Collaborative Sciences Center for ROAD SAFETY

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Emerging Technologies for Micromobility: What do we know, what do we not know, and what do we do?

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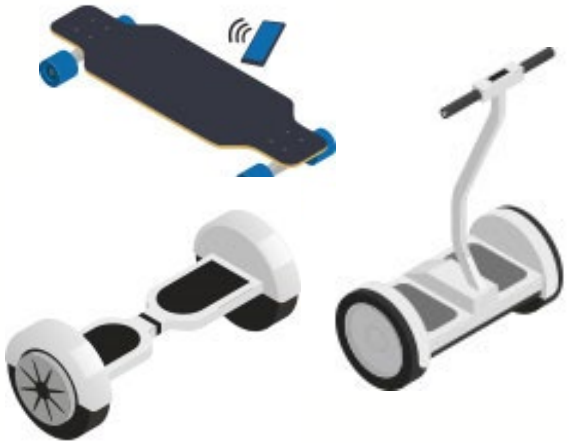
What do we mean by micromobility?

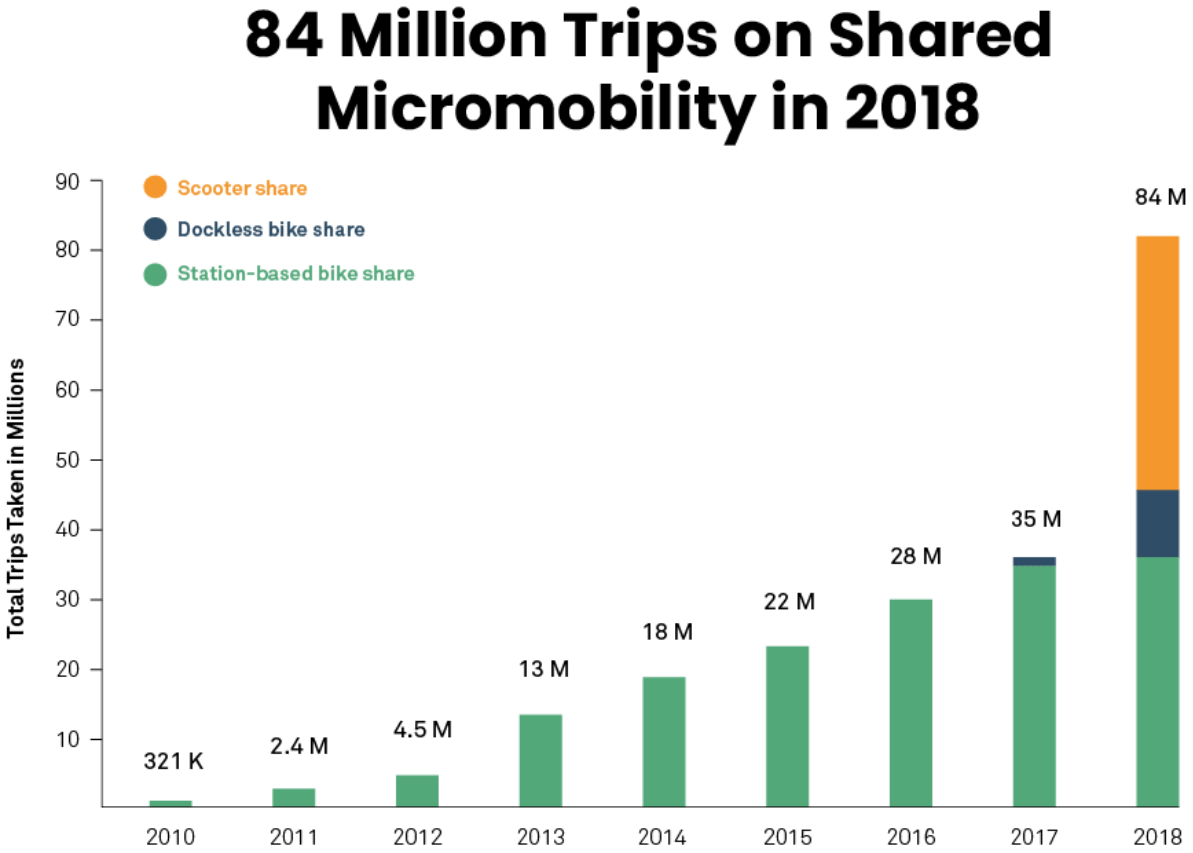
Ultralight (<75 lbs.) and light (75-100 lbs.) personal conveyances that travel (self and non-self balancing)



Electric kick/standing scooter" or "e-scooter"

Electric/powered bike

What are the trends?



Source: National Association of City Transportation Officials, *Shared Micromobility in the U.S.: 2018*

When disruption occurs, expect:

Source: Library of Congress, circa 1913

- Lack of appropriate, safe, and maintained facilities and pavement
- Immature “culture” of how to safely interact with other road users
- Operator errors and inexperience
- Technology malfunction/glitches
- New data needs

Preliminary studies

JAMA Network | Open

Original Investigation | Emergency Medicine

Injuries Associated With Standing Electric Scooter Use

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Abstract

IMPORTANCE Since September 2017, standing electric scooters have proliferated rapidly as an inexpensive, easy mode of transportation. Although there are regulations for safe riding established by both electric scooter companies and local governments, public common use practices and the incidence and types of injuries associated with these standing electric scooters are unknown.

OBJECTIVE To characterize injuries associated with standing electric scooter use, the clinical outcomes of injured patients, and common use practices in the first US metropolitan area to experience adoption of this technology.

DESIGN, SETTING, AND PARTICIPANTS This study of a case series used retrospective cohort medical record review of all patients presenting with injuries associated with standing electric scooter use between September 1, 2017, and August 31, 2018, at 2 urban emergency departments associated with an academic medical center in Southern California. All electric scooter riders at selected public intersections in the community surrounding the 2 hospitals were also observed during a 7-hour observation period in September 2018.

MAIN OUTCOMES AND MEASURES Incidence and characteristics of injuries and observation of riders' common use practices.

RESULTS Two hundred forty-nine patients (145 [58.2%] male; mean [SD] age, 33.7 [15.3] years) presented to the emergency department with injuries associated with standing electric scooter use during the study period. Two hundred twenty-eight (91.6%) were injured as riders and 21 (8.4%) as nonriders. Twenty-seven patients were younger than 18 years (10.8%). Ten riders (4.4%) were documented as having worn a helmet, and 12 patients (4.8%) had either a blood alcohol level greater than 0.05% or were perceived to be intoxicated by a physician. Frequent injuries included fractures

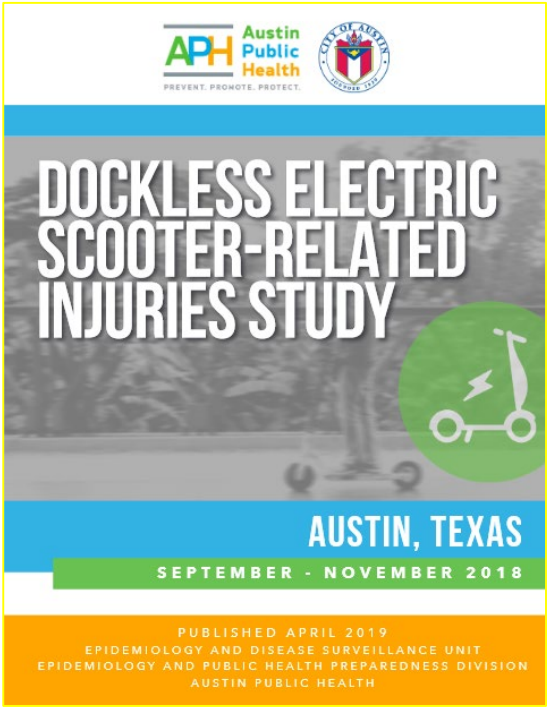
Key Points

Question What are the types of injuries associated with standing electric scooter use and the characteristics and behaviors of injured patients?

Findings In this study of a case series, 249 patients presented to the emergency department with injuries associated with electric scooter use during a 1-year period, with 10.8% of patients younger than 18 years and only 4.4% of riders documented to be wearing a helmet. The most common injuries were fractures (31.7%), head injuries (40.2%), and soft-tissue injuries (27.7%).

Meaning In this study, injuries associated with electric scooter use were common, ranged in severity, and suggest low rates of adherence to existing regulations around rider age and low rates of helmet use.

+ Invited Commentary
+ Supplemental content



	Preliminary e-scooter trends		
Characteristic	**Santa Monica Study (JAMA)**	**Austin, TX Study (DPH/CDC)**	**Portland Study (PBOT/Health Department)**
Study period	1 year (Sept. 1, 2017 - Aug. 31, 2018)	3 months (Sept. 5 – Nov. 30, 2018)	4 months (July 25 – Nov. 20, 2018)
Setting	2 hospitals	9 hospitals	? EDs/urgent care clinics
Study population	249 patients: 228 riders & 21 non-riders	192 patients: 190 riders & 2 non-riders	176 patients: 174 riders & 2 nonriders
Demographics	58% male Mean age: 34 years 11% <18 years	55% male Median age: 29 years	Not reported
Injury type	32% had fractures 40% had head injuries	19% had fractures 50% had head injuries (7% TBIs)	7% had TBIs
Hospital admission	6% admitted to hospital	14% admitted to hospital	Not reported
Injury rate	Not calculated	20 per 100K trips or 21 per 100K miles	25 per 100K trips or 21 per 100K miles
Helmet usage (confirmed)	4% of riders	<1%	3%

United States e-scooter fatalities (October 2019)

No	Date of Event	City	State	Name	Location	Age	Gender	Time	Involved motor vehicle?	Striking vehicle type
1	18-Aug-18	Cleveland	OH	Jenasia Summers	Street	21	Female	10pm	Yes	Passenger car
2	1-Sep-18	Dallas	TX	Jacoby Stoneking	Street	24	Male	~12am	Unknown	Unknown
3	24-Sep-18	Washington	DC	Carlos Sanchez-Martin	Street	20	Male	10am	Yes	SUV
4	22-Dec-18	Chula Vista	CA	Esteban Galindo	Street	26	Male	4am	Yes	Passenger car
5	1-Feb-19	Austin	TX	Mark Sands	Street	21	Male	1am	Yes	Passenger car
6	11-Apr-19	Fort Lauderdale	FL	Mathias Huff	Street	27	Male	11:30pm	Yes	Passenger car
7	13-Apr-19	Hollywood	CA	Evan Faram	Street	31	Male	3am	Yes	Pickup
8	18-Apr-19	San Diego	CA	Christopher Conti	Sidewalk	53	Male	10pm	No	N/A
9	23-Apr-19	Tulsa	OK	Caiden Reyes-Ortiz	Street	5	Male	8:30pm	Yes	Passenger car
10	16-May-19	Nashville	TN	Brady Gaulke	Street	26	Male	10pm	Yes	SUV
11	16-May-19	Atlanta	GA	Eric Amis	Street	20	Male	12am	Yes	SUV
12	20-Jun-19	Tampa	FL	John Edgerton	Street	33	Male	4:45pm	Yes	Semi
13	24-Jun-19	San Diego	CA	Brian Witzeman	Sidewalk	48	Male	1:30pm	No	N/A
14	16-Jul-19	Atlanta	GA	William / Brad Alexander	Street	37	Male	10:30pm	Yes	Bus
15	17-Jul-19	Atlanta / East Point	GA	Quineterry McGriff	Street	46	Male	6:30am	Yes	Truck
16	27-Jul-19	Atlanta	GA	Amber Ford	Street	34	Female	10pm	Yes	Passenger car
17	4-Aug-19	Denver	CO	Cameron Hagan	Street	26	Male	8pm	Yes	Passenger car
18	9-Oct-19	Spokane	WA	Tyler Chestnutt	Street	28	Male	11:30pm	Yes	SUV

Early insights into behavioral and environmental contributing factors to crashes

- Higher proportion of medically attended injuries involving:
  - Novice e-Scooter users (i.e., first time riders)
  - People riding on the sidewalk (as opposed to in-street)
    - Speed/infrastructure mismatch

- Serious/fatal incidents have a higher proportion:
  - In-street/involving MVCs
  - Involving alcohol
  - Nighttime riding (50+%)

Problems identified with e-scooter rideshares

- Device malfunction
  - Vandalism
  - Wear or poor maintenance
  - Software or battery glitches/bugs
- Operator errors
  - Balance and steering
  - Braking/acceleration
  - Distraction or impairment
- Roadway design
  - Lack of safe, protected facilities
  - Poor pavement conditions

Image Source: David Dudley/CityLab

What are cities saying and doing about micromobility?

- PBIC study led by partner, Toole Design Group (TDG)
- Interviewed 8 mid-size cities regarding their experiences
- Common safety issues and lessons:
  - Facilities
  - Culture/behavior
  - Data

City	Population
Columbus, OH	880,000
Charlotte, NC	860,000
Portland, OR	650,000
Memphis, TN	650,000
Tucson, AZ	540,000
Spokane, WA	220,000
Providence, RI	180,000
South Bend, IN	100,000
Charlottesville, VA	50,000

Source: Adrian Witte, TDG

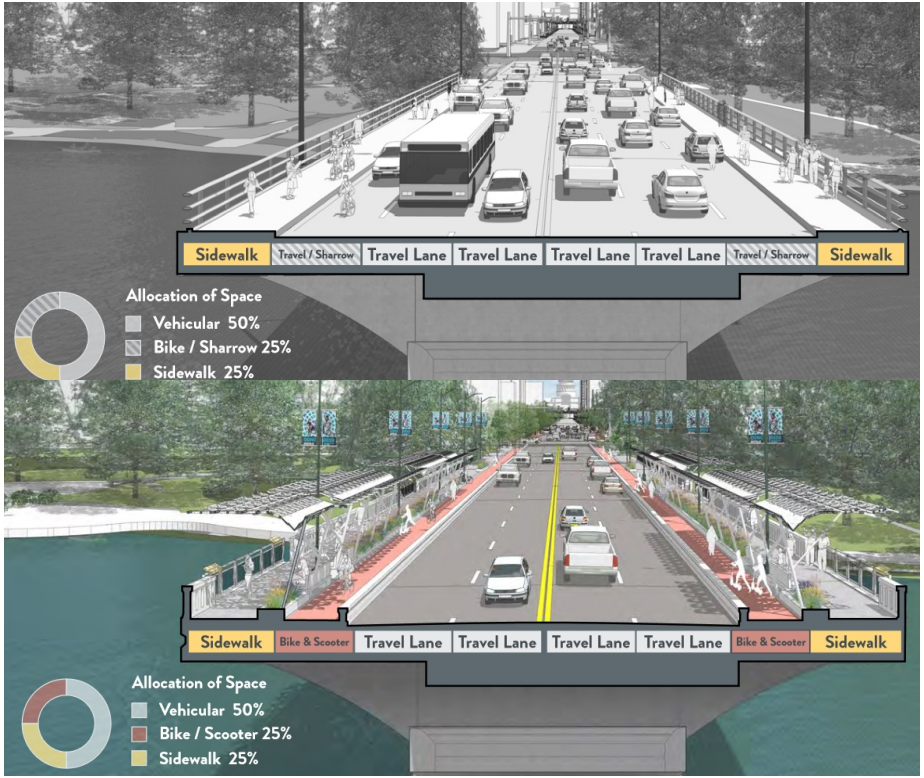
Facilities

"We are fortunate to have some protected bike lanes downtown already."

--City of South Bend

Image Source:
pedbikeinfo.org/Toole Design Group

Facilities can be improved to accommodate e-scooters and other forms of active transportation



Source: City of Austin, Our Congress Avenue Envision! Public Meeting: https://austintexas.gov/department/congress-avenue-urban-design-initiative

Facilities: Parking and ADA

"Half of the complaints received are about parking."

--City of Providence

Source:
Laura Sandt

Parking can be managed through…

- Service levels/fleet size included in regulation
- User education
- Designated parking areas
- Fees / enforcement


Source: Laura Sandt


Source: City of South Bend


Source: Laura Sandt

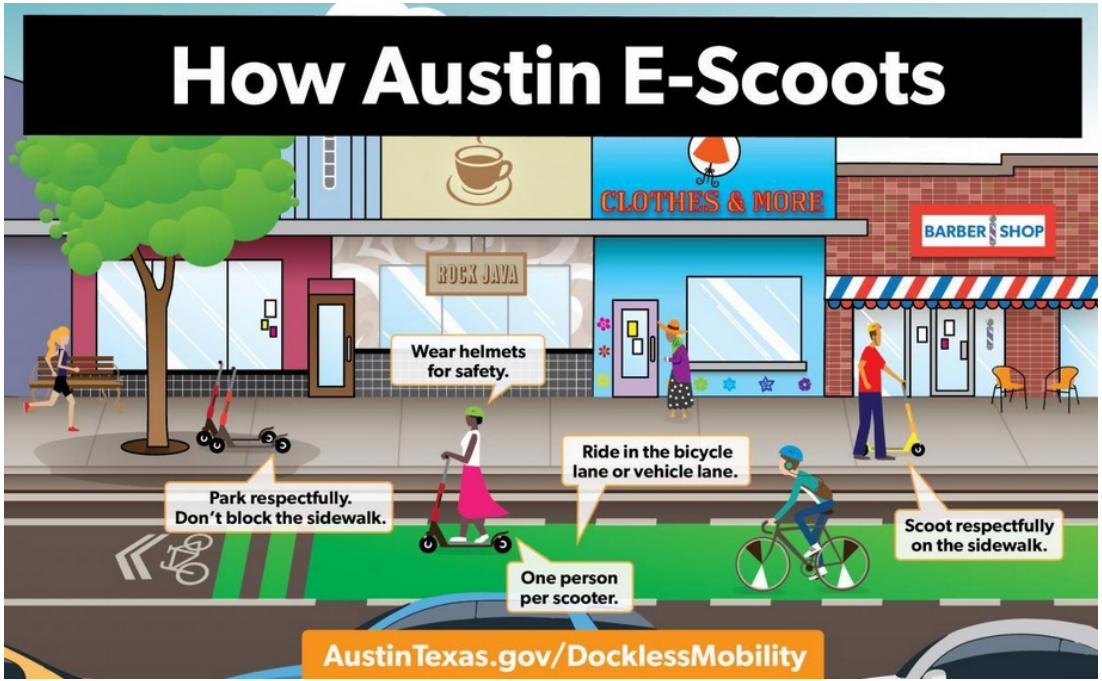
Facilities + behavior

"On streets with no bike lane, expect sidewalk riding."

--Portland, OR Bureau of Transportation

Source: Laura Sandt

Promoting positive cultural norms and safety behaviors



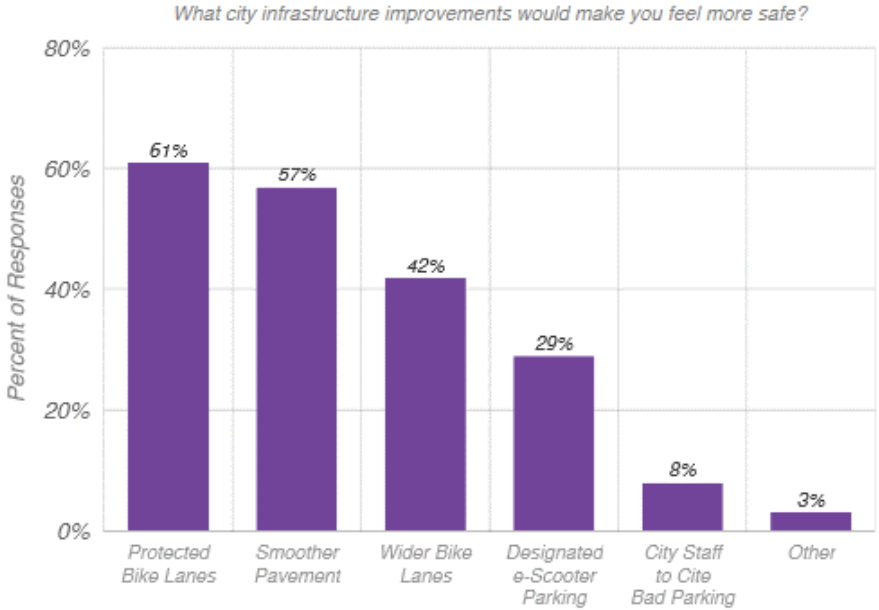

Source: City of Spokane

Industry initiatives to improve safety

- Hardware/software improvements
- Education and training
  - E.g., Bird SHARE
  - Lime Ride Academy
- Helmet distribution
- Data collection opportunities

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

Figure 3 - Desired Infrastructure Improvements (Bird Rider Survey)[26]



Injury surveillance challenges

- Different data sources tell different stories
  - Media reports (more sensational)
  - Trauma data (severe injuries)
  - Emergency department data
  - Police call or collision reports
- Different or improper coding leads to misclassification of injuries
  - Motorcycles
  - Mobility scooters
  - Pedestrians

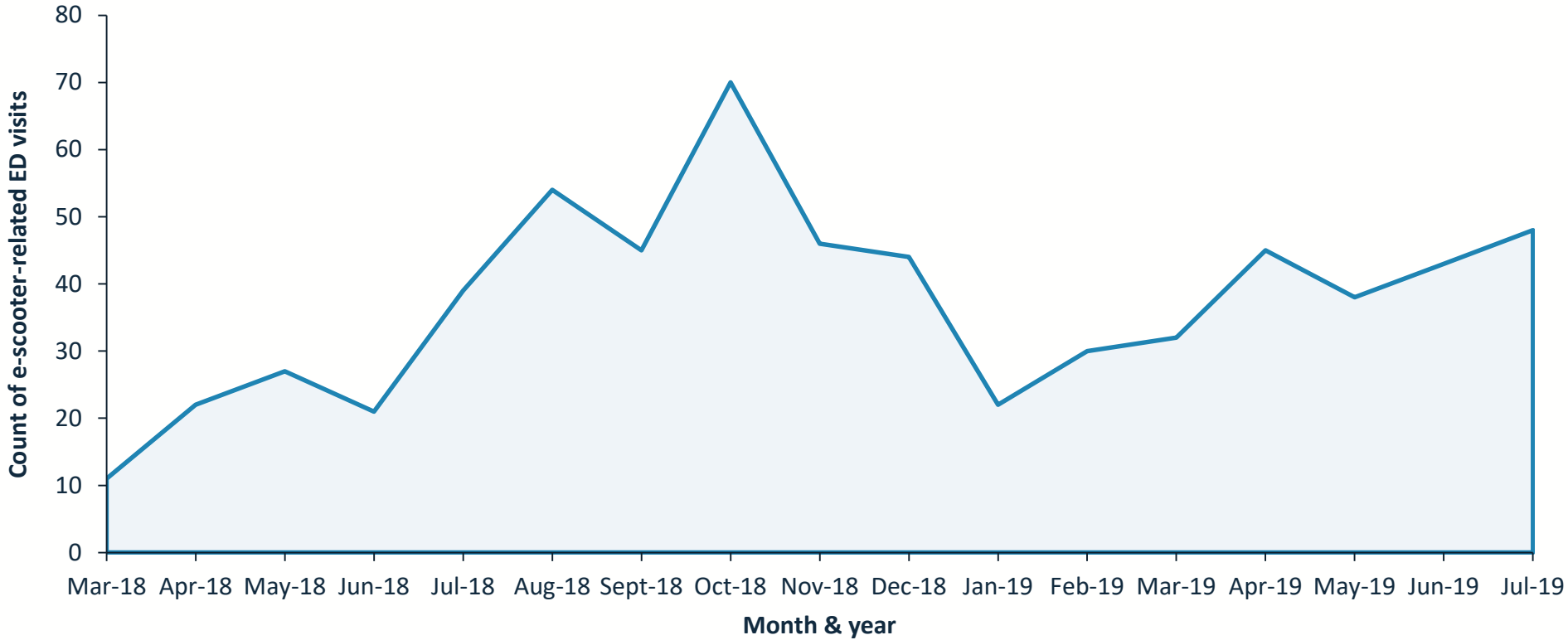
Examples of e-scooter injuries presenting to the emergency department: Illustrative examples captured by NC's statewide syndromic surveillance system (NC DETECT)*

Riders				
Age	**Transport Mode**			**Disposition**
30-39	Walk-in following transport via public transportation	**Bird Scooter** Accident	F10.920 - ALCOHOL USE, UNSPECIFIED WITH INTOXICATION, UNCOMPLICATED; S00.81XA - ABRASION OF OTHER PART OF HEAD, INITIAL ENCOUNTER *-* V00.831A - **FALL FROM MOTORIZED MOBILITY SCOOTER**, INITIAL ENCOUNTER *-* S40.012A - CONTUSION OF LEFT SHOULDER, INITIAL ENCOUNTER	Discharged
20-29	Walk-in following transport via private transportation	Pt fell off a **lime scooter** on and drove down a flight of stairs at 17 mph. **No helmet**, no head injury. Road rash bilateral.	S20.211A - CONTUSION OF RIGHT FRONT WALL OF THORAX, INITIAL ENCOUNTER *-* V28.0XXA - **MOTORCYCLE DRIVER INJURED IN NONCOLLISION TRANSPORT ACCIDENT** IN NONTRAFFIC ACCIDENT, INITIAL ENCOUNTER *-* S20.212A - CONTUSION OF LEFT FRONT WALL OF THORAX, INITIAL ENCOUNTER *-* S60.512D - ABRASION OF LEFT HAND, SUBSEQUENT ENCOUNTER	Discharged
10-19	Walk-in following transport via private transportation	Pt arrives to ED with complaints of injury to his right lower leg. Patient reports that he was on an **electric scooter** and landed really strange.	S82.421A - DISPLACED TRANSVERSE **FRACTURE** OF SHAFT OF RIGHT FIBULA, INITIAL ENCOUNTER FOR CLOSED FRACTURE *-* W19.XXXA - **UNSPECIFIED FALL**, INITIAL ENCOUNTER	Discharged
Bystanders				
<10	Walk-in following transport via private transportation	Patient was on his bike, swerved to miss an **electric scooter** and fell in to ditch on to left arm.	S42.412A - DISPLACED SIMPLE SUPRACONDYLAR FRACTURE WITHOUT INTERCONDYLAR FRACTURE OF LEFT HUMERUS, INITIAL ENCOUNTER FOR CLOSED FRACTURE *-* V18.0XXA - **PEDAL CYCLE DRIVER INJURED IN NONCOLLISION TRANSPORT** ACCIDENT IN NONTRAFFIC ACCIDENT, INITIAL ENCOUNTER	Admitted

*The examples provided have been significantly altered to protect patient anonymity – these examples are for illustrative purposes only.

Seasonal trends: e-scooter-related emergency department visits identified using test CDC syndrome: NC DETECT – Durham, Forsyth, Guilford, Mecklenburg, & Wake Counties, March 2018 – July 2019*

*PROVISIONAL DATA – Not all counties had active e-scooter programs for entire period

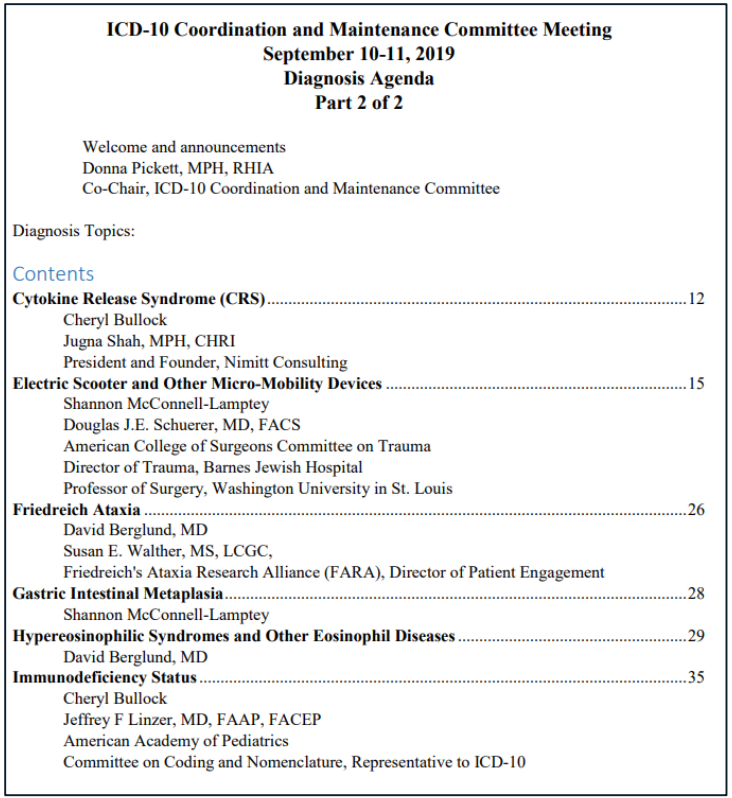


Injury surveillance data needs

- Need timely, accurate micromobility injury data
- Challenging without applicable ICD-10-CM codes and surveillance definitions
  - Collaborating with hospitals to adapt existing ICD-10-CM codes for on-going micromobility injury surveillance activities
    - Created poster to assist clinicians, nurses, and medical coders with coding micromobility injuries
    - Has been distributed to >1500 individuals in NC, other states, and internationally
    - Editable template available upon request

Injury surveillance data needs con.

- New ICD-10-CM codes specific to e-scooters and other micromobility devices
  - Proposal for new codes submitted to the National Center for Health Statistics ICD-10-CM Coordination and Maintenance Committee on September 11, 2019
  - Currently under review



ICD-10 Coordination and Maintenance Committee Meeting
September 10-11, 2019
Diagnosis Agenda
Part 2 of 2

Welcome and announcements
Donna Pickett, MPH, RHIA
Co-Chair, ICD-10 Coordination and Maintenance Committee

Diagnosis Topics:

Contents

Other data needs

- Consistent and industry-standard data reporting
- Usable data platforms for exposure monitoring
- Third-party vendor options are available
- Proactive partner engagement around crash and incident reporting
  - Police, medical, and other data sources

This is only the beginning for micromobility…

Source: Bird

Source: Ojo

Source: Rivard Report

Acknowledgments

- This work is funded by the CSCRS as part of Project R26: “Understanding micromobility safety behavior and standardizing safety metrics for transportation system integration” (PI: Chris Cherry, UTK).
- A special thanks to Adrian Witte, TDG
- And Will Curran-Groome, Jennifer Palcher-Silliman, Jonathon Weisenfeld, and other CSCRS staff who contributed to this presentation.

Questions?

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The potential health, environmental, and congestion relief benefits of e-scooters, e-bikes, and station-based and dockless bike share transportation systems are promising as a complement to existing modes of travel. They also provide "micromobility" and an affordable, low emissions alternative to driving. Many communities see possibilities in micromobility to help extend the transit ridership shed and support first/last mile trips to transit connections. As with all new innovations, there is much to learn about safe implementation, compliance, equity considerations, and infrastructure planning and design to support emerging forms of transportation and technology.

Since 2017, a proliferation of start-ups distributed electric kick-scooters for use in shared mobility systems across the U.S., generating millions of trips per year. Electric bicycles provide new opportunities for flexible personal travel and also pose challenges for safety, regulation, and planning. Best practices and new policies are continually evolving and may be specific to location or context.

Resources

Shared Micromobility in the U.S.: 2018 reports comprehensive count of all shared micromobility in the U.S. including average trip duration, distances, and prices per ride.

Remix Three-Part Info Brief on Micromobility covers policies, city needs for mobility data, and equitable access.

Shared Micromobility Playbook explores core components of a comprehensive shared micromobility policy for local governments to consider.

Dockless Electric Kick Scooter Systems: What we know and don't

Examples

Smart Cities Dive: Mapping the Impact of Dockless Vehicles maps cities exploring and implementing shared mobility.

Measuring Equitable Access to New Mobility provides overview of dockless system in Washington, District of Columbia.

Injuries Associated with Standing Electric Scooter Use explores types of injuries associated with e-scooters and the characteristics and behaviors of injured patients.

Dockless Electric Scooter-Related Injuries Study serves as the first epidemiological study to conduct

Related Webinars

Safety Performance Measures for Bicyclists and Pedestrians (12/14 /2017)