Scooting into a New Era: A Review of Agency Regulations on Shared E-Scooters Programs

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ABSTRACT

Technological advances and trends have recently shifted towards micro-mobility and shared methods, resulting in a rapidly changing transportation landscape. While there has been a sharp increase in one of these technologies, shared electric scooters (or e-scooters), cities have had to work quickly to develop, adopt, and revise new regulatory policies to address and manage these new entities. The result has been city-led efforts grappling with policies managing everything from placement, parking, geofencing, vehicle specification requirements, fee structures, data management and sharing, safety features, to liability—all of which have implications on equitable access, economic development, public health, safety, and welfare. This study aims to illuminate the concerns and considerations of agencies across the US through their regulatory policies managing public access to shared e-scooter programs.

The objectives of this study are two-fold. First, we aim to explore the limited (but growing) literature concerning studies and evaluations of shared e-scooter programs along themes of safety, use and users, and operations and management. Second, we provide a detailed analysis of regulations adopted from 39 agencies within the US. This analysis documents themes and considerations across all types of policies—from permitting requirements to public ordinances. In this paper, we aim to expand and update the number of cities reviewed by Anderson-Hall et al. (2019).

Keywords: e-scooter, micro-mobility, policy, regulation

INTRODUCTION

Whereas urban transportation methods have heavily relied on transit and car-centric means, technological advances and trends have recently shifted towards micro-mobility and shared methods, resulting in a rapidly changing transportation landscape. While there has been a sharp increase in one of these technologies, shared electric scooters (or e-scooters), cities have had to work quickly to develop, adopt, and revise new regulatory policies to address and manage these new entities. The result has been city-led efforts grappling with policies managing everything from placement, parking, geofencing, vehicle specification requirements, fee structures, data management and sharing, safety features, to liability—all of which have implications on equitable access, economic development, public health, safety, and welfare. This study aims to illuminate the concerns and considerations of agencies across the US through their regulatory policies managing public access to shared e-scooter programs.

E-scooters have been praised for being fun, convenient, and a sustainable alternative to car-oriented means (such as one-person trips, car-share and ride-hailing services) and a supplement to a multimodal lifestyle. However, both public and academic leaders also have concerns based on questions related to public safety, dockless disorganization, and the reduction of pedestrians, bicyclists and transit riders who utilization them in lieu of their normal transportation method. It is around these topics that agencies find themselves questioning: what do we know about the impacts of e-scooters or other micro-mobilities? And how do cities regulate such a new and popular method of transportation method? Studies that support new policies are limited but growing.

The objectives of this study are two-fold. First, we aim to explore the limited (but growing) literature concerning studies and evaluations of shared e-scooter programs along themes of safety, use and users, and operations and management. Second, we provide a detailed analysis of regulations adopted from 39 agencies within the US. This analysis documents themes and considerations across all types of policies—from permitting requirements to public ordinances. A similar review was completed last year by Anderson-Hall et al; however, e-scooter programs have grown ten-fold over the past year, with substantially more agencies engaging in the regulation of this new transportation technology. In this paper, we aim to expand and update the number of cities reviewed from Anderson-Hall's review. But first, we provide a review of the background from academic research, white papers, and news reports.

BACKGROUND

Overall, there is a limited (but accelerating) literature considering the implications of e-scooters on cities and individuals. While some studies have suggested e-scooters and other similar micro-mobility options may provide a viable low-cost transportation option, others point to the mounting concerns related to the safe operation and use of the technology. This short background review touches on the studies evaluating or predicting the safety, use and users, and operation and maintenance of e-scooters. In general, findings across studies have not yet identified a consistent narrative of the users or use of the tool, leading many to predict ridership using existing similar modes, such as dockless and station-based bikeshare (either electric or manual).

Injuries & Safety

Proper policy making for new modes must balance the goal of maximizing transportation options while also ensuring public safety (*1*). And although a 2018 poll suggests general public favor (70% to 30%) for micro-mobility options in major U.S. cities (*2*), concerns about the safety of e-

scooters are not entirely unfounded. Safety concerns have reached such a point that the US Centers for Disease Control and Prevention has initiated an effort to try to better understand injuries from this new mode with an epidemiological lens (*3*). In a study focusing on both electric bicycles (aka. e-bikes) and e-scooters, Siman-Tov et al (*4*) estimated that e-bike and e-scooter related injuries increased by 600% over a two-year period. In a smaller pilot study, the initial findings suggest that micro-mobility users demonstrate unsafe behavior at similar rates to cyclists (*5*)—finding indications that increases in active transportation usage at a downtown protected intersections can primarily be attributed to micro-mobility e-scooters. In most jurisdictions with pilot programs or e-scooter legislation riding on the sidewalk is often prohibited, but enforcement of illegal riding is inconsistent (*1–3*, *6–10*). Although most municipalities, required e-scooter users to wear helmets, observed helmet use is very low across all jurisdictions, creating safety concerns relating to head injuries (*3*, *7–9*). During the micro-mobility pilot period implemented in Portland, Oregon, for example, recorded helmet use was found to be around 10% (*7*), and as low as 2% among riders in Austin, Texas (*3*). As e-scooters are new to urban areas, few studies have quantified crash rates, including the type and severity of crashes and potential causes. A brief study during the Portland pilot identified 176 emergency room visits as a result of scooter operations out of a total of 700,000 recorded scooter trips. During this period, no fatal injuries were recorded as a result of e-scooter operations. The most common injuries consisted of head and superficial extremity injuries. One third of recorded injuries were to the head and neck and 7% of emergency room visits resulted in a concussion diagnosis (*11*).

Use and Users

In a broad exploration of data collected across the United States, Populus (*2*) found that women have used station-based bikeshare services at nearly half the rate of men (12% versus 21%) accounting for approximately 25% of all station-based bikesharing trips, suggesting a gender-gap in station-based bikesharing use. While their data are limited, Populus (*2*) estimates that a smaller percent of women have since tried e-scooters compared with men. However, more recently, evidence from the Portland, Oregon pilot (not yet peer reviewed) suggests that women in Portland may enjoy e-scooters for recreation, but use them less for commuting (*12*). In terms of demographics, Circella et al (*13*) indicates the likely micro-mobility users are 'active travelers' who tend to live in smaller households with fewer children, have fewer vehicles available, and live in urban neighborhoods with better access to non-motorized modes. While some argue that micro-mobility technologies may compete with public transit usage, in 2017, an estimated 74% of the growing 35 million e-scooter trips occurred in transit-rich urban areas (*14*). In contrast, Smith and Schwieterman (*15*) estimated the use of e-scooters in Chicago provide a low-cost transportation option that operates as a strong compliment to transit. In Portland, e-scooter trips from residents (34%) and visitors (48%) tended to replace driving and ride-hailing trips (*7*).

Operations & Management

At present, e-scooter operations and management (O&M) practices have been primarily built into the permit application terms of pilot programs. Elements of O&M include things like: the spatial distribution of scooters (restrictions in service areas, distribution across space), any redistribution requirements, vehicle parking requirements, or vehicle servicing and reporting requirements. However, the success of these regulations—that constrain or incentivize spatial deployment of vehicles; redistribution of vehicles; and maintain compliance in regards to parked

vehicles—are unclear. In Portland, 72.8% of scooters were compliant in the parking requirements, 2.8% of e-scooters parked impeded access to ADA facilities, 5.3% of parked e-scooters completely blocked pedestrian traffic, and 8.1% partially blocked pedestrian traffic (*7*). In San Jose, 72% of scooters were parked on sidewalks, and 23% were parked on adjacent properties—90% of parked scooters did not impede pedestrian traffic (*16*). Parking issues in Portland, however, made up 14% of all complaints issued and by anecdotal observation, pilot staff observed fewer parking related complaints as the pilot program progressed (*7*).

METHODS & DATA

In this section, we describe the two-step process we used to: (a) identify and collect; and then (b) code and analyze e-scooter regulations which come in many forms including, but not limited to: adopted memorandums, policies, regulations, permitting requirements, ordinances, and codes. As we identified new agencies, we added new documents—and corresponding new themes and characteristics—to our sample. Initial documents were then re-reviewed to ensure a consistent coding of documents. We continued to iterate through this process until we could no longer identify any new major themes or characteristics.

Identifying and Collecting Agency Regulations

First, to identify and collect regulations from cities or counties, we completed an iterative series of online searches. These searches included investigating existing comprehensive internet websites—Smart Cities Drive or SCD (*17*) and the Shared Use Mobility Learning Center or SUMLC (*18*)—and individual agency websites that were known to have e-scooters in (or near) service. Most jurisdictions we observed have programs that were operational, a handful had yet to begin (e.g., Chicago and Winston-Salem), and several had finished and/or extended their pilot program. One such case, St. Paul, re-implemented their e-scooter program for the 2019 year. St. Paul's second year of operation allows 2,000 shared-mobility devices, raised from 300 during the 2018 pilot program.

Through SCD's website, we identified key qualities of e-scooters regulations in cities across the U.S., such as: spatial locations & dispersion; e-scooter bans; currently permitted vender(s); and spatial distribution of vender(s). This map enabled us to identify additional agencies to explore manually. While SCD provides some hyperlinks to relevant documents, not all of the links were relevant for this study. For example, some lead to the city's educational page on local e-scooter rules, related news articles, or adopted policies related to their program's enactment.

The SUMLC yielded several agency documents related to their e-scooter programs. To identify relevant documents, keyword searches were performed on terms such as: "dockless", "shared mobility", "pilot program", "e-scooter", "active transportation", and "micro-mobility". SUMLC provides a summary of the act of legislation by the local jurisdiction along with hyperlinks to the related permitting documents.

Outside of the SCD and SUMLC resources, the process of aggregating e-scooter policies and regulations proved to be difficult. E-scooter policies of many of the cities that are known to have e-scooters were often unable to be found publicly online, and this constrained identifying cities by the availability of documents online. We were not able to find any publicly available regulations for at least two dozen agencies that are known to have e-scooters currently operating in their jurisdictions. It is possible that these agencies do not have any regulations in place. The final sample of regulations analyzed in this sample includes forty agencies representing the

sample of current policy trends for shared micro-mobility, specifically e-scooters (see TABLE 1).

TABLE 1 Jurisdictions Included in this Policy Review

Jurisdiction (citation)	Policy Reference	Transit Systems	Population in 2018[3]
Albuquerque, NM	(*19*, *20*)	BRT, CR, LB	560,218
Arlington County, VA[1]	(*21*)	SW, BRT, LB	237,521
Atlanta, GA	(*22*, *23*)	CR, SC, SW, LB	498,044
Austin, TX	(*24*)	CR, LB	964,254
Baltimore, MD	(*25*, *26*)	SW, CR, LR, LB	602,495
Boise, ID	(*27*)	LB	228,790
Charlotte, NC	(*28*)	LR, SC, LB	872,498
Chicago, IL[1]	(*29*)	SW, CR, LB	2,705,994
Cincinnati, OH	(*30*, *31*)	LB, SC	302,605
Columbus, OH	(*32*)	BRT, LB	892,533
Dallas, TX	(*33*)	LR, CR, SC, LB	1,345,047
Detroit, MI	(*34*)	LR, LB	672,662
Denver, CO	(*35*, *36*)	CR, LR, LB	716,492
Durham, NC	(*37*, *38*)	LB	274,291
Fort Lauderdale, FL	(*39*)	CR, LB	182,595
Greensboro, NC	(*40*)	LB	294,722
Indianapolis, IN	(*41*)	LB	867,125
Lubbock, TX	(*42*)	LB	255,885
Long Beach, CA	(*43*)	LR, LB	467,354
Memphis, TN	(*44*)	LB	650,618
Miami, FL	(*45*)	SW[2], LB	470,914
Minneapolis, MN[1]	(*46*, *47*)	LR, BRT, CR, LB	425,403
Montgomery County, MD[1]	(*48*)	SW, CR, LR, LB	1,052,567
Oakland, CA	(*49*)	SW, LB	429,082
Oxford, OH	(*50*)	LB	22,885
Portland, OR[1]	(*7*)	LR, CR, SC, LB	583,776
Providence, RI	(*51*)	LB	179,335
Raleigh, NC	(*52*)	LB	469,298
Sacramento, CA	(*53*)	LR, LB	508,529
Salt Lake City, UT	(*54*)	LR, CR, SC, LB	200,591
San Diego, CA	(*55*, *56*)	LR, BRT, CR, SC, LB	1,425,976
San Francisco, CA	(*57*)	SW, LR, CR, SC, LB	892,533
San Jose, CA	(*58*, *59*)	LR, BRT, CR, LB	1,030,119
Scottsdale, AZ	(*60*)	LB	255,310
St. Louis, MI	(*61*)	LR, LB	302,838
St. Paul, MN	(*62*, *63*)	LR, BRT, LB	307,69
Virginia Beach, VA	(*64*)	LB	450,189
Washington, D.C.	(*65*, *66*)	SW, CR, SC, LB	702,455
Winston-Salem, NC	(*67*)	LB	246,328

Notes:
SW: Subway; LR: Light-rail; BRT: Bus Rapid Transit; CR: Commuter Rail; SC: Streetcar; and LB: Local Bus.

[1] Regulations originally implemented for a pilot or demonstration program.

[2] Miami has above-group mass transit system that operates similar to a subway.

[3] U.S. Census Bureau (2018) Estimates (Table: PEPANNRES – Annual Estimates of the Resident Population: April 1, 2010 to July 1, 2018).

Analyzing Agency Documents

Once the agency documents were compiled, we dissected the documents to identify patterns of similarities and differences. Throughout this iterative process of reviewing and coding the documents, we identified 9 initial overarching themes: fee schedule; presence; reasons for removal; data sharing; equity; parking regulations; safety factors; education requirements; and goals.

We then reviewed the full set of documents more thoroughly, coding the documents based on qualities and differences within each of the themes. The details of different elements of regulations were coded in excel to distill major patterns discussed in the following section. During this process, we also looked for elements of any one agency's documents that might vary. For example, when reviewing varying requirements associated with "Regulations Related to Safety", we identified several categories of Safety—e.g., brake requirements, front and/or rear lights, speed limits, rider education, age requirements, and safety reporting. The full coding scheme was then reviewed (and repeated) for consistency.

During this second more thorough review, if new agencies and/or documents were identified, the new documents were coded based on the revised criteria, reviewed for any new themes or element. This iterative review process continued until the authors were confident they captured the major themes and variations in the corresponding criteria for all agencies studied. The major themes identified during this process and explored below include: fees and charges; ridership and data requirements; vehicle specifications and safety concerns; parking and restricted access; and equity.

RESULTS

Fees & Charges

Not surprisingly, one of the most common features in e-scooter regulations are fees and charges: application and permitting of venders, device and/or per day or per trip fee. Permitting and/or licensing fees are paid by the vender annually to operate within the jurisdiction. Alternatively, cities may charge a 'per trip' fee to the rider. These fees are akin to automobile vehicle licensing fees, but in micro-mobility policies that take many different forms.

In the case of permitting and application fees, most agencies charge an annual and/or daily device fee. Ranges of these fees was as little as $250 for Durham and up to $50,000 for Miami's "licensing fee". Portland was a unique outlier, charging a per-trip fee of $0.25 per trip taken on an e-scooter. Two agencies currently impose more than one use fee to the vender and/or rider. The wide variation in fee rates and units may correspond to state or county regulations defining or restricting the use and application of fees.

TABLE 2 Fees and Charges by Jurisdiction

Jurisdiction	Fee Type	Who is charged?	Amount (USD)	Unit
Atlanta, GA	Application Fee	Vendor	$100	Per application
	Permit Fee	Vender	$12,000	Per vender license
Chicago, IL	Application Fee	Vender	$250	Per application
Cincinnati, OH	Application Fee	Vender	$5,000	Per application
	Per Day Fee	Vender	$1	Per scooter
Columbus, OH	Annual Fee	Vender	$2,100	1-100 scooters;
			$4,200	101-200;

			$6,300 $8,400 $9,600 $21 per device	201-300; 301-400; 401-500; >500
Dallas, TX	Application Fee	Vender	$808	Per application
Denver, CO	Application Fee	Vender	$150	Per application
	Permit Fee	Vender	$15,000	Per vender license
Durham, NC	Application Fee	Vender	$1,000	Per application
	Permit Fee	Vender	$250	Per vender license
	Annual Fee	Vender	$100	Per scooter
Fort Lauderdale, FL	Permit Fee	Vender	$150	Per vender license
	Annual Fee	Vender	$10	Per vender license
Greensboro, NC	Permit Fee	Vender	$500	Per vender license
	Annual Fee	Vender	$50	Per scooter
Indianapolis, IN	Permit Fee	Vender	$15,000	Per vender license
	Per Day Fee	Vender	$1	Per scooter
Long Beach, CA	ROW Fee	Vender	$2,336	Per vender license
	License Fee	Vender	$177.62	Per vender license
Lubbock, TX	Permit Fee	Vender	$750	Per vender license
Miami, FL	License Fee	Vender	$50,000	Per vender license
	Per Day Fee	Vender	$1	Per scooter
Portland, OR	User fee	Rider	$0.25	Per trip taken
	Application Fee	Vender	$250	Per application
	Permit Fee	Vender	$5,000	Per vender license
Providence, RI	Per Day Fee	Vender	$1	Per scooter
San Francisco, CA	Application Fee	Vender	$5,000	Per application
	Permit Fee	Vender	$25,000	Per vender license
St. Louis, MO	Application Fee	Vender	$500	Per application
	Annual Fee	Vender	$10	Per scooter
St. Paul, MN	Annual Fee	Vender	$100	Per scooter
	Park Impact Fee	Vender	$0.25	Per scooter per trip for all trips that begin or end on parkland
Winston-Salem, NC	Application Fee	Vender	$1,000	Per vender license
	Annual Fee	Vender	$100	Per scooter

Notes:
For any jurisdiction listed in TABLE 1 but not listed in this table, this indicates no relevant requirements were identified in the documents reviewed.

Ridership & Data Requirements

Many agencies view the 'utilization' of e-scooters as an important metric to evaluate how effective an e-scooter system may be and if the venders are meeting any city requirements or goals. For the cities reviewed in this study, the effective usage of the scooters has been measured in distance ridden, time ridden, frequency of trips or 'active' riders, or number of times a device is used.

Agencies generally aim to track whether e-scooters (a) are not oversaturating neighborhoods, and (b) that the devices are consistently available for their residents within service areas. Many require venders to meet a Minimum Utilization Rate, or MUR. The MUR calculates the average number of trips per device within a fleet conducts in daily, weekly, and/or

monthly—i.e., a fleet size of 500 devices yielding 1,300 rides in one day has a MUR of 2.6 rides per device. Depending on the MUR, a vender's fleet size can be evaluated for possible expansion, reduction, or maintenance. Of those observed agencies, the required MUR fell between 2.0 and 3.0 average trips per device. Per Charlotte's ordinance, an operator's fleet must maintain a MUR average of at least 2.0 per month, or the fleet is subject to removal in increments of 50 at a time; MURs greater than 3.0 may request an increase in fleet size of 50 mobility devices per month. It should be noted that some cities cap the number of excess scooters that are permitted as variances.

To calculate MUR, 23 agencies required some form of minimum data sharing. There are prominent and consistent data requirements shared amongst the cities, including the number of trips taken in a particular period (day, week, and/or month), the duration (both time and distance) of a trip, and, as mentioned previously, MUR. The majority of the observed cities also require the origin and destination of each trip (the format of longitude and latitude) to be shared. The most common data formats required include: Mobility Data Specification (MDS), JSON, and/or General Bike Feed Specification (GBFS). GBFS was the most preferred. Application Program Interface (API) was typically required to review use data, to access real-time evaluation and monitoring of operations and redistributions. In Washington, D.C., an "On-board GPS technology" is required, allowing real-time data via API that "does not obtain spatial information by relying on a customer's smart phone". 13 of the jurisdictions reviewed have required the location where trips originate and where they end. Less frequently, the agencies of Arlington, Minneapolis, and Portland include a clause requiring spatial maps displaying trips taken.

In addition to user-behavior data, most cities may have some stipulation that require vendors to provide spatial information about the e-scooters when parked. The data requirements typically include data describing scooter locations (both in parked, and when in motion) and ridership information. As an example, Washington, D.C. requires the dockless sharing vehicles to transmit GPS data "at a minimum of every 90 seconds while in use" and "at a minimum of every 60 minutes while parked".

Processing raw e-scooter data can be problematic for jurisdictions with limited budget for processing 'big data'. In response, some agencies included requirements allowing the data to be shared to contracted third-party data aggregation firms. Data processing and analysis capabilities vary across agencies, but some agencies have opted to outsource the analysis and data privacy concerns to third-party data companies, including Populus, Shared Streets, and Remix. In an initial review of similar services range from no fees to upwards to $30,000 annually, depending on jurisdiction size, service areas, and the complexity of requested analysis. Capabilities of these companies include: the spatial depiction of reported accidents; providing heat maps of routes traveled; and spatial depiction of e-scooters in use or parked. Beyond these capabilities, the staff time that would be dedicated to understanding and computing the provided data could be onerous. Logically, agencies could circumvent the cost of the third-party data firms by accessing internal data processing skills and labor, or justifying this cost within their fee schedules.

Vehicle Specifications & Safety Concerns

Most agencies place restrictions on the vehicle specifications, likely in response to safety concerns. The most common specifications included the shared mobility devices being equipped with front lights, back lights, brakes, unique identifying numbers, and (less common) a device that has the capability of emitting an alert noise. Some ordinances specified to what distance the lights must be visible, as indicated within Table 3.

Common also was the maximum speed restriction of e-scooters. 21 jurisdictions outlined a maximum speed: 17 restricted scooters to 15 Miles Per Hour (MPH); 2 jurisdictions required a lower speed (Arlington and Washington, D.C.); and 2 cities placed their limit at 20 MPH (Columbus and Indianapolis).

Associated with speed and safety, 3 cities restricted speeds in specific areas: Baltimore limits the scooters to 8 MPH along the Inner Harbor Promenade; San Jose's restriction to 12 MPH in the Downtown Core; and St. Paul's 10 MPH limit in designated parkland areas. Although required, there has been some concern whether these vehicles can be adequately constrained to their location-specific speed restrictions.

TABLE 3 Jurisdictions with Vehicle Specification

Jurisdiction	Front Light [1]	Rear Light [1]	Brake	Speed Limit (MPH)	Reduced Speed Zones (MPH)
Arlington, VA	Yes	Yes	Yes	10	-
Atlanta, GA	-	-	-	15	-
Austin, TX	Yes (300')	Yes (300')	Yes	15	-
Baltimore, MD	Yes	Yes	Yes	15	Yes, 8
Boise, ID	-	-	-	15	-
Charlotte, NC	Yes	Yes	Yes	15	-
Chicago, IL	Yes	Yes	Yes	15	-
Cincinnati, OH	-	-	-	15	-
Columbus, OH	Yes	Yes	Yes	20	-
Detroit, MI	Yes	Yes	Yes	15	-
Fort Lauderdale, FL	-	-	-	15	-
Indianapolis, IN	Yes	Yes	-	20	-
Long Beach, CA	-	-	Yes	15	-
Lubbock, TX	Yes (500')	Yes (500')	Yes	-	-
Miami, FL	-	-	-	15	-
Montgomery County, MD	-	-	-	15	-
Portland, OR	-	-	-	15	-
Sacramento, CA	-	-	-	15	-
San Francisco, CA	Yes	Yes	Yes	-	-
San Jose, CA	-	-	-	15	12
St. Louis, MO	Yes (300')	Yes (500')	Yes	15	-
St. Paul, MN	Yes	Yes	-	-	10
Winston-Salem, NC	Yes (500')	Yes (500')	Yes	-	-
Washington, D.C.	-	-	-	10	-

Notes:
-: Indicates no mention of vehicle specification requirements
[1] If the requirement specified the distance from which the light must be seen, the distance is included in parentheses.
For any jurisdiction listed in TABLE 1 but not listed in this table, this indicates no relevant requirements were identified in the documents reviewed.

Twelve agencies required a minimum rider age between 16 through 18: (N=7 for 16 years; N=5 for 18 years). Albeit, Chicago requires granted permission for anyone between 16 and 18 to ride, and Columbus requires anyone between 16 and 18 to wear a helmet when riding a device. Oxford's ordinance states "persons holding a valid driver's license" may operate an e-scooter.

We were surprised to discover that there are few requirements related to injury or crash reporting. Arlington and Portland included language relating to injury reporting within their data share agreements. It is speculated that many injuries go unreported, perhaps due to incidents involving solely the user, and that privacy laws inhibit that reporting from being shared.

Rebalancing/Removal

As e-scooters are dockless, many agencies have expressed concern about how e-scooters are rebalanced across service areas. Dockless means that the user may end their trip in any acceptable location. Multiple agencies observed have specific time frames that improperly parked and/or malfunctioning e-scooters must be rebalanced and/or removed following a reported complaint. The response times to which a reported scooter must be addressed range from 1 hour and up to 12 hours. This varies by jurisdiction but primarily by the time of day and which day of the week. To ensure rebalancing on reported e-scooters occurs, 19 of the jurisdictions require a 24-hour customer care line, 5 require operators to maintain a local office, and 15 require a dedicated point-of-contact from the company.

TABLE 4 Operation and Response Time Requirements by Jurisdiction

Jurisdiction	Required Response Time (weekdays)	Required Response Time (holidays and weekends)	Hours of Operation
Arlington, VA	2 hrs.	2 hrs.	-
Austin, TX	2 hrs. (6:00AM – 6:00PM), 10 hrs. otherwise	10 hrs.	-
Baltimore, MD	-	-	4:00AM – 11:00PM
Charlotte, NC	2 hrs.	2 hrs.	-
Chicago, IL	2 hrs.	2 hrs.	5:00AM – 10:00PM
Cincinnati, OH	2 hrs.	2 hrs.	-
Dallas, TX	2 hrs.	12 hrs.	-
Durham, NC	2 hrs.	12 hrs.	-
Fort Lauderdale, FL	2 hrs.	12 hrs.*	-
Indianapolis, IN	2 hrs. (6:00AM – 9:00PM), 6 hrs. (9:01PM – 5:59AM)		-
Long Beach, CA	2 hrs.	2 hrs.	-

Lubbock, TX	2 hrs.	2 hrs.	-
Miami, FL	2 hrs.	2 hrs.	-
Montgomery County, MD	2 hrs. (6:00AM – 11:00PM), Response prior to 8:00AM (11:00PM – 6:00AM)		5:00AM – 10:00PM
Oakland, CA	3 hrs. (9:00AM – 6:00PM), 12 hrs. otherwise	12 hrs.	-
Oxford, OH	2 hrs. (6:00AM – 6:00PM), 10 hrs. otherwise	10 hrs.	6:00AM – 9:00PM (removal by 10:00PM)
Portland, OR	Varies by Classification: 20 minutes: Emergency (obstruction of dedicated transit lanes, tracks, travel and bicycle lanes); 30 minutes: Emergency (obstruction of pedestrian thruways, other obstruction requiring immediate removal); 60 minutes: Non-emergency (placed on private property, rebalancing off-hours, other obstructions and nuisances)		-
Providence, RI	2 hrs.	2 hrs.	"Unavailable for rental and removed from the street between sunset and sunrise"
Raleigh, NC	2 hrs.	2 hrs.	7:00AM – 10:00PM
Sacramento, CA	2 hrs.	2 hrs.	-
San Diego, CA	2 hrs.	10 hrs.	-
San Francisco, CA	1 hr.	1 hr.	-
San Jose, CA	2 hrs.	2 hrs.	-
St. Paul, MN	2 hrs.	2 hrs.	-
Washington, D.C.	2 hrs.	2 hrs.	24 hours / 7 days a week / 365 days a year
Winston-Salem, NC	2 hrs.	2 hrs.	6:00AM – 9:00PM

Notes:
-: Denotes information that was not identified in the documents reviewed.
*: Fort Lauderdale requires a 12-hour response time during holidays only; All other days are 2 hours
For any jurisdiction listed in TABLE 1 but not listed in this table, this indicates no relevant requirements were identified in the documents reviewed.

Out of the 27 observed agencies, 25 require the operators to address the rebalancing and/or removal issue when related to a reported complaint of an improperly parked and/or non-functioning e-scooter within 2 hours of the complaint. Outlier Portland included additional specification by establishing a hierarchy of obstructions ranging from 20 minutes to 1 hour.

Pertaining to special events, some agencies have a clause granting them the right to require the operator to remove devices if deemed unsafe for the public. Three cities, Cincinnati, Providence and Arlington, reserve the right to require operators to remove devices in extreme weather events.

Many agencies appear concerned about e-scooters during specific times of the day, most notably late evening and before dawn, where individuals riding e-scooters may face a higher risk of incidents on public transportation facilities. From this, 6 agencies have language within their regulations that require e-scooters to be completely removed from city streets.

Parking & Spatial Restrictions

Restrictions on parking primarily address the complications associated with obstruction of dockless scooters. Various prohibitions are identified, with restricted proximity in terms of distance to fire hydrants, intersection pedestrian push buttons, transit platforms and stops, bicycle racks, bicycle share points. Cities and counties have also been dealing with improper parking of scooters by imposing mandates including: in-app education; requiring users to photograph parked vehicle to end rides; outlining 'bins' or designated e-scooter parking places in popular known parking areas; and geofencing of areas where e-scooter use is deemed to be problematic.

Contrary to the common discussion in the media, few agencies offer clear restrictions in terms of providing designated/painted 'bins' or parking spaces for the scooters. Perhaps this is the case as when the programs start, agencies and the operators may have a general idea and/or area where e-scooter users will be parking but await operations and the retrieval of data to identify target areas for bins. However, having the clause may provide the city with power it could wield in the future.

Geofencing, the capability to spatially constrict e-scooters into, or outside of, designated areas, prohibit users from ending rides, and lower traveling speed, is another common requirement. Geofencing was referenced in 12 jurisdictions, with language stating that the operator must have geofencing capabilities, or the city retains the right to decide if areas could have further restrictions.

TABLE 5 Parking and Spatial Restrictions by Jurisdiction

Agency	Capability in Geofencing?	Photo Required	Sidewalk Space Clearance	Bins	Distance related to ADA
Arlington, VA	Yes	-	-	-	-
Atlanta, GA	Yes	-	-	-	-
Austin, TX	Yes	-	3'	Yes	-
Baltimore, MD	Yes	-	-	-	-
Charlotte, NC	Yes	-	6'	-	-
Chicago, IL	Yes	Yes	6'	-	-
Cincinnati, OH	Yes	-	-	-	-
Dallas, TX	Yes	-	4'	-	-
Denver, CO	Yes	-	5' (8' on arterial roads)	-	-
Detroit, MI	Yes	-	6'	-	6'
Fort Lauderdale, FL	-	-	4'	-	-
Greensboro, NC	-	-	6'	-	-
Indianapolis, IN	Yes	Yes	-	Yes, "Drop zones"	-
Long Beach, CA	Yes	-	4'	Yes, "Home zones"	4'
Miami, FL	Yes	-	3'	-	-
Montgomery County, MD	-	-	-	Yes	-
Oxford, OH	Yes	-	-	Yes	-
Portland, OR	-	-	6'	-	5'
Providence, RI	-	-	4'	-	-
Raleigh, NC	Yes	-	5'	-	-

Sacramento, CA	-	-	-	Yes	-
Salt Lake City, UT	-	-	10’ on Main Street; 8’ elsewhere in Zone 1; 5’ in Zones 2 and 3	Yes	15’
San Diego, CA	Yes	Yes	-	-	
San Jose, CA	-	-	-	Yes	“Complies with Americans with Disability Act clearance standards”
St. Paul, MN	Yes	-	5’	-	“Adjacent to, within, or blocking”
Washington, D.C.	Yes	-	5’	-	-

Notes:
-: Denotes information that was not identified in the documents reviewed.
For any jurisdiction listed in TABLE 1 but not listed in this table, this indicates no relevant requirements were identified in the documents reviewed.

In cities that did require geofencing, commonalities were noticed: dense, urban parks and plazas, trails, cemeteries, stadiums and convention centers were the typical areas that were prohibited for parking, or scooter activity all together: Baltimore, St. Louis, and Washington, D.C. geofenced their stadiums; Charlotte and Arlington geofenced cemeteries; Miami, Florida and San Diego geofenced marinas; Atlanta and Dallas have restricted access on inner-city trails. Some universities also had restricted access or limited speed: Boise State University in Boise has enacted a ‘slow-zone’ and North Carolina State University in Raleigh has prohibited scooting all together.

Equity

While less apparent, 17 agencies include policies that aim to promote equity ranging from: equity-zone terms; cash-free options; smartphone-free accessibility; and discount opportunities (see TABLE 6). Although the terms vary, equity-zone policies indicate neighborhoods or districts where (a) venders are required to offer some minimum level of service or (b) venders may receive some additional benefit from servicing. Across the 13 jurisdictions with equity-zone terms, some require a count of vehicles or percentage of the vender’s fleet required within designated zones. Durham set their boundaries by census tracts; Portland used areas that were identified in their 2035 Comprehension Plan; and Minneapolis identified areas based on an update within its Transportation Action Plan.

Accessing e-scooters is typically processed through the operator’s smartphone application. Recognizing that all residents may not possess a phone capable of said apps, 11 of the agencies have embedded smartphone-free accessibility into their regulations to ensure all individuals may have access to e-scooters.

Discounted opportunities and cash-free options were required by 16 jurisdictions. However, 2 agencies required operators to provide unlimited, 30-minutes-or-less trips to

individuals who met a certain financial requirement. Oakland and Oxford, respectively require operators to offer:

> "*a discounted membership plan for those with low-incomes, equivalent for one year of unlimited 30 minute rides for those who participate in the State Nutritional Assistance Program (SNAP) or California Alternative rates for Energy (CARE)*"

and:

> "*low-income customer plan that waives any applicable bicycle/e-scooter deposit or unlock fee and offers an affordable payment option and unlimited trips for under 30 minutes to any customer with an income level at or below 200% of the federal property guidelines, subject to annual renewal*".

TABLE 6 Equity Policies by Jurisdiction

Agency	Smartphone-free Option	Cash Option	Discount Option	Equity Zones	Percentage and/or Numbers
Atlanta, GA	Yes	Yes	Yes	Yes	-
Baltimore, MD	Yes	Yes	Yes	Yes	No more than 35% in one of the three zones
Chicago, IL	Yes	Yes	Yes	Yes	25% of devices in each of two sub-areas
Denver, CO	Yes	Yes	Yes	Yes	100 of 350 in fleet in 'Opportunity Zones'
Durham, NC	Yes	Yes	-	Yes	20% of devices in certain census tracts
Fort Lauderdale, FL	Yes	-	-	-	-
Minneapolis, MN	Yes	Yes	Yes	Yes	800 in downtown and surrounding neighborhoods; At least 600 in other specified neighborhoods
Oakland, CA	-	-	Yes	Yes	At least 50% deployed in "Community of Concern'
Oxford, OH	Yes	Yes	Yes	Yes	No more than 50% in Uptown District
Portland, OR	-	-	Yes	-	Deploy a minimum of 100 or 20% of a fleer (whichever is less) in areas defined within the 2035 Comprehensive Plan
Providence, RI	-	Yes	Yes	Yes	-
Sacramento, CA	-	-	-	Yes	-
San Francisco, CA	-	Yes	Yes	-	-
San Jose, CA	-	-	Yes	Yes	At least 20% must deploy in 'Community of Concern'
St. Paul, MN	Yes	Yes	-	Yes	Minimum of 30% of fleet in 'Areas of Concentrated Poverty

					where 50% or more of the residents are people of color'
Winston-Salem, NC	Yes	Yes	-	-	-
Washington, D.C.	Yes	Yes	-	-	-

Notes:
-: Denotes information that was not identified in the documents reviewed.
For any jurisdiction listed in TABLE 1 but not listed in this table, this indicates no relevant requirements were identified in the documents reviewed.

DISCUSSION & CONCLUSIONS

This study reviewed a sample of agency documents – including vender permitting requirements, ordinances, and adopted regulations from 39 jurisdictions. The sample pool of the cities ranged in sizes from 22,885 people (Oxford) to 2,705,994 (Chicago). The agencies spanned 19 states and the District of Columbia.

Amongst the shared-mobility documents, the most prominent themes include: fees and charges; ridership and data requirements; vehicle specifications and safety concerns; parking and restricted access; and to a lesser extent, equity concerns. Within those themes were topics that were consistent across the majority of the agencies. Although shared across multiple cases, differences emerged and language varied amongst the lines being accessible by time, toll-free, amongst other qualities.

While this paper provides an updated review of requirements from U.S. agencies, extending the Anderson-Hall (*1*) review, it is worth noting that many agencies may be looking towards and adopting regulations taken from other agencies. For example, St. Paul and Denver required venders to submit an MDS format developed by the City of Los Angeles. It is unsurprising with such a new method and trend in transportation that cities are adopting regulations established in peer cities. One recommendation for cities considering developing their own regulations is to consider the importance of context-sensitive regulations when examining differences across regulations. For example, a city within the same state have representative legal considerations regarding the types of fees or the vehicle specifications.

There exists a gap between the research and regulator concerns regarding whether e-scooter programs improve social equity and environmental conditions. However, little research or regulatory frameworks exist to confirm and manage these assumptions. The traffic and emissions generated from the redistribution of e-scooters throughout cities could offset the reductions in vehicle travel facilitated by scooter programs. Social equity is also a concern as e-scooters have the ability to improve access to jobs, goods, and services. Many pilot programs stress or require adherence to minimum unit deployment numbers for underserved and low income areas. However, regulations which make the equitable distribution of devices a reality do not appear to exist, or at most, they are infrequently enforced.

E-scooters face similar regulatory gaps to those of e-bikes, and in the early 2000's, Segways. In countries which have adopted alternative mobility devices, including e-scooters, a comprehensive set of national standards for regulating these devices do not exist (*4*). Gaps in standards and regulations can lead to higher rates of unsafe use, improper parking, and increased rates of injuries among users (*9*). Additionally, a general lack of enforcement by both law enforcement and the e-scooter companies themselves does not serve to support proper use and rider safety (*1*, *2*, *6*, *7*). Lastly, it is worth commenting on the speed of which regulations have

changed and evolved since the last review of considerations (*1*) just a year ago. The ability for agencies to foster the development of these and other new services and technologies for the benefit of the public will also require agencies to respond faster than they ever have before with regards to both regulations and the evaluation of programs. The adoption of e-scooter—or more generally, micro-mobility—programs may help cities anticipate the flexibility, speed, and data processing requirements that will be necessarily in the transportation landscape of tomorrow.

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The authors confirm contribution to the paper as follows: study conception and design: Griffee, Currans; data collection: Griffee, Currans; analysis and interpretation of results: Griffee, Currans, Lyons; draft manuscript preparation: Griffee, Currans, Fitzpatrick, Lyons. All authors reviewed the results and approved the final version of the manuscript.

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