# EMERGING MOBILITY INJURY MONITORING IN SAN FRANCISCO, CALIFORNIA UTILIZING HOSPITAL TRAUMA RECORDS: A METHODOLOGY

**VERSION 2.0**
**SAN FRANCISCO, CALIFORNIA**
***JUNE 2019***

**Vision Zero SF Injury Prevention Research Collaborative**
**A Collaboration between the**
**San Francisco Department of Public Health's Program on Health, Equity and Sustainability**
**and the Zuckerberg San Francisco General Hospital and Trauma Center**

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## About the Vision Zero SF Injury Prevention Research (VZIPR) Collaborative

The ***VZIPR Collaborative*** is composed of epidemiologists, physicians, and key staff from the San Francisco Department of Public Health (SFDPH) and Zuckerberg San Francisco General Hospital and Trauma Center (ZSFG). As the city's only Level I Trauma Center, ZSFG treats nearly all patients who sustain traumatic injuries in San Francisco, California. The VZIPR Collaborative thus has a unique opportunity to analyze the full spectrum of severe traffic injuries occurring in our city. VZIPR has been working since 2014 to develop, institutionalize, and utilize comprehensive injury data in support of strategic research and analyses for Vision Zero SF, San Francisco's policy and commitment to eliminate traffic deaths on city streets.

The following current and former VZIPR Collaborative members, listed alphabetically by last name, contributed to the methodology and this report:

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## Related terms

micro-mobility, last-mile transportation, light electric vehicles, shared mobility, short-term rentals, powered scooters, stand-up scooters, e-scooters, electric kick scooters, dockless scooters, transportation network companies

## Updates from Version 1.0

This document was originally released in January 2019. The current 2.0 version adds a “Standardizing ICD-10 Codes” section to the Methodology and updates the “Reporting and Next Steps” section to reference interim reporting on preliminary data. It also adds a new point of contact, reformats the “About” section, and reformats and reorders Appendices B and C for clarity.

# Background

### What are Emerging Mobility Services and Technologies?

Innovations in the transportation industry are drastically expanding the transportation options available within cities. With its proximity to Silicon Valley and reputation as a center for innovation, San Francisco has been an epicenter for the introduction of **emerging mobility services and technologies** (EMST). EMST encompasses both new types of transportation devices and novel technologies that facilitate sharing of these devices. EMST currently available in San Francisco include:

- Electric bicycles (e-bikes): electric assisted pedal bicycles
- Electric scooters (e-scooters, powered stand-up scooters): electric powered stand-up kick scooters
- Motor-driven bicycles and mopeds: gasoline or electric powered sit-down vehicle with a floorboard; or gasoline powered or assisted pedal bicycle
- Electric skateboards (e-skateboards): electric powered board with four wheels
- Hoverboards/unicycles: electric powered vehicle designed to be stood upon while riding, with one or two wheels
- Segway-type vehicles: electric powered, self-balancing stand up vehicle with chest- or knee-height handlebars
- Transportation Network Companies (TNC, e.g. Uber, Lyft): a motor vehicle engaged in ride-hail service provision through a third-party application programming interface
- Autonomous Vehicles (AVs): vehicles with partial or (in future) complete automation of driving activity. With ongoing development of the technology, AVs are expected to have an increasing presence as TNCs, shuttle services, and personal vehicles[7].

### Monitoring Injuries Associated with EMST

With the introduction of EMST in San Francisco, it became apparent that existing methods of injury surveillance did not capture sufficiently detailed data to analyze injuries related to these technologies. At the same time, inquiries from trauma centers and transportation agencies throughout the country highlighted the lack of consensus surrounding data collection. The VZIPR Collaborative began efforts to modify its methods of injury surveillance in order to assess the impact of and respond to inquiries regarding injuries related to emerging mobility modes.

Trauma registry data is a critical source of injury data for new modes of transportation and can potentially capture injuries not included in police reports**.** Existing surveillance of transportation-related injuries in San Francisco utilizes San Francisco Police Department (SFPD) collision reports as well as data entered into the trauma registry at Zuckerberg San Francisco General Hospital and Trauma Center (ZSFG). Specially trained trauma nurses abstract transportation mode data from hospital and prehospital patient care records and enter it into the trauma registry. As the sole

[7] Source: https://www.sfcta.org/emerging-mobility/inventory

level I trauma center in San Francisco, nearly all victims with severe transportation-related injuries that occur in the City and County of San Francisco are treated at ZSFG. Recent research conducted by the VZIPR Collaborative found that 29% of patients who were injured in transportation-related crashes, transported by ambulance, and required hospitalization at ZSFG were not reported in police records. Among cyclists, this proportion was even greater at 39%[8]. This finding highlights the importance and utility of hospital data to understanding injury patterns, including for new transportation modes.

Prior to October 2018, the trauma registry data-entry fields allowed for transportation modes to be classified as bicycle, motorcycle, or motor vehicle (e.g. auto, train, etc.). These categories lack the necessary specificity to identify injuries that involve the use of EMST. In addition, a lack of consensus among medical providers about how to categorize EMST made collection of accurate data challenging. Electric bicycles, for example, are categorized as motorcycles, while users of powered stand-up scooters are likely to be categorized as pedestrians. The VZIPR Collaborative developed a new methodology for data collection in order to address these challenges.

## Methodology

The VZIPR Collaborative includes the ZSFG Trauma Center, which supplies trauma registry data. Classification of transportation mode within the trauma registry relies on chart narratives entered by healthcare providers, which are then abstracted from patient records by a dedicated team of nurses at ZSFG. This workflow was identified as an opportunity for improvement; by expanding the available options for classifying mode of transportation in the trauma registry database and educating healthcare providers about the importance of accurately identifying EMST in their chart narratives, the data collected at ZSFG would be more useful for tracking and analyzing the burden of injuries related to EMST use.

We began our efforts by identifying stakeholders among Emergency Medicine and Trauma Surgery clinicians, Trauma Program Nurses and Registrars, Emergency Medical Services (EMS) providers, the SF Police Department, and the SF Municipal Transportation Agency. The resulting group created a list of transportation modes that was sufficiently granular to track the vehicle types each stakeholder sees in the hospital and on city streets. These vehicle categories also intentionally align with the California Highway Patrol's (CHP) vehicle categories which will help Vision Zero surveillance data ultimately link hospital, EMS and police (including CHP) data. In addition to identifying new modes of transportation, we took the opportunity to begin collecting data about whether the injury is related to sharing technology—i.e. accessed through an app or sharing service, inclusive of ride hail apps or an automated vehicle.

[8] Source: https://www.sfdph.org/dph/files/EHSdocs/PHES/VisionZero/Vision_Zero_High_Injury_Network_Update.pdf

### Adding Variables to the Trauma Registry

Through this process three key questions were identified as additional trauma registry variables:

1. Was a new type of transportation vehicle involved in the collision and, if so, what type?
2. Was an emerging mobility service or sharing technology involved in the collision?
3. Was an autonomous vehicle (AV) involved in the collision?

The allowed responses for each question and guidance regarding classification of transportation devices (including visual aids) are included in Appendix A. We modified the ZSFG trauma registry to include fields for responses to each of these questions, generating three new categorical variables (see Appendix B).

### Standardizing ICD-10-CM Codes for New Vehicle Types

Because of the novelty of such devices and services, to date both practice and guidance on how to capture injuries associated with EMST in medical records has lacked standardization across the United States.[9]

The VZIPR team maintains that the ICD-10-CM codes which specify "other pedestrian conveyance" (V00-V09) are the best fit for purposes of tracking e-scooter associated injury– as well as injury related to electric skateboards, hoverboards, electric unicycles, and Segway-type vehicles– within the current ICD-10 system. These codes both represent pedestrian conveyances and exist in a section which includes motorized devices among its examples. The associated ICD-10 codes listed in Appendix C allow for identification of other vehicle types involved in collisions. Combined with the three additional trauma registry data fields shown in Appendix B, this strategy provides the most descriptive and informative data possible, absent ICD-10 modifications to identify e-scooters and other novel vehicle types as unique mechanisms of injury. Given differing and incompatible surveillance strategies in other jurisdictions (including employing codes not designed to reflect a motorized type of conveyance to represent e-scooters) there is a clear need for national or international guidelines on how best to capture EMST for reliable comparisons across health systems and over time.

## Outreach and Education on New Methodology

Information on whether an injury involved the use of EMST must be abstracted from patient care records created by EMS, emergency medicine, emergency nursing and trauma surgery providers. These include data on helmet usage and other injury-related factors that are abstracted as a part of the trauma data collection. These data directly reflect the information captured in the patient record by medical providers. Thus, a critical component to this initiative is to prioritize training

[9] Rix, K., & Edwards, C. (2019, February 14). Improving our Understanding of Dockless Motorized Electronic Scooters [Webinar]. American Trauma Society.

and communication with pre-hospital and hospital staff about efforts to improve upstream data collection.

The VZIPR collaborative developed posters to display in the ambulance bay, emergency department and resuscitation rooms (see Appendix D). These posters include visual representations of the types of vehicles within each category. They are particularly useful for providers who are less familiar with the differences between vehicles that look similar but are categorized separately, such as electric and motor-driven bicycles. In order to raise awareness about this initiative, VZIPR representatives have led educational sessions at departmental grand rounds, faculty & staff meetings and at the Bay Area Regional Trauma Coordinating Committee (RTCC) meeting.

SFPD has undergone a similar process to educate officers about existing vehicle-type categories and relevant regulations. They have also created a "cheat sheet" for officers with visual aids similar to those in Appendix D, consistent with state collision reporting categories. SFPD collision reporting forms were updated in April 2018 with new variables to capture the involvement of TNCs and AVs in collisions as well.

## Reporting and Next Steps

We implemented the changes described in this methodology in October 2018. We will review our six-month data to report a preliminary analysis of the burden of injury related to EMST in San Francisco, CA in fall 2019. Our 2018 data were employed as a part of a mid-point evaluation of the year-long powered scooter pilot currently underway in San Francisco, which allows two private companies to make e-scooters available for rent on city streets. A more comprehensive look at e-scooter associated collision and injury in San Francisco over the course of 2018 (a VZIPR product, and an appendix to the former document) is presently available.[10]

## Regional and National Collaboration

As noted earlier, national analysis of EMST-related injuries is significantly limited by the variability in data collection between individual trauma hospitals. This is additionally compounded by a lack of consensus on how to assign ICD-10-CM External Cause Codes to injuries involving EMST. Through an informal survey of ICD-10-CM coding for e-scooter injuries at 17 trauma hospitals throughout the country, we found that over thirty ICD-10 codes were used to classify injuries involving e-scooters (see Appendix E[11]; codes used locally at ZSFG are enumerated in Appendix C). With the increasing availability and popularity of EMST vehicles in cities, inquiries about the safety profiles of these devices are becoming commonplace. There is a clear need for a coordinated national approach to EMST-related injury surveillance in order to accurately assess the relevant injury burden. The VZIPR Collaborative is engaged in a national dialogue with

[10] Vision Zero SF Injury Prevention Research Collaborative. 2019. E-Scooter Collision and Injury Analysis. San Francisco, CA. Available at: https://www.sfdph.org/dph/EH/PHES/PHES/TransportationandHealth.asp

[11] This work was spearheaded by Christy Adams, UC Davis Health Trauma Prevention Coordinator

stakeholders in public health and injury prevention, trauma surgery and traffic safety to address these issues and inform targeted recommendations for national standards. One forthcoming action is to request the National Center for Health Statistics ICD-10-CM Coordination and Maintenance committee to revise and/or expand ICD-10 codes for incidents involving different types of EMST, with an initial focus on e-scooters and e-bikes.

## Conclusion

The recent proliferation of EMST in urban centers across the country– and internationally– presents a unique challenge to the local and state governments who regulate them, and the hospitals and trauma centers charged with treating injuries associated with these emerging vehicle types. This methodology is a response to the need for timely and high-quality data to empirically track and better understand injuries arising from use of these formerly uncommon vehicles. It provides an opportunity to study emerging innovations and to inform data-driven injury prevention efforts. The VZIPR Collaborative is well-poised to continue to address future emerging mobility safety concerns with the goal of supporting safe, sustainable and equitable transportation in San Francisco and throughout the nation.

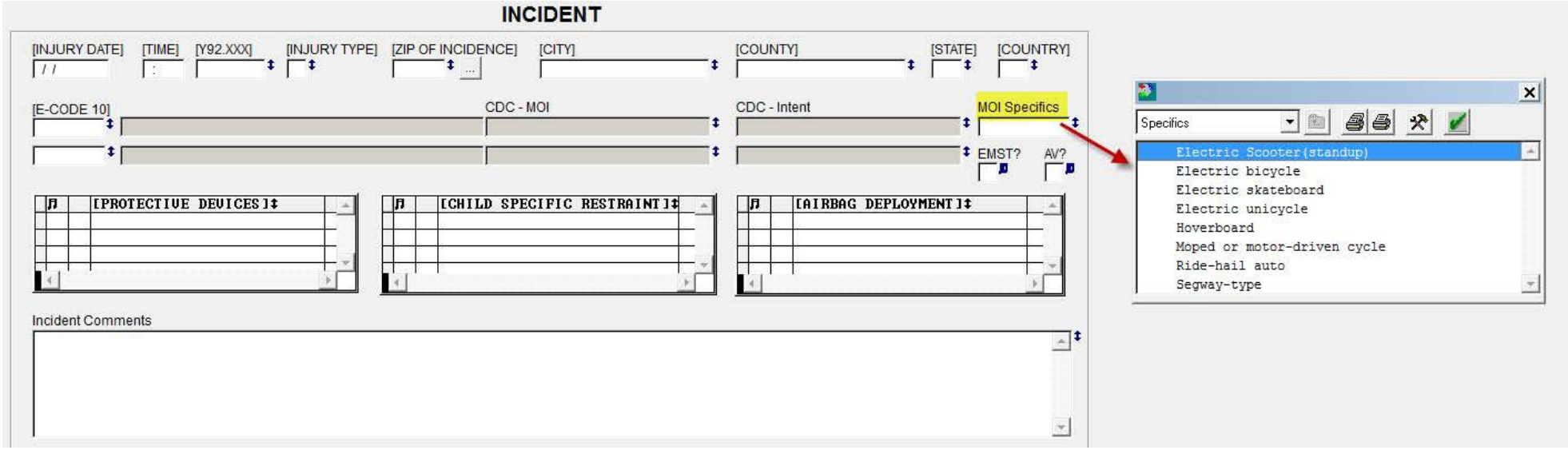
## Appendix A: Additions to Trauma Registry Questions

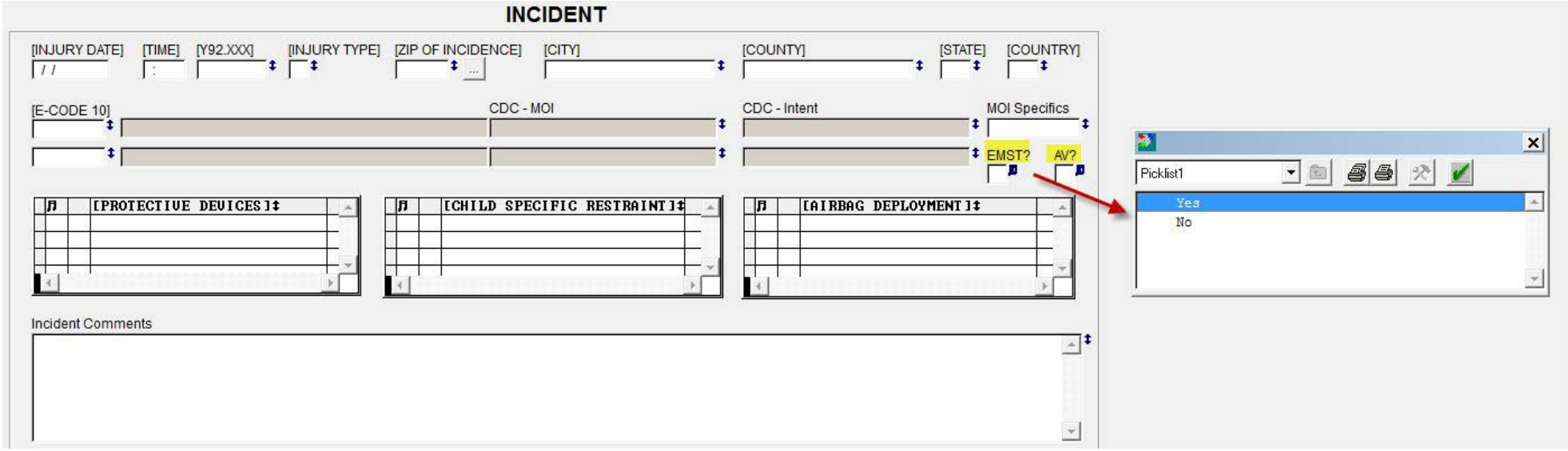
| Question | Answer choices | Example Image |
|---|---|---|
| 1) New vehicle type | 0 None (N/A) | |
| | 1 Unknown | |
| | 2 Electric bicycle |  |
| | 3 Powered scooter (standup) |  |
| | 4 Moped or motor-driven cycle |  |
| | 5 Electric skateboard |  |
| | 6 Hoverboard, electric unicycle, other electrically motorized board |  |
| | 7 Segway-type vehicle |  |
| | 8 Ride-hail vehicle, Transportation Network Company car (TNCs; e.g. Uber, Lyft) |  |
| | 9 Other | |

## Appendix A: Additions to Trauma Registry Questions

| | | | |
|---|---|---|---|
| 2) | Was an emerging mobility service or sharing technology involved in the collision? (e.g. Lyft, Uber, Scoot, Ford GoBike, JUMP Bike, Lime, Skip, Chariot, Zipcar, City Carshare, Maven, Waymo, etc.) | 0<br>1<br>2 | Unknown<br>No<br>Yes |
| 3) | Was an autonomous vehicle (AV) involved in the collision? | 0<br>1<br>2 | Unknown<br>No, conventional vehicle<br>Yes |

## Appendix B: Screenshot of Data Entry into ZSFG Trauma Registry



## Appendix C: ICD-10-CM Codes Used Currently at ZSFG for EMST-related Injuries

| ICD-10 CM Code | Code description |
|---|---|
| V00.09XA | Pedestrian on foot injured in collision with other pedestrian conveyance* |
| V00.891A | Fall from other pedestrian conveyance* |
| V00.892A | Pedestrian on other pedestrian conveyance* colliding with stationary object |
| V00.898A | Other accident on other pedestrian conveyance* |
| V01.09XA | Pedestrian with other conveyance injured in collision with pedal cycle in nontraffic accident† |
| V01.19XA | Pedestrian with other conveyance injured in collision with pedal cycle in traffic accident (not limited to EMST-related accidents) |
| V02.09XA | Pedestrian with other conveyance injured in collision with two- or three-wheeled motor vehicle in nontraffic accident† |
| V02.19XA | Pedestrian with other conveyance injured in collision with two- or three-wheeled motor vehicle in traffic accident |
| V03.09XA | Pedestrian with other conveyance injured in collision with car, pick-up truck or van in nontraffic accident† |
| V03.19XA | Pedestrian with other conveyance injured in collision with car, pick-up truck or van in traffic accident |
| V04.09XA | Pedestrian with other conveyance injured in collision with heavy transport vehicle or bus in nontraffic accident† |
| V04.19XA | Pedestrian with other conveyance injured in collision with heavy transport vehicle or bus in traffic accident |
| V05.09XA | Pedestrian with other conveyance injured in collision with railway train or railway vehicle in nontraffic accident† |
| V05.19XA | Pedestrian with other conveyance injured in collision with railway train or railway vehicle in traffic accident |
| V06.09XA | Pedestrian with other conveyance injured in collision with other nonmotor vehicle in nontraffic accident† |
| V06.19XA | Pedestrian with other conveyance injured in collision with other nonmotor vehicle in traffic accident |

* "*Other pedestrian conveyance*" includes powered scooter (stand up), electric skateboard, hoverboard, electric unicycle, Segway-type vehicle

† "*Nontraffic accident*" refers to an incident that didn't occur on a roadway or street

## Appendix C: ICD-10-CM Codes Used Currently at ZSFG for EMST-related Injuries

| ICD-10 CM Code | Code description |
|---|---|
| V20.4XXA | Motorcycle‡ driver injured in collision with pedestrian or animal in traffic accident |
| V20.5XXA | Motorcycle‡ passenger injured in collision with pedestrian or animal in traffic accident |
| V21.4XXA | Motorcycle‡ driver injured in collision with pedal cycle in traffic accident |
| V21.5XXA | Motorcycle‡ passenger injured in collision with pedal cycle in traffic accident |
| V23.4XXA | Motorcycle‡ driver injured in collision with car, pick-up truck or van in traffic accident |
| V23.5XXA | Motorcycle‡ passenger injured in collision with car, pick-up truck or van in traffic accident |
| V24.4XXA | Motorcycle‡ driver injured in collision with heavy transport vehicle or bus in traffic accident |
| V24.5XXA | Motorcycle‡ passenger injured in collision with heavy transport vehicle or bus in traffic accident |
| V25.4XXA | Motorcycle‡ driver injured in collision with railway train or railway vehicle in traffic accident |
| V25.5XXA | Motorcycle‡ passenger injured in collision with railway train or railway vehicle in traffic accident |
| V26.4XXA | Motorcycle‡ driver injured in collision with other nonmotor vehicle in traffic accident |
| V26.5XXA | Motorcycle‡ passenger injured in collision with other nonmotor vehicle in traffic accident |
| V27.4XXA | Motorcycle‡ driver injured in collision with fixed or stationary object in traffic accident |
| V27.5XXA | Motorcycle‡ passenger injured in collision with fixed or stationary object in traffic accident |
| V28.4XXA | Motorcycle‡ driver injured in noncollision transport accident in traffic accident |
| V28.5XXA | Motorcycle‡ passenger injured in noncollision transport accident in traffic accident |
| V87.7XXA | Person injured in collision between other specified motor vehicles (traffic) |
| V87.8XXA | Person injured in other specified noncollision transport accidents involving motor vehicle (traffic) |
| V87.9XXA | Person injured in other specified (collision)(noncollision) transport accidents involving nonmotor vehicle (traffic) |

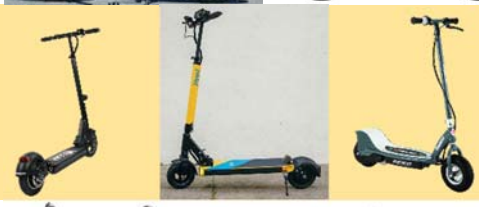
‡ "*Motorcycle*" includes: shared moped or motor scooter and e-bicycle

Appendix D: New Transport Modes Poster

# How to Classify New Modes of Transportation

**What we're doing:** SFDPH and SFPD are working to better **capture and track injuries involving newer vehicle types** and methods of transportation access (e.g. vehicle sharing programs and app-accessed ride hail) to inform injury prevention measures.

**The ask:** Pre-hospital and ER staff collect crucial information about collisions that patients may not be able to report themselves. To assist **we ask that you include any of the following terms that may apply to a collision in the narrative description**. Example images are included for clarity:

| | |
|---|---|
| **Electric bicycle (or e-bicycle, e-bike)** |  |
| **Powered standup scooter (or e-scooter)** |  |
| **Moped or motor-driven cycle** |  |
| **Electric skateboard (or e-skateboard)** |  |
| **Hoverboard, electric unicycle, other electrically motorized board** |  |
| **Segway-type vehicle** |  |
| **Ride-hail vehicle, Transportation Network Company car (TNCs; e.g. Uber, Lyft)** |  |
| **Autonomous vehicle** |  |

Please refer questions to shamsi.soltani@sfdph.org

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VISION ZERO SF

## Appendix E: ICD-10-CM Codes Currently Used Regionally for e-Scooter Injuries

| | |
|---|---|
| V00.09XA | Pedestrian on foot injured in collision with other pedestrian conveyance |
| V00.141A | Fall from scooter (nonmotorized) |
| V00.142A | Scooter (nonmotorized) colliding with stationary object |
| V00.148A | Other scooter (nonmotorized) accident |
| V00.181 | Fall from other rolling-type pedestrian conveyance |
| V00.182 | Pedestrian on other rolling-type pedestrian conveyance colliding with stationary object |
| V00.188 | Other accident on other rolling-type pedestrian conveyance |
| V00.381A | Fall from other flat-bottomed pedestrian conveyance |
| V00.381A | Fall from other flat-bottomed pedestrian conveyance |
| V00.382A | Pedestrian on other flat-bottomed pedestrian conveyance colliding with stationary object |
| V00.388A | Other accident on other flat-bottomed pedestrian conveyance |
| V00.831A | Fall from motorized mobility scooter |
| V00.832A | Motorized mobility scooter colliding with stationary object |
| V00.891A | Fall from other pedestrian conveyance |
| V00.892A | Pedestrian on other pedestrian conveyance colliding with stationary object |
| V00.898A | Other accident on other pedestrian conveyance |
| V01.09XA | Pedestrian with other conveyance injured in collision with pedal cycle in non- traffic accident |
| V01.19XA | Pedestrian with other conveyance injured in collision with pedal cycle in traffic accident |
| V03.19XA | Pedestrian with other conveyance injured in collision with car, pick-up truck or van in traffic accident |
| V04.19XA | Pedestrian with other conveyance injured in collision with heavy transport vehicle or bus in traffic accident |
| V05.19XA | Pedestrian with other conveyance injured in collision with railway train or railway vehicle in traffic accident |
| V06.99XD | Pedestrian with other conveyance injured in collision with other nonmotor vehicle, unspecified whether traffic or nontraffic accident |
| V23.0XXA | Motorcycle driver injured in collision with car, pick-up truck or van in nontraffic accident |
| V23.4XXA | Motorcycle driver injured in collision with car, pick-up truck or van in traffic accident |
| V27.0XXA | Unspecified motorcycle rider injured in collision with fixed or stationary object in nontraffic accident |
| V28.1XXA | Motorcycle passenger injured in noncollision transport accident in nontraffic accident |
| V28.4XXA | Motorcycle driver injured in noncollision transport accident in traffic accident |
| V87.7XXA | Person injured in collision between other specified motor vehicles (traffic) |
| V87.8XXA | Person injured in other specified noncollision transport accidents involving motor vehicle (traffic) |
| V87.9XXA | Person injured in other specified (collision)(noncollision) transport accidents involving nonmotor vehicle (traffic) |
| V87.7XXA | Person injured in collision between other specified motor vehicles (traffic) |
| V87.8XXA | Person injured in other specified noncollision transport accidents involving motor vehicle (traffic) |