count/Rate of E-scooter & Other Micromobility Injuries Reported in NC DETECT ED Visit Data, by County of Residence for Six Selected Counties



- Counties with e-Scooter Programs in 2024:
  - Durham
  - Forsyth
  - Guilford
  - Mecklenburg
  - New Hanover
  - Wake

Data attribution & disclaimer: NC DETECT is a statewide public health syndromic surveillance system, funded by the NC Division of Public Health (NC DPH) Federal Public Health Emergency Preparedness Grant and managed through collaboration between NC DPH and UNC-CH Department of Emergency Medicine's Carolina Center for Health Informatics. The NC DETECT Data Oversight Committee does not take responsibility for the scientific validity or accuracy of methodology, results, statistical analyses, or conclusions presented.

Source: UNC Highway Safety Research Center, 2025, using NC DETECT data

BTS-10 project evidence base

Evidence	Description
Literature review	Reviewed and synthesized 349 studies identified between 2017 and October 2020, including peer-reviewed articles and pilot program reports
Practitioner survey	Asked about 70 different practices and approaches to safety management; received 207 responses from 85 cities in 38 states with existing micromobility programs.
Populus Groundtruth survey	Examined e-scooter ridership travel behavior and demographics using a sampling of 18 metro areas in an ongoing travel survey.
NC emergency department visit data	Compared patient (age 14-59) injuries from 487 e-scooter riders, 1,581 bicyclist, and 1,440 pedestrians from same Emergency Departments (in 5 NC counties) and time period.
Field observations of e-scooters and cyclists	Examined social and environmental factors affecting or constraining e-scooter rider behaviors related to sidewalk riding and decisions around parking. Gathered field and video data from two cities in October 2021.
Interviews with micromobility program managers	Interviewed staff from five city agencies to help fill gaps identified through the literature review and practitioner survey related to community engagement, engagement with State Highway Safety Offices (SHSOs), planning and operations, and data and analysis.

General findings: State of use, context, and safety issues

Characteristics	Pedestrians	E-scooter Riders	Bicycle Riders
Demographics	More females than males; all ages and income levels.	Slightly more males than females (though highly variable by location); majority of shared e-scooter users are between the ages of 18-35 years old; skew white and middle-income.	Many more male riders than female riders; average age is slightly older than e-scooter riders and higher income.
Speed range	Walking speed is typically 3.5 ft/sec or 2 MPH.	Riding speed can be limited by policy or geographic location; range from 10-15 MPH.	Ranges from 8-13 MPH for traditional bikes and higher for e-bikes (10-15 MPH).
Travel behaviors	More likely to be accessing transit than e-scooter or bicycle modes.	Seasonal ridership similar to bicycles; helmet use is lower for e-scooters than for bicyclists; more likely to be using shared devices than owned devices, in comparison to bicycles.	Similar to e-scooter riders, though less nighttime ridership and longer average trip length.
Facility preferences	Prefer sidewalks when provided the option.	Prefer separated bike facilities over sidewalks when provided the option.	Prefer separated bike facilities when provided the option.

General findings: E-scooter injury circumstances and contributing factors

Characteristics	Pedestrians	E-scooter Riders	Bicycle Riders
Impairment patterns	In 2020, about 10% of non-fatally injured pedestrians and 31% of fatally injured pedestrians are reported as being alcohol or drug impaired. 16% of drivers involved in pedestrian crashes were impaired, not counting hit and run incidents where driver condition is unknown (National Center for Statistics and Analysis 2022).	About 6% of non-fatally injured e-scooter riders reported as being alcohol or drug impaired. Of the 69 known e-scooter fatalities in the US, an estimated 4% involved reportedly impaired riders, another 4% were ruled to have not involved impairment, and the remaining cases were unknown or missing impairment data (Cherry et al 2022).	In 2019, about 6.5% of non-fatally injured bicyclists and 20% of fatally injured bicyclists (involved in motor vehicle crashes, only) were reported as being alcohol or drug impairment. Around 12% of drivers involved in bicycle crashes were impaired, not counting hit and run incidents where driver condition is unknown (National Center for Statistics and Analysis 2021).
Injury profile	Data on falls and crashes with modes other than drivers are lacking, but most fatal injuries involve a motor vehicle.	More falls and fewer motor vehicle involved crashes than other modes: 90% of injuries occur off road and/or do not involve a motor vehicle; 70% of fatal injuries involve a motor vehicle. May be more vulnerable to roadway surface irregularities (including stormwater grates, rail crossings, cracks, etc.) than bicycles. Hardware failure or malfunction and rider inexperience are also contributing factors.	Data on falls and crashes with modes other than drivers are lacking, but most fatal injuries involve a motor vehicle.

Proper helmet-wearing reduces public healthcare costs, but current e-scooter helmet use is low

- **Head injuries,** including abrasions to traumatic brain injuries, are the most common *location* of e-scooter injury requiring medical treatment (28-40%).
- **Fractures**, particularly involving the lower arm and wrist, are the most common *type* of injury (25-31%).
- **Severity** is generally low, **about 10% emergency department visits** are classified as Severe (e.g., requiring admission to hospital)
- Studies of injured pedestrians in one state found that **more than half rely on publicly funded healthcare programs**.
- This study and others have observed **e-scooter helmet use is low, and consistently lower than bicyclist helmet use**.

Source BTS-10 Project team: *Shared e-scooter rider safety behaviour and injury outcomes: a review of studies in the United States.* Transport Reviews. https://doi.org/10.1080/01441647.2023.2219838

Key issue: pavement hazards at rail crossings, intersections, and transitions to sidewalk

Source for all photos on this slide: BTS-10 project team

Mitigating harmful behaviors

- Humans being humans, we are likely to continue seeing:
  - Social (double) riders
  - Stunt/trick riders
  - Wrong-way riders
  - Inexperienced or confused road users
  - Impatient or indifferent road users
  - Impaired road users
  - Riders without helmets

- Not all these behaviors pose serious injury risks, and not all occur at the same frequency
- Some of these behaviors can be mitigated through thoughtful roadway design practices and community engagement


Source: BTS-10 project team


Source: BTS-10 project team

Field data collection highlights

Nashville sites

Portland sites

Source: BTS-10 project team

Field data collection highlights

E-scooter and bicycle rider location by infrastructure and traffic volume (Nashville and Portland)

E-Scooter

Street Type	No Bike Lane		Bike Lane	
High Volume	Sidewalk Usage:	73%	Bike Lane Usage:	72%
	Travel Lane Usage:	26%	Sidewalk Usage:	22%
			Travel Lane Usage:	6%
Low Volume	Sidewalk Usage:	34%	Bike Lane Usage:	76%
	Travel Lane Usage:	66%	Sidewalk Usage:	12%
			Travel Lane Usage:	12%

Bicycle

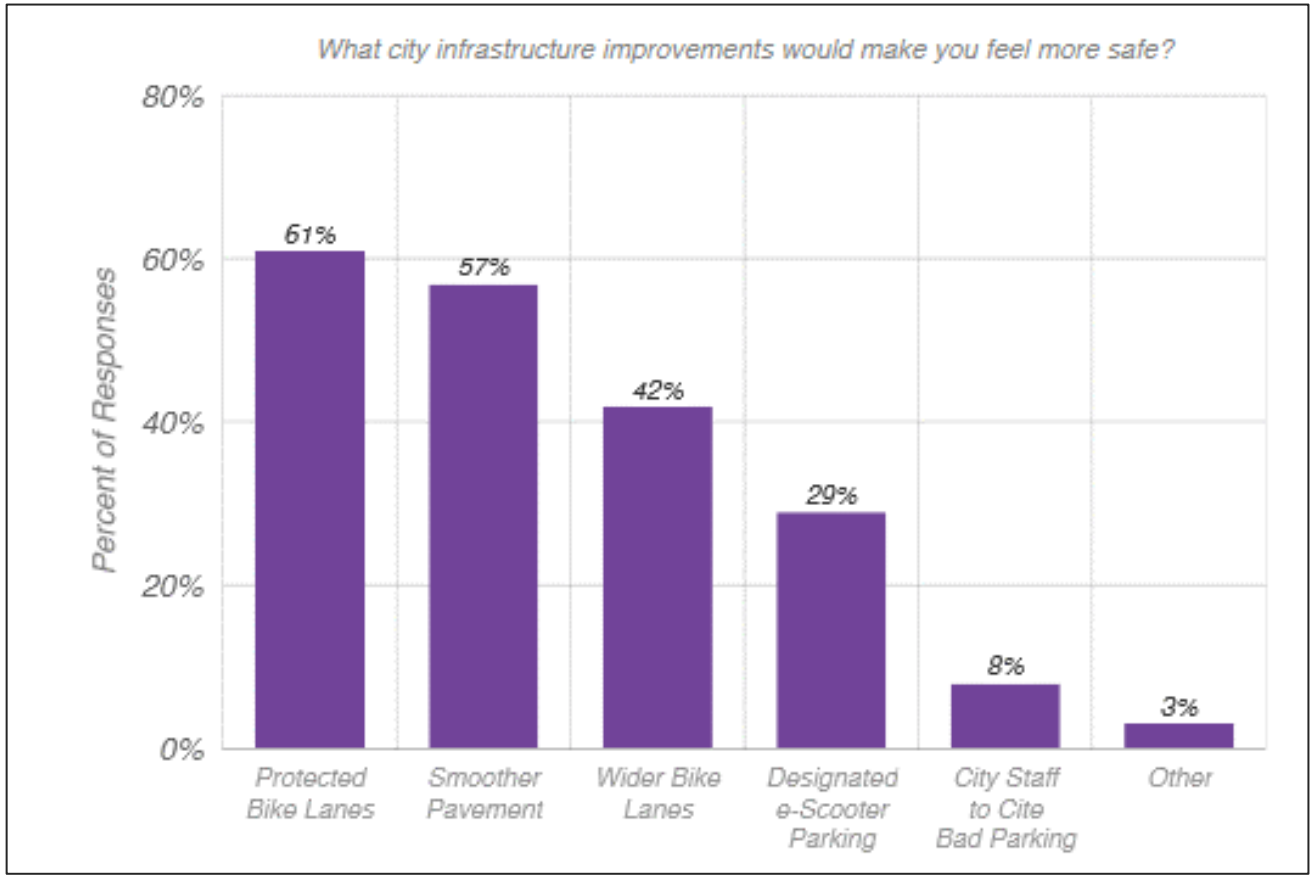
Street Type	No Bike Lane		Bike Lane	
High Volume	Sidewalk Usage:	49%	Bike Lane Usage:	82%
	Travel Lane Usage:	51%	Sidewalk Usage:	10%
			Travel Lane Usage:	8%
Low Volume	Sidewalk Usage:	2%	Bike Lane Usage:	79%
	Travel Lane Usage:	98%	Sidewalk Usage:	12%
			Travel Lane Usage:	9%

Nashville's Broadway "redesign"

Source: BTS-10 project team
TRB Annual Meeting 2024 Paper

Connected, low stress bike networks also work for e-scooter safety and perceptions of comfort

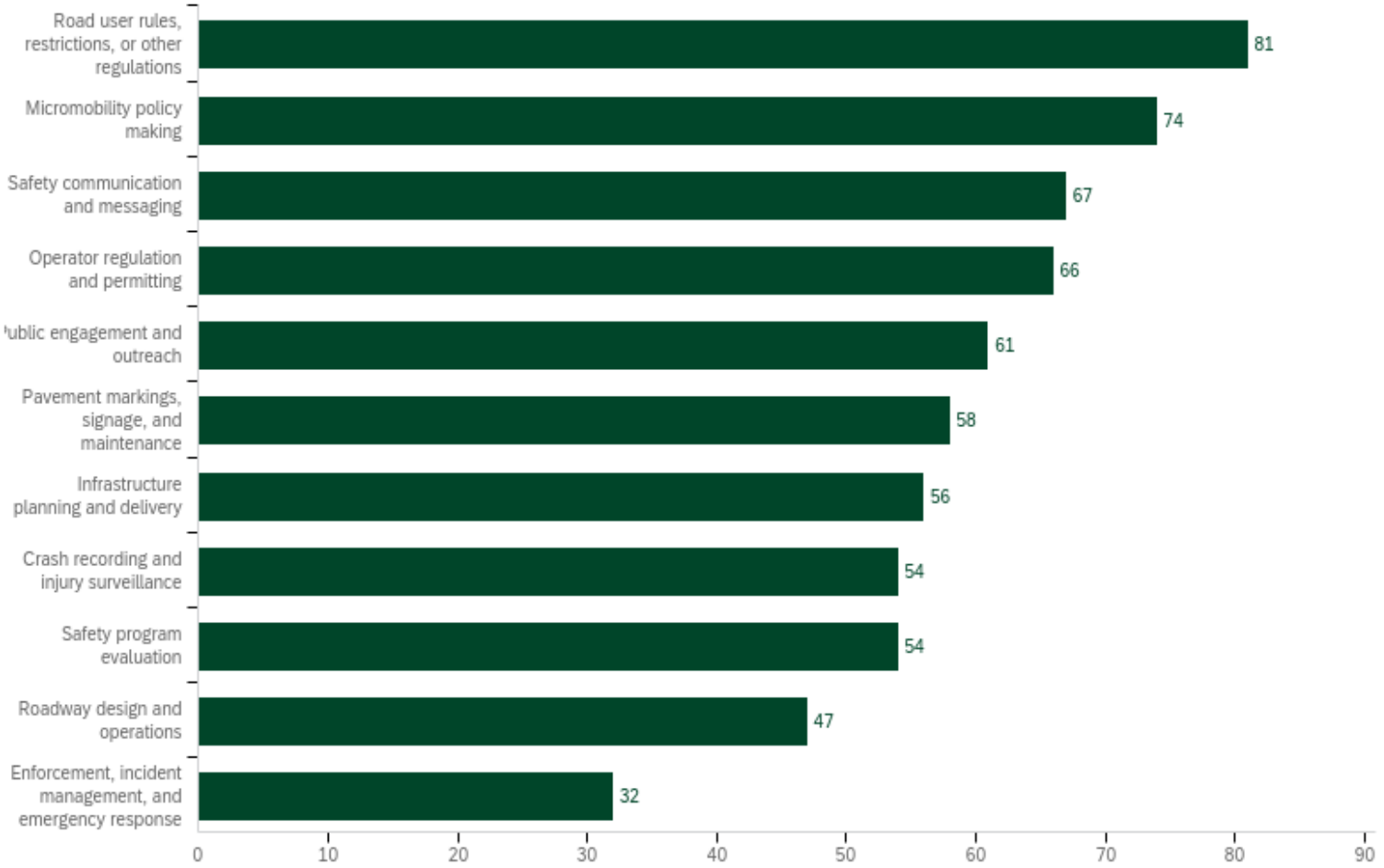
- Roads with bike lanes are associated with:
  - Fewer e-scooter injuries
  - Less sidewalk riding
  - More satisfied e-scooter riders



Source: Bird Report: *A Look at E-scooter Safety*, April 2019

General findings: Safety management practices

- Wide range of practices taking place
- Very few robust evaluations of safety interventions and/or impacts

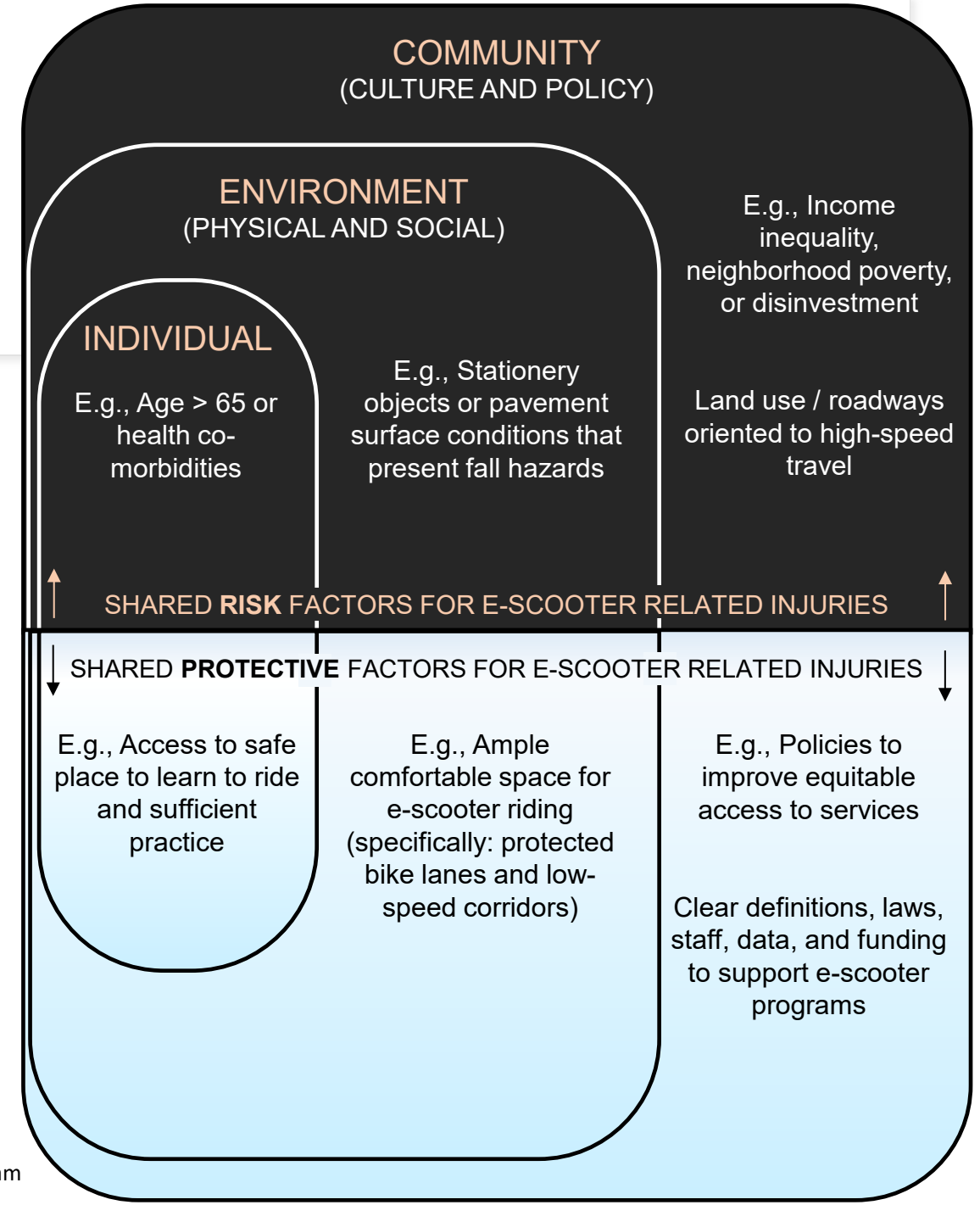


Source: BTS-10 project team

What makes e-scooter riders safe?

Safe System principles of:

- Separation of road users (in space or in time of facility use)
- Spaces for practice and opportunities to gain experience
- Inclusive, friendly streets designed for e-scooter usage
- Slow vehicle speeds



Source: BTS-10 project team

BTS-10 Research Products

1. Research Results Digest: https://nap.nationalacademies.org/catalog/26756/e-scooter-safety-issues-and-solutions
2. Toolbox: https://www.trb.org/Main/Blurbs/183094.aspx
   - *Fundamental concepts related to e-scooter safety*
   - *Promising practices to improve e-scooter safety*
   - *Data tools and methods for safety evaluation*
   - *Key resources and case examples*
3. Final Report: https://www.trb.org/main/blurbs/183095.aspx
   - *Additional info and data collection tools*

Toolbox offering: A summary of safety management practices

Domain	Description of Safety Management Practice	Current Level of Adoption	Current Strength of Injury Prevention Evidence
Categorizes the practices in terms of which primary Safe Systems area it falls under: • Safe Roads • Safe Vehicles • Safe Speeds • Safe People • Post-Crash Harm Reduction • Safety Evaluation	Provides a description of the practice and indicates the typical agency lead (S = SHSO; D= State DOT; L = Local agency); also links to the relevant section of the final report to find additional resources or supporting literature	Based on the BTS-10 survey and literature review, indicates low, medium, or high levels of current adoption	Based on the BTS-10 literature review and expert input, indicates the current evidence base supporting the practice: • No demonstrated effectiveness; • Limited or no high-quality evidence; • Promising/ Likely effective; or • High demonstrated effectiveness

Toolbox offering: E-scooter risk assessment tool

- Provides a list of discussion prompts
- Can be used in “road safety audit” like activities, or could be integrated into routine travel surveys

Table 3. List of discussion prompts to examine if an area is supportive of safe and inclusive e-scooter travel.

Question	Response
1. Is there a comfortable physical space to ride for people of all ages and abilities?	☐ Yes, there are protected spaces (i.e., separated from vehicle traffic and pedestrians) for bicyclists that can also be used by e-scooter riders. ☐ No, the space has the following problems (check all that apply): ☐ People must ride on sidewalks because there are no other protected spaces to ride ☐ The space is not wide enough to be shared by e-scooters and people walking, bicycling, or using wheelchairs ☐ The space to ride abruptly ends ☐ The space is often blocked by parked cars, delivery vans, signs, trash cans, etc. ☐ The space is often encroached by drivers entering/exiting driveways or parking spaces ☐ Pedestrians often encroach into the space ☐ Nearby traffic is moving too fast ☐ Lighting of the space is poor ☐ The space is not well-maintained (e.g., litter and trash are present) ☐ Other (please describe):_____
2. Does the available space to ride connect people to where they need or want to go?	☐ Yes, there is a supportive network of spaces for e-scooters riders to use. ☐ No, the space has the following problems (check all that apply): ☐ People can’t cross a bridge because the protected space ends ☐ People can’t get through an intersection because there is no protected space ☐ There are not enough opportunities to cross the street ☐ The space to ride does not extend to the locations where buses or trains depart ☐ There aren’t enough curb cuts in places where e-scooters need to access the sidewalk or parking locations ☐ Other (please describe):_____

Source: BTS-10 project team

Proactive risk identification can pre-empt injuries and complaints

- 90% of e-scooter injuries occur off road and/or do not involve a motor vehicle
- Screen the network for:
  - Stationary objects: curbs, light poles, manhole covers, grates, railroad tracks
  - Poor roadway surface conditions (potholes, pavement cracks, lips)
  - Topography challenges
  - Poor lighting

Source: BTS-10 project team

Source: www.pedbikeimages.org/ Reed Huegerich

Toolbox offering: Data improvement support

- Principles of quality data
- Overview of key data sources and elements for examining e-scooter risks
- Community “checklist” (shown previously)
- Protocols and data collection forms for manual and video data collection (provided in Final Report)

Table 5. Data needs and which collection methods can provide such data to augment crash and injury records.

Data Elements	(1) Intercept Survey	(2) Web-based Survey	(3) Direct Manual Observation	(4) Indirect Manual Observation (Video recording + processing)	(5) Indirect Automated Observation (automated counters, sensors, etc.)	(6) Mobility-firm provided data
Trip purpose	Yes	Yes	No	No	No	No
Trip length / distance	Yes	Yes	No	No	No	Yes
Trip duration / time spent riding	Yes	Yes	No	No	No	Yes
Trip location/ route	No	No	No	No	No	Yes
Roadway, lighting, traffic, and weather conditions	No	No	Yes	Yes	No	No, unless data are linked
E-scooter device characteristics	Yes	Yes	Possibly	Possibly	Possibly	Yes
E-scooter speed	Self-reported	Self-reported	Directly measured	Directly measured	Directly measured, depending on tech	Yes
Rider demographics	Yes	Yes	Possibly	Possibly	No	Yes
Rider characteristics (riding in group, carrying objects, etc.)	Yes	Yes	Yes	Yes	No	No
Helmet use	Self-reported	Self-reported	Directly measured	Directly measured	Directly measured, depending on tech	Possibly, if firm gathers
Rider interactions and conflicts with other road users	Self-reported	Self-reported	Possibly	Possibly	No	No
Perceptions of safety	Yes	Yes	Indirectly based on behaviors	Indirectly based on behaviors	No	Possibly, if firm gathers
Rider behaviors (signaling, gesturing, yielding, piggybacking, using devices, looking, dismounting, parking, etc.)	Self-reported	Self-reported	Directly measured	Directly measured	No	No

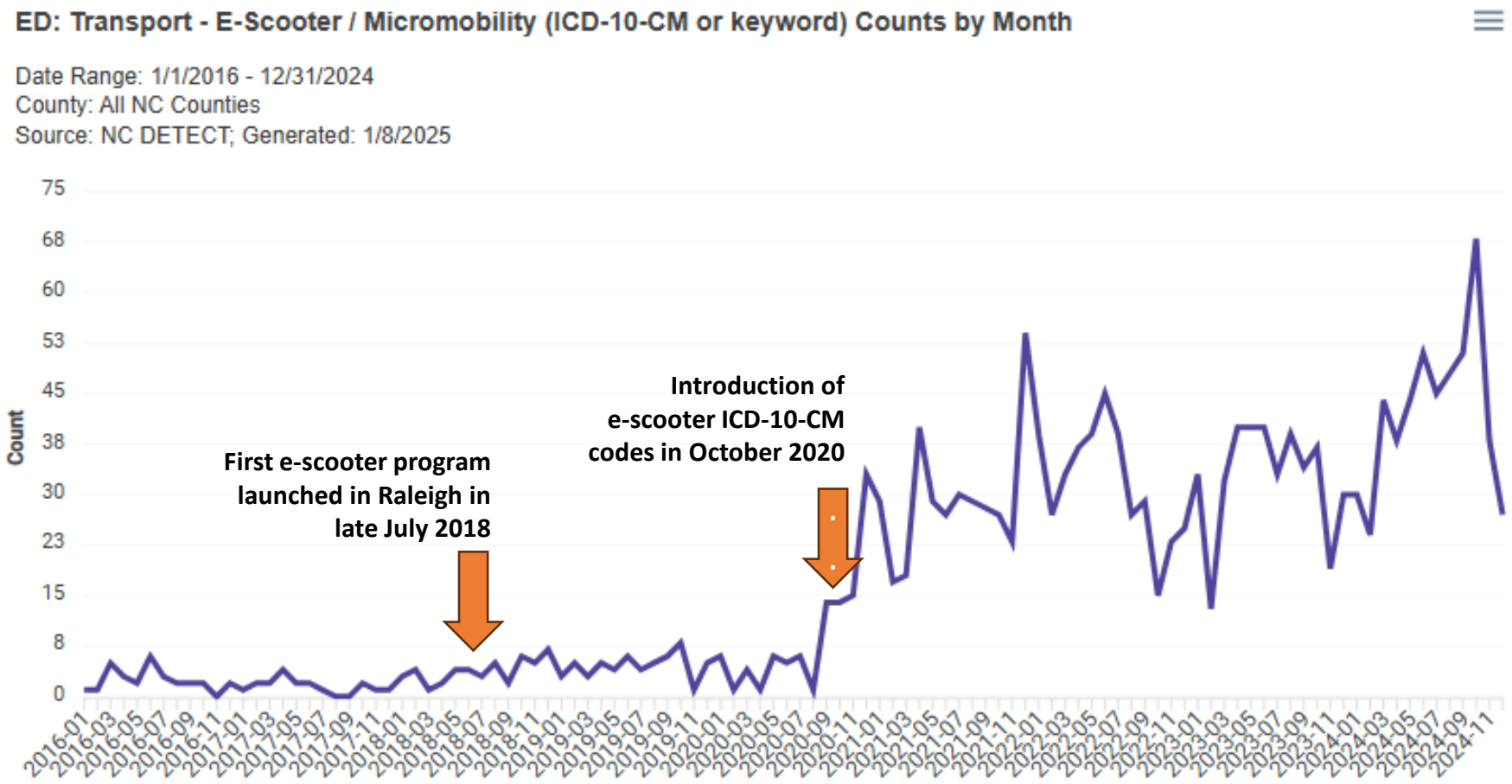
Source: BTS-10 project team

Toolbox offering: Partners and practices for data improvement

- Engage Traffic Records Coordinating Committees (TRCCs) on e-scooter data improvements
- Partner with State/local Departments of Health and utilize injury surveillance systems
- Share and standardize best practices in police and healthcare system e-scooter injury coding and reporting

Source: UNC Highway Safety Research Center, 2020

Standardizing case definitions for e-scooter injuries means seeing the fuller picture of events



Since October 1, 2020, there have been 1,689 ED visits attributed to micromobility devices:

- Average of 33/mth
- Max: 68/mth (Oct 2024)
- 111 (7%) hospitalizations/ transfers (no deaths)

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Source: UNC Highway Safety Research Center, 2025, using NC DETECT data

Acknowledgements

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