Micromobility In Canada

Risks, Regulations, Knowledge Gaps & Opportunities

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TRAFFIC INJURY RESEARCH FOUNDATION

Traffic Injury Research Foundation

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Executive summary

Motorized bicycles and scooters are commonly referred to as e-bikes and e-scooters. These devices have significantly transformed urban mobility in the past decade by offering convenient, eco-friendly and affordable alternatives to traditional motor vehicles. But they have also created some new challenges for urban planning and road safety. Findings from an international review of the literature with respect to knowledge about the road safety risks associated with these devices and current legislative and regulatory practices are presented in this report. However, the current prevalence of these devices on the roads is relatively low because their emergence is still relatively new. Moreover, there are wide variations in their regulation and implementation across jurisdictions. As such, it is perhaps premature to establish best practices in the absence of more research.

Variations in definitions of these devices are considered along with critical gaps in data collection strategies. These findings can provide direction to strengthen data improvements to better-address research questions that remain. The diverse experiences across jurisdictions regarding strategies to safely integrate these devices into the transportation network are also examined. These findings can provide much-needed guidance to inform policy discussions and policy development at all levels. Finally, tips for safe riding are also provided.

More broadly, this report identifies important gaps in legislation, regulation and implementation to provide a framework for policy makers at Federal, provincial and municipal levels and road safety advocates. This *knowledge can increase understanding* about the use of these mobility options as well as provide direction regarding issues that warrant attention to *optimize the safe implementation of these mobility options*.

Definitions

Up until 2020, in Canada, e-bikes were referred to as power-assisted bicycles (PABs) under Canada's **Motor Vehicle Safety Regulations**. Riders did not require a licence to operate one of these vehicles which were defined as two- or three-wheeled bicycles. Characteristics of e-bikes included being equipped with handlebars and operable pedals and an attached electric motor of 500W or less. They were mandated to travel at a maximum speed of 32 km/h from the motor over level ground (Transport Canada, 2024).

However, this section of the Motor Vehicle Safety Regulations was repealed in 2020 and in February 2021, Transport Canada decided it will no longer regulate PAB, choosing to leave this determination to provincial/territorial Ministries of Transportation. As such, this regulation no longer served as a benchmark to assess whether manufactured or imported e-bikes were deemed compliant. Instead, Transport Canada modified their approach to initially assess the design characteristics of e-bikes to determine their on-road versus off-road use. Irrespective of speed limitations, if e-bikes possessed features resembling an on-road class of vehicles (e.g., motorcycles or scooters), then they would be assessed against these design features. In addition, imported e-bikes with a maximum speed of 32 km/h possessing off-road characteristics are considered non-regulated, however, those e-bikes which surpass this speed will be deemed restricted-use vehicles and must comply with import requirements (Transport Canada, 2024).

Other jurisdictions including Europe and Australia have also put in place definitions and gone further to distinguish between different classes of e-bikes, most notably with lower power and speed limits. Based on experiences from jurisdictions around the world, it appears there are some important elements of definitions that clearly distinguish e-bikes from bicycles, mopeds and motorcycles. Most notably, e-bikes should have an adjustable seat and pedals, and the device must be physically powered by the rider. In addition, the motor power and speed should be limited and only available when the rider is actually pedalling.

Similarly, while legal definitions of e-scooters may vary from one jurisdiction to another, they can generally be described as:

> *A two- or three- wheeled device powered by an electric motor, consisting of a platform between the front and rear wheels that the rider stands on (and in some cases a seat that the rider sits on) and a steering column with handlebars that allow the rider to steer, accelerate, and brake. In contrast with electric bicycles and mopeds, e-scooters do not have pedals. (Sandt et al., 2023; p.x).*

Risks associated with e-bikes & e-scooters

Knowledge about the safety risks associated with e-bikes and e-scooters is currently limited. This is due, in part, to the relatively short time these devices have been available combined with their relatively low levels of adoption. Additionally, at present, most collision reports do not contain specific data elements to permit the capture of important details of crashes involving e-bikes and e-scooters, and there does not appear to be clear consensus in terms of how they are coded.

Increasing awareness of e-bikes and e-scooters' impact on roads shared with other types of road users, as well as increasing understanding of the risks they pose and ways those risks can be mitigated is *essential*.

E-bikes. With respect to the characteristics of e-bike riders, injury and crash characteristics, and patterns of risk-taking, a majority of riders were younger and mostly male. Riders experienced more safety critical events which were often associated with riding outside of designated locations, riding with passengers, riding too fast for roadway conditions, and failing to follow road rules. Injuries were more often associated with upper extremities including face, neck, arms, torso and soft-tissue injuries. The most common examples of risk-taking included speeding and aggressive driving. Speed violations with faster speeds resulted in more severe injuries. Single vehicle collision incidents

were more typical of collisions in this group. In addition, prevalent risks included running red-lights or travelling in the opposite direction of traffic. A comparison of e-bike collision characteristics was not dissimilar to those of conventional bicycles.

E-scooters. With respect to the characteristics of e-scooter riders, injury and crash characteristics, and patterns of risk-taking, a larger proportion of riders were younger and mostly male. Crashes more often occurred in densely populated areas and on sidewalks. These riders experienced more safety critical events which were often associated with riding in locations that were not permitted, riding with passengers, poor roadway conditions, and failing to follow road rules. Injuries were more often associated with falls and occurred to upper extremities including face, neck, arms, torso and soft-tissue injuries. The most common examples of risk-taking included speeding and speed violations, with faster speeds resulting in more severe injuries. Single vehicle collision incidents were more common in this group and common risk-taking behaviours included riding without a helmet, riding with passengers and riding on sidewalks. In addition, prevalent risks included running red lights or travelling in the opposite direction of traffic.

Regulatory practices

Regulation regarding the use of micromobility devices can be beneficial to shape the safe integration of these devices into the road network. These tools can establish a framework describing where and how different micromobility options are deployed on roads and specifying who is permitted to use them. Regulations describing the functional and operational requirements of e-bikes and e-scooters span a wide range of topics including licensing and registration, insurance, and the types of roads where they can be used. Several jurisdictions have regulations in place for micromobility users which describe who can utilize these devices and under what conditions such as minimum age of riders, the use of safety equipment, and restrictions to prohibit risk-taking such as speed, impairment, distraction and passengers.

Some of the most important issues addressed through regulation include:

- geographic locations, types of roads or pathways where riding is permitted
- maximum speeds
- lights, brakes, pedals, weight and power output
- minimum rider age
- mandatory helmet use and other safety equipment
- prohibition on passengers

These devices are most often restricted to use on roads and bike paths as opposed to sidewalks. The maximum weight and power restrictions are higher in North America (500 watts and 32 km/h) compared to a majority of European and Australian jurisdictions (250 watts and 25 km/h). These lower levels may be a result of important distinctions between classes of devices in regulation, as well as their long history with cycling generally. In addition, a growing number of jurisdictions such as Canada and New York are reviewing standards and safety requirements associated with lithium-ion batteries and this may have implications for e-bikes such as requirements that lithium-ion batteries are either covered or in an insulated case to protect them from the elements (Preston, 2024; Health Canada, 2023).

In light of the motorized nature of these devices and the speeds at which they travel, it is more common for some jurisdictions to restrict riders of e-bikes and e-scooters to ages 16 and older. Many jurisdictions require helmet use along with either reflective clothing or lights or a horn/bell. Prohibitions on carrying passengers are also typical unless devices are specifically designed for this purpose.

Knowledge gaps & opportunities

E-bikes and e-scooters are becoming more prevalent on roadways in Canada. The use of these devices has increased because they are a more affordable, more efficient, and more convenient option for many road users. They are also more environmentally-friendly, which adds to their appeal.

Yet many questions remained unanswered. Collaborative work across jurisdictions can help bring consistency to the management of these devices on Canada's roads. Sharing experiences to date can provide insight into optimal safety practices, as well as streamline educational strategies. This approach can also help to enhance data collection about these devices to facilitate research and answer important questions about safety.

Some opportunities to help address gaps and build a national framework for these devices, as well as guide the implementation and use of them in the Canadian context are shared below for consideration.

- Establish a provincial/territorial working group comprised of government representatives, industry partners and other key stakeholders.
- Review Federal regulations to strengthen definitions of permitted devices which can be brought into Canada and used on our roads.
- Encourage education to promote the safe use of devices.
- Support the enforcement of road rules to reduce risks for all road users.
- Pursue research to fill gaps in knowledge and data collection / coding to answer key questions and inform policy decisions and safety frameworks.
- Identify qualifications for vendors who provide shared services or sell devices.
- Educate consumers about insurance implications of e-bikes & e-scooters.

E-bike & e-scooter riding safety tips

Before you ride

- Conduct a pre-ride check
- Wear protection
- Be visible
- Avoid distractions
- Ride sober
- Avoid bad weather

When you ride

- Start slow
- Observe the path
- Ride solo
- Ride single file
- Watch traffic
- Obey the rules of the road
- Watch for pedestrians
- Sidewalks are off-limits

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Introduction

Electric bicycles and scooters, commonly referred to as e-bikes and e-scooters, have significantly transformed urban mobility in the past decade by offering convenient, eco-friendly and affordable alternatives to traditional motor vehicles. However, along with benefits, such micromobility alternatives also present some new challenges for urban planning and road safety. Indeed, as these options have become more commonplace in urban areas, whether they are part of a shared service or are privately owned, the frequency of related collisions involving them has also significantly increased. This has prompted growing public concern about their use and safety. In light of the increasing prevalence of these devices on local roads, often in urban centres, it is timely to more closely examine their role in facilitating the mobility of Canadians. At the same time, it is essential to increase awareness of their impact on roads shared with other types of road users, as well as increase understanding of the risks they pose and ways those risks can be mitigated.

Increasing awareness of e-bikes and e-scooters' impact on roads shared with other types of road users, as well as increasing understanding of the risks they pose and ways those risks can be mitigated is *essential*.

Broadly speaking, legislation and regulations governing e-bikes and e-scooters are not well-developed. Federal regulations determine what types of devices may enter the country, as the manufacturing of e-bikes and e-scooters is not common in Canada. There is also provincial legislation in the form of Highway Traffic Acts which determine how these devices are defined and on which roadways they may operate as well as at what speeds. Finally, regional or municipal regulations set out requirements for the operation of these devices in a jurisdiction. Presently, legislation and regulation are often inconsistent across jurisdictions as is their enforcement, which may even be non-existent. More generally speaking, regulations have been proven effective in reducing injuries involving micromobility devices (Dibaj et al., 2024).

However, where regulations do exist, they typically address a few issues, including:

- minimum rider age
- mandatory helmet use

- permittance of passengers
- lights, brakes, pedals, weight and power output
- maximum speeds
- geographic locations, types of roads or pathways where riding is permitted

The inconsistency in primarily provincial legislation and municipal regulations across jurisdictions reflects a legal landscape that is evolving in response to the experiences with these devices and the emergence of new challenges. Moreover, there is a critical distinction between shared service (i.e., rental) and privately-owned devices. Legislation may apply to both whereas regulations are more often only applicable to the former. Generally, there is an absence of stringent regulations for private e-bikes and e-scooters compared to their rental counterparts that can also result in inconsistencies in safety standards and safe riding habits which may translate into differences in crash-involvement. More concerning, these inconsistencies in regulations can lead to confusion and affect the safety and usage of e-bikes and e-scooters. As such, greater awareness of these differences can lay the foundation to better-inform the development of more consistent regulations and guide the development of effective policy and interventions. This approach can help mitigate risks associated with the use of these devices.

E-bike & e-scooter prevalence & risks

The use of e-bikes and e-scooters for travel is rapidly increasing. As of 2023, 41 cities in Canada, 371 cities in the United States, and nine cities in Mexico had shared e-bike or e-scooter systems in place. During this particular year, micromobility riders were reported to have taken 39.7 million e-bike trips and 69.8 million e-scooter trips (NABSA, 2024). Statistics reporting the purpose of these trips according to a micromobility user survey data (2020-2023) from 16 cities in the United States and Canada (including Quebec City and Calgary) showed trips related to social activities (e.g., entertainment, dining out) were taken by 31% of users, while 26% took trips for exercise and recreation, 25% took trips to and from work or school, while 18% took trips for shopping, errands, and appointments (NABSA, 2024).

Studies about the use of e-bikes have shown they increase the frequency and length of cycling trips compared to conventional bicycles, and are primarily used for commuting, shopping and running errands as opposed to recreational use (Bourne et al., 2020). Bourne et al. (2020) also reported that motivations for purchasing e-bikes include easier riding for hilly terrain and faster trips. In addition, the appeal among younger riders included reduced car use and environmental concerns. E-bike use appears to decline as riders age (Kroesen, 2017). Females were reported to be more likely to buy an e-bike to overcome hilly terrain compared to men (MacArthur et al., 2018), while the evidence suggested men ride e-bikes more often and farther (Cooper et al., 2018; Jahre et al., 2019). The use of e-bikes has been shown to increase the distances of trips over conventional bicycles by 50% to 100% (Bjørnarå et al., 2019; Castro et al., 2019).

Research suggests shared e-scooters are mainly utilized by young individuals, particularly for leisure activities during the weekend, whereas privately-owned e-scooters are more commonly used for commuting purposes (European Commission, 2021). Another study from Europe showed riders are predominantly 26 to 35 years old and choose e-scooters for their efficacy in managing the first/last mile of urban commutes (Šucha et al., 2023). E-scooter trips are often short distances and involve different behavioural dynamics compared to other micromobility options. Riders often display a hybrid behaviour, frequently shifting between e-scooters, walking, and other modes of transport

within a single trip (Karpinski et al., 2023). These devices are favored over walking and, to a slightly lesser extent, over public transport. Their appeal is based on their easy accessibility and low operational costs. A review of studies from North America, Europe, Australia and New Zealand showed the typical rider profile includes individuals looking for quick and convenient travel options within urban settings, often as a complement to public transit (Wang et al., 2023). E-scooter riders are generally early adopters of new technologies and characterized by a greater propensity for risk-taking than those who do not ride e-scooters (International Transport Forum, 2023; Pourfalatoun et al., 2023). They also tend to have positive perceptions of the safety of e-scooters, often preferring them over bicycles for their ease of use and accessibility (Pourfalatoun et al., 2023). The rapid adoption of e-scooters in urban environments reflects their appeal among technology-savvy users seeking efficient, flexible travel options (Winchcomb, 2023).

Definitions & importation rules

Canada. E-bikes were previously described as power-assisted bicycles (PABs) under Canada's Motor Vehicle Safety Regulations, however, this was repealed in 2020. In February 2021, Transport Canada decided it will no longer regulate PAB, choosing to leave this determination to provincial/territorial Ministries of Transportation and instead modified their approach to initially assess the design characteristics of e-bikes to determine their on-road versus off-road use. Irrespective of speed limitations, if e-bikes possessed features resembling an on-road class of vehicles (e.g., motorcycles or scooters), then they would be assessed against these design features. In addition, imported e-bikes with a maximum speed of 32 km/h possessing off-road characteristics are considered non-regulated, however, those e-bikes which surpass this speed will be deemed restricted-use vehicles and must comply with import requirements (Transport Canada, 2024).

United States. Motorized micromobility devices are often treated as bicycles regardless of how e-bikes and e-scooters are defined in state laws. In fewer cases, they are subject to similar requirements as mopeds, scooters or motor vehicles (Kolpakov et al., 2022).

Europe. In other countries where cycling has been much more well-established and prevalent, definitions tend to be more developed. According to European regulations (CARE definition U-2.21: E-pedelec), e-bikes are defined as vehicles with at least two wheels with pedal assistance, and that are equipped with an auxiliary electric motor. These devices have a maximum continuous rated power of 0.25 kW. However, the output of the motor is progressively reduced and finally stopped as the vehicle reaches a speed of 25 km/h, or sooner, if the cyclist stops pedalling (For

more information see: **https://road-safety.transport.ec.europa.eu/system/files/2021-07/cadas_glossary_v_3_8.pdf**).

Australia. In South Australia, e-bikes are referred to as power-assisted pedal cycles, with pedals being a key component of the definition. According to regulations, the primary source of propulsion of the e-bike must come from human power in the form of pedalling. It may also have an electric motor as an additional source of propulsion. However, a critical distinction is that the e-bike cannot be propelled just by the motor, and riders *must use the pedals to keep the e-bike in motion*. The total weight of the e-bike, including any batteries, must be less than 50 kg, and the maximum power output of the motor cannot be greater than 200 watts. The e-bike must also have a seat that can be adjusted according to height (For more information see: **https://www.sa.gov.au/topics/driving-and-transport/cycling/riding-a-power-assisted-bicycle**).

Similarly, in Victoria, Australia, e-bikes are referred to as electrically power-assisted cycle (EPAC). This is a specific type of e-bike that has at least one auxiliary propulsion motor which provides assistance to the rider *only when they are pedalling* the e-bike and travelling between 6 km/h and km/h. In addition, the motor can have a maximum power of 250 watts and it must not provide power when the bike is travelling at speeds greater than 25 km/h. (See: **https://transport.vic.gov.au/road-rules-and-safety/bicycles/electric-bikes**).

Australian definitions of these devices are more robust than other jurisdictions because they were developed based on definitions which were created previously to distinguish power-assisted bicycles from motorcycles and mopeds. These definitions also recognized and gave consideration to the EU's definition of a pedalec. Moreover, e-bikes that are not compliant with motor power and speed restrictions are instead deemed to be motorcycles or mopeds (depending on state regulations).

Based on experiences from jurisdictions around the world, it appears there are some important elements of definitions that clearly distinguish e-bikes from bicycles, mopeds and motorcycles. Most notably, e-bikes should have an adjustable seat and pedals, and the device must be physically powered by the rider. In addition, the motor power and speed should be limited and only available when the rider is actually pedalling.

While legal definitions of e-scooters may vary from one jurisdiction to another, they can generally be described as:

> *A two- or three-wheeled device powered by an electric motor, consisting of a platform between the front and rear wheels that the rider stands on (and in some cases a seat that the rider sits on) and a steering column with handlebars that allow the rider to steer, accelerate, and brake. In contrast with electric bicycles and mopeds, e-scooters do not have pedals. (Sandt et al., 2023; p.x).*

Collection of collision data & challenges

Understanding road safety challenges associated with the use of e-bikes and e-scooters is limited by available data currently collected in collision reports. Since these micromobility devices are relatively new modes of transportation, there are important gaps and inconsistencies in how collisions involving these types of vehicles are collected and categorized (e.g., whether they are coded separately, together, or within a broader category including bicycles, mopeds, and scooters). Furthermore, police-reported collision data may not include cases where an e-scooter or e-bike is involved in a single-vehicle collision, or collisions may only be included if they strike or are struck by a highway vehicle (e.g., automobile, truck, van, bus, motorcycle).

Moreover, collision reports do not presently differentiate between micromobility devices and other modes of transportation, nor indicate whether they are part of a shared service or privately-owned. However, there is some speculation that those who operate their own micromobility devices behave differently than those riders who rent or share these devices. However, this information can help guide and inform the development of appropriate regulations and enforcement strategies across the country.

In addition, while research has been undertaken to examine the risks associated with these devices in several countries, not all of the research and data are available in English. This makes it difficult to assess what other studies have been undertaken, any data limitations, or what new knowledge has been gained.

Report scope

This report summarizes what is known about road safety risks associated with these devices and current legislative and regulatory practices based on an international review of the literature. Given the relatively new emergence in the prevalence of these devices, and the wide variation that exists in their use across jurisdictions, it is perhaps premature to establish best practices in the absence of more evaluation work.

Variations in definitions of these devices are considered along with critical gaps in data collection strategies. These findings can provide direction to strengthen data improvements to better-address research questions that remain. The diverse experiences across jurisdictions regarding strategies to safely integrate these devices into the transportation network are also examined. These findings can provide much-needed guidance to inform policy discussions and policy development at all levels. Finally, tips for safe riding are also provided.

More broadly, this report identifies important gaps in legislation, regulation and implementation to provide a framework for policymakers at Federal, provincial and municipal levels and road safety advocates.

This knowledge can *increase understanding* about the use of these mobility options as well as *provide direction* regarding issues that warrant attention to optimize the safe implementation of these mobility options.

Risks associated with e-bikes & e-scooters

As is the case with the introduction of any new modes of transportation, it is critical to gauge and assess their risks. Awareness and understanding of risks are essential to guide strategies to mitigate them and ensure the safety of these modes is optimized to prevent road crashes, injuries and fatalities. However, understanding of safety risks associated with e-bikes and e-scooters is currently limited. This is due, in part, to the relatively short time these devices have been available combined with their relatively low levels of adoption. Additionally, at present, most collision reports do not contain specific data elements to permit the capture of important details of crashes involving e-bikes and e-scooters and there does not appear to be clear consensus in terms of how they are coded. For example, e-bikes are more often coded as bicycles meaning that datasets cannot be easily queried to determine the specific characteristics or role of e-bike collisions distinct from other cycling collisions. Similarly, e-bike collisions may alternatively be coded in moped, pedestrian, or other categories. In contrast, e-scooters are not typically classified at all in collision reports. In other words, there can be substantial differences in whether and how these incidents are coded. For both e-bikes and e-scooters, it is often the case that if collisions do not involve a motor vehicle (e.g., car, truck, bus, motorcycle), they may not be captured at all. As such, there are important data gaps which must be filled to create a better understanding of risks posed by these micromobility options, and some jurisdictions are beginning to move in this direction. For example, Alberta now has a collision code for e-scooters although e-bikes are still coded as bicycles.

To create a better understanding of risks posed by these micromobility options, important data gaps must be filled.

Similarly, in administrative health data, e-bike and e-scooter incidents may be coded differently, depending on several factors, including jurisdictional practice. Currently, it may be possible to identify e-bike and e-scooter injury and fatality cases in narrative-based systems such as the Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP) and the Traffic Injury Research Foundation's National Fatality Database, although narratives are often not easily queried. However, for e-bikes, there is some uncertainty about the various types of e-bikes involved in these cases since there is wide variation in type and design.

Despite the data challenges, some knowledge on e-bike and e-scooter collision risk has been gained through analyses of police-reported collision data, hospital data, and public survey research. A brief summary of knowledge of this topic, mostly from North America and Europe, follows. Prevalence and characteristics of injuries and crashes are described followed by what is known about specific contributing factors.

Risks associated with e-bikes

Prevalence. There were 387 e-bike injury cases in Canada identified in the Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP) surveillance system data from 2011-2022, with a trend analysis showing a significant annual increase since 2011. Most incidents involved male riders, and the most frequently injured age group was 50-64 years. Almost all (94%) were e-bike riders, and more than half (65%) were traffic incidents (Public Health Agency of Canada, 2024). Most riders were wearing a helmet at the time of injury and just 8% involved substance use. An analysis of the United States National Electronic Injury Surveillance System (NEISS) also revealed a substantial increase in e-bike injury rates, from 0.05 injuries per 100,000 population in 2012 to 0.25 in 2017 (Wen et al., 2019). Interestingly, a European study that surveyed collision and non-collision involved e-bike riders and conventional bike riders (Schepers et al., 2018) reported the collision risk of e-bikes compared to conventional bicycles was the same.

Injuries. E-bike injuries, as reported in the United States, Europe and Israel, often included fractures, head injuries, soft tissue injuries, dental injuries and organ injuries, commonly affecting the head, neck, upper and lower extremities, and abdomen (Gross et al., 2017; Hermon et al., 2020; Papoutsi et al., 2014; Karepov et al., 2019; Tark, 2023; Zmora et al., 2019). These injuries were typically a result of losing traction, falling, collisions and speed. Several studies in European countries showed e-bike collisions were, in general, equally severe as conventional bike collisions (Schepers et al., 2014; Fyhri et al., 2019; Schepers et al., 2020).

Crash characteristics. A Swiss study (Hertach et al., 2018) reported that 17% of e-bike riders had experienced a single-vehicle collision and almost all were related to road conditions, (e.g., a slippery roadway or being caught in streetcar tracks. Other contributing factors included riding too fast for conditions and an inability to maintain balance. Hertach et al. (2018) concluded e-bike collisions were typically preceded by incidents of speeding.

Speed. Research from many Western countries suggested the speeds of e-bikes were not dissimilar to typical or average speeds of conventional bicycles. American studies of e-bike rider behaviours (Langford et al., 2015; Langford et al., 2017) reported that e-bike riders rode approximately three km/h faster in mixed traffic and one and a half km/h slower on shared use pathways than conventional bicycles. It also revealed e-bike speeds were faster on uphill segments but generally similar in flat and downhill segments of road. MacArthur and Cherry (2019) reviewed eight studies investigating the average operating speed of e-bikes compared to conventional bikes, also finding e-bikes travelled about three km/h faster than conventional bicycles. A similar margin was also shown in a naturalistic study of German cyclists (Schleinitz et al., 2017). Conversely, in China, studies reported e-bike travel speeds were 40–50% faster than conventional bicycles, reflecting the larger market share of throttled e-bikes able to operate above 25 km/h (Cherry & He, 2010; Lin et al., 2008).

Similarly, pedelec speeds (able to travel up to 45km/h) in Germany were found to be 62% faster than conventional bicycles (Schleinitz et al., 2017).

Rider characteristics. Both sex and driving experience have been shown to impact e-bike collisions. Males and riders without a licence to drive a motor vehicle were reported more likely to have at-fault collisions (Wu et al., 2012). Riding errors and aggressive behaviours were also demonstrated to be significant factors for predicting at-fault collisions. Male e-bike riders were also more likely to run a red light, as were young and middle-aged riders compared to older riders (Wu et al., 2012).

Risk-taking. Common risky e-bike behaviours included illegal occupancy of motor vehicle lanes, speeding, red-light running, illegal carrying of passengers, and riding in the opposite direction (Ma et al., 2019). Wrong-way riding, stop-sign and signal compliance have been shown to have similar violation rates between riders of e-bikes and conventional bicycles (Langford et al., 2015; Langford et al., 2017; MacArthur and Cherry, 2019). Other studies using instrumented e-bikes (Dozza et al., 2014; Huertas-Leyva et al., 2018) demonstrated e-bike riders had more safety critical events, in particular conflicts with motorized vehicles, faster speeds and more hard-braking events. A similar study (Petzoldt et al., 2017) reported a higher rate of conflicts associated with e-bikes only occurred at intersections.

E-bike summary

With respect to e-bike usage characteristics, injury and crash characteristics, and patterns of risk-taking, a majority of riders were younger and mostly male. Riders experienced more safety critical events which were often associated with riding outside of designated locations, riding with passengers, riding too fast for roadway conditions, and failing to follow road rules. Injuries were more often associated with upper extremities including face, neck, arms, torso and soft-tissue injuries. The most common examples of risk-taking included speed and aggressive driving. Speed violations with faster speeds resulted in more severe injuries. Single vehicle collision incidents were more typical of collisions in this group. In addition, prevalent risks included running red-lights or travelling in the opposite direction of traffic. A comparison of e-bike collision characteristics was not dissimilar to those of conventional bicycles.

E-bike riders experienced more safety critical events when riding outside of designated locations, riding with passengers, riding too fast for roadway conditions, and failing to follow road rules.

Risks associated with e-scooters

Prevalence. An international public opinion survey collected data in 2023 from respondents about their e-scooter usage and collision involvement during the preceding 12 months. It revealed 30% of respondents in eight countries across North and South America (Brazil, Canada, Chile, Colombia, Mexico, Panama, Peru, United States) reported riding an e-scooter, and 2.5% of e-scooter riders reported being involved in a collision that resulted in injury (Delavary et al., 2024). A literature review of studies from the United States, Europe, Asia and Australia showed most e-scooter collisions occurred in densely populated environments (Kazemzadeh et al., 2023) and injuries associated with e-scooters commonly occurred on sidewalks (Toofany et al., 2021). Although e-scooter riders may feel safer riding in spaces separated from motor vehicles, pedestrians in the United States often reported feeling unsafe sharing their walking spaces with e-scooter riders (James et al., 2019).

Injuries. A summary of international, English-language literature suggests the severity of injuries involving e-scooters varies, with a considerable number of cases reporting minor injuries, although serious injuries occurred as well (Toofany et al., 2021). Toofany et al. (2021) underscored that the lack of protective gear, especially helmets, was a significant factor in the severity of injuries sustained in e-scooter collisions. This observation was consistent with findings from Trivedi et al. (2019), who reported that only four percent of injured riders were wearing a helmet at the time of their collision. Studies of injury patterns, primarily from the United States but also Europe and South Korea, showed injuries involved the upper extremities, head, and lower extremities as well as the head and face, and commonly included soft tissue injuries, fractures, and dental injuries (Toofany et al., 2020; DiMaggio et al., 2019; Alwani et al., 2020; Bloom et al., 2021; Moftakhar et al., 2021; Anderson et al., 2021; Faraji et al., 2020; Tischler et al., 2021; Kim et al., 2021).

Crash characteristics. According to the European Transport Safety Council (2023), serious e-scooter incidents and injuries were primarily single-vehicle incidents (i.e. no motor vehicle involved), often resulting from poor road conditions, lack of proper road maintenance, excessive speed, and not wearing helmets, with head injuries being particularly prevalent (Winchcomb, 2023). Single-vehicle incidents occurred more frequently than collisions with other vehicles and accounted for the prevalence of injuries in the United States (Sandt et al., 2023a; Sandt et al., 2023b), with loss of balance and falls being major contributors to e-scooter injuries (Alwani et al., 2020; Anderson et al., 2021; Bloom et al., 2021; Tischler et al., 2021). High speed was reported as a factor by 37% of riders in Austin, Texas (Austin Public Health, 2019).

Rider characteristics. E-scooter riders involved in incidents predominantly consisted of young, urban individuals seeking quick and flexible transportation options. A substantial number were males who utilized these devices for both short commuting and leisure trips (Badia & Jenelius, 2021; European Commission, 2021; Karpinski et al., 2023; Kazemzadeh et al., 2023; Sandt et al., 2023a; Sandt et al., 2023b; Toofany et al., 2021; Useche et al., 2022; Winchcomb, 2022; 2023). The lack of specialized training for riders and inconsistent legal frameworks were noted as exacerbating risk-taking behaviours on the road among e-scooter riders (Useche et al., 2022).

Risk-taking. Generally speaking, risk-taking on e-scooters was reported to be somewhat less prevalent in North and South America (the Americas) compared to Europe. Self-reported data about risky riding behaviours (Delavary et al., 2024) showed a significant percentage of riders engaged in unsafe practices:

- riding without a helmet (26% in the Americas, 45% in Europe)
- carrying multiple passengers (31% in the Americas, 32% in Europe)
- riding under the influence of alcohol (17% in the Americas, 21% in Europe)
- riding on sidewalks (33% in the Americas, 44% in Europe)
- crossing against red lights (21% in the Americas, 27% in Europe
- age-related trends showed older riders exhibited higher rates of helmet non-use in the Americas, whereas in Europe, younger riders were more likely to forgo helmets.

> 33.2% reported riding e-scooters on pedestrian paths or sidewalks in the Americas whereas nearly half of European respondents (44.4%) reported doing so.

E-scooter summary

With respect to e-scooter usage characteristics, injury and crash characteristics, and patterns of risk-taking, a larger proportion of riders were younger and mostly male. Crashes more often occurred in densely populated areas and on sidewalks. These riders experienced more safety critical events which were often associated with riding in locations that were not permitted, riding with passengers, poor roadway conditions, and failing to follow road rules. Injuries were more often associated with falls and occurred to upper extremities including face, neck, arms, torso and soft-tissue injuries. The most common examples of risk-taking included speed and speed violations with faster speeds resulting in more severe injuries. Single vehicle collision incidents were more common in this group and common risk-taking behaviours included riding without a helmet, riding with passengers and riding on sidewalks. In addition, prevalent risks included running red-lights or travelling in the opposite direction of traffic.

E-scooter riders experienced more safety critical events when riding in locations that were not permitted, riding with passengers, poor roadway conditions, and failing to follow road rules.

Regulatory practices

Regulation regarding the use of micromobility devices can be beneficial to shape the safe integration of these devices into the road network. These tools can establish a framework describing where and how different micromobility options are deployed on roads and specifying who is permitted to use them. Authority with respect to the classification of e-bikes has traditionally been the purview of the Federal Government in Canada. Federal regulations typically specify what types of devices may be brought into the country. However, Federal Motor Vehicle Safety Regulations which previously defined e-bikes was deemed to be no longer in force as of February 4th, 2021 (Transport Canada, 2024).

Provincial regulations regarding e-bikes are most often located in provincial highway traffic acts and correspond with regulations related to mopeds or low-speed motorcycles. However, as a result of the repeal of Federal regulation, in Ontario, there has since been a review of the regulation and definition of e-bikes. New legislation in the form of the Moving Ontarians Safely Act, 2021 (MOMS Act) was introduced on June 3rd, 2021 (Ministry of Transportation of Ontario, 2024a) and it included legislative amendments to redefine power-assisted bicycles (i.e., e-bikes) under the Highway Traffic Act. This amendment proposed setting new requirements for three variations of e-bikes which were described as bicycle-style, moped-style and motorcycle-style. It further noted that this amendment would be proclaimed at a later, undetermined, time.

Then in early 2024, the Ministry of Transportation of Ontario proposed the Safer Roads and Communities Act, 2024. If this legislation were adopted it would provide authority to establish regulations within the Highway Traffic Act to establish three distinct classes of e-bikes, each associated with specific rider and vehicle safety requirements. However, as of yet the repealed Federal definition of an e-bike continues to apply legally to Ontario's HTA until reference to it is officially removed and replaced.

In other words, to date e-bikes can be ridden on-road and must adhere to rules applying to bicycles with some additional specifications. Riders must be 16 years of age and wear a helmet. Devices are restricted to a maximum speed of 32 km/h, must weigh no more than 120 kg (264 lbs), and pedals must be operable. Riders do not require a driver's licence, registration, plates or insurance (Ministry of Transportation of Ontario, 2024b).

Of concern, modifications to devices such as removing pedals and increasing speed means these devices are thereby reclassified as illegal motor vehicles (Ministry of Transportation of Ontario, 2024b). Yet there has been a rapid proliferation of devices failing to meet this definition and road requirements, and the enforcement of restrictions has been a significant challenge in jurisdictions across the country. Equally concerning, imports of e-bikes failing to comply with regulations has become commonplace across Canada as many models are incorrectly labelled as e-bikes by manufacturers or retailers. Moreover, legal e-bikes can be quite easily modified with instructions provided in online tutorials (Ministry of Transportation of Ontario, 2024b).

This knowledge can *increase understanding* about the use of these mobility options as well as *provide direction* regarding issues that warrant attention to optimize the safe implementation of these mobility options.

Additionally, some jurisdictions have local regulations or rules in place that distinguish between different types of e-bikes and also make distinctions based on speed, engine size or weight. In the Yukon, Class 1 e-bikes have an electric motor that provides assistance only when the rider is pedalling. But it no longer provides assistance once the e-bike reaches a speed of 32 km/h. It has a maximum continuous wattage output of 500 watts. Class 2 e-bikes have an electric motor which can be used exclusively to propel the bicycle (throttle equipped) but it no longer provides assistance when the e-bike reaches 32 km/h. Class 3 e-bikes are equipped with a pedal or throttle assist electric motor with a power output rating of 750 watts or less which ceases to provide assistance when the bicycle reaches 45 km/h (City of Whitehorse, 2021).

Conversely, rules for e-scooters are more similar to how bicycles are governed under highway traffic acts. Typically, there are specific municipal regulations established by communities which govern the use of e-scooters. Shared services may by subject to additional restrictions such as designated riding areas, road types, or geographic locations. However, there are some areas of regulation which are specific to scooters and are neither applicable to mopeds nor bicycles. For example, in some jurisdictions, e-scooter riders are mandated to wear reflective clothing if they ride at night. There may also be maximum allowable weights for e-scooters, and they may not be permitted between specified hours (i.e., usually nighttime).

This section contains an overview of provincial and territorial legislation and municipal regulatory requirements organized according to two main topics.

1) Device legislation & regulations
2) Usage legislation & regulations for users

Within each category, a summary of specific features is shared and differences across jurisdictions are highlighted where available.

Device regulations & legislation

Regulations describing the functional and operational requirements of mobility devices span a wide range of topics including licensing and registration, insurance, and the types of roads where they can be used. Requirements also mandate seasons and times of day when devices can be used. Legislation in the form of highway traffic acts govern vehicle requirements which may include which accessories are necessary (e.g., lights and/or/reflectors, horn or bell), as well as requirements related to brakes, maximum power and weight, and restrictions with respect to battery maintenance and storage. Each of these features is described in more detail below. Canadian requirements are

described first, followed by international requirements.

- **Licensing, registration & insurance requirements.** There are no requirements that e-bike riders be licensed in most Canadian jurisdictions, although this is a topic that is emerging in response to the speed of these devices, their presence on shared roadways with vehicles, and collision involvement. Riders of power cycles in Saskatchewan need a learner's permit (Saskatchewan Government Insurance, 2024a) while e-bike riders in Quebec aged 14-17 need a moped permit (Société de l'assurance automobile du Québec, 2024). Similarly, e-bike riders aged 14 to 17 years in Newfoundland and Labrador need a special permit (EUNORAU Canada, 2024).

  As for e-scooter riders in Canada and most other countries, individuals do not need to be licensed, registered nor insured. In countries such as Poland, Latvia and Slovenia, younger e-scooter riders must have a permit or valid bicycle licence. In Israel, e-scooter riders must not only register their vehicles but also obtain plates as well. Private e-scooters need to be insured in some European countries. Some cities have also been known to place restrictions on the size of e-scooter fleets (Daus et al., 2024).

- **Sidewalk vs bike-lane vs on-road permissions.** With the exception of Calgary which permits sidewalk riding only under specific conditions, the jurisdictions reviewed as part of this study did not permit sidewalk riding. Among shared services, geofencing is intended to restrict access or control power of micromobility vehicles in crowded streets with the intention of minimizing conflicts with pedestrians and other vulnerable road users. However, there is some consideration that geofencing could be subject to modification at the discretion of the regulating authority (Nikiforiadis et al., 2023).

  Concerns about the perceived safety of riding on streets with motor vehicles may prompt some e-scooter riders to ride on sidewalks. This, in turn, can make pedestrians feel less safe (Jafari & Liu 2024). In a survey of e-scooter riders in Germany, those who rode on sidewalks appeared to do so because it was convenient (Anke et al., 2023). Many Canadian jurisdictions prohibit e-scooters from riding on sidewalks. In a survey of e-scooter riders, 45% reported riding on sidewalks (City of Edmonton, 2020) even though they were prohibited from doing so. There are exceptions for e-scooters to be operated on selected sidewalks in some municipalities (e.g., Airdrie, Calgary, Red Deer). A study of micromobility users in Seoul, Korea prompted its authors to suggest that if rules regarding riding speeds in pedestrian areas could not be enforced, it might be better to simply ban the use of these devices in such locations altogether (Tamakloe et al., 2024).

- **Bike paths & lanes.** While most e-bike regulations in Canada are applied provincially, there are some municipal restrictions regarding on which bike paths or recreational trails these vehicles can be used. Most municipalities in Canada permit e-scooters to be used in bike lanes, however they are not permitted in Toronto bike lanes. It should be noted that this municipal ban applies anywhere except private property.

- **Public roads.** E-bikes are generally permitted on many public roads in Canada with a maximum speed of 50 km/h or less. In Nova Scotia, e-bike riders must stay within one meter of the curb or edge of the road on public roads (Nova Scotia Transportation and Public Works, n.d.). E-scooters may or may not be permitted on public roads and this is dependent on local regulations.

- **Divided highways.** Neither e-bikes nor e-scooters are permitted on divided highways in Canada or other countries. Restrictions about where bicycles are permitted appear to also be applied to other micromobility modes.
- **Night-time & seasonal restrictions.** Several jurisdictions have implemented regulations which govern the time of year and times of day when e-bikes and e-scooters can be used. In addition, there may be restrictions regarding on what types of roads, pathways, or trails these vehicles can be used. Given that e-bikes are treated as low-speed motorcycles and they are mostly privately owned, there are no curfews in place. Ottawa was one of the few municipalities in Canada that had a curfew in place restricting the operation of e-scooters between one am and five am, however this restriction was removed in April 2024 (City of Ottawa, 2025).

  In the United States, Atlanta city council implemented a curfew prohibiting e-scooters from being used between nine pm and four am. This was introduced in the wake of several e-scooter fatalities. Recently the curfew has been reduced to between two am to four am (WSBTV.com, 2024). In Europe, Oslo and Helsinki also have night-time curfews in place for e-scooters. Several cities have rules in place that restrict hours of operation for e-scooters. In Helsinki, for example, there is a night-time ban on e-scooter use from midnight to five am on Saturdays and Sundays (Dibaj et al., 2024).

  With respect to seasonal use, in Prince Edward Island, e-bikes are allowed on the Confederation Trail between April 1st and November 30th. During the remainder of the year, the trail is used by snowmobiles (PEI Transportation and Infrastructure 2023). In some cases, the e-scooter season may be subject to contractual agreements between providers and municipalities. For e-scooters, in Ottawa the winter ban was in effect from November 15, 2024 to May 14, 2025 (City of Ottawa, 2025).
- **Safety equipment.** In each of Canada's jurisdictions, helmet use is mandatory for e-bike riders. This is largely due to e-bikes being classified as limited speed motorcycles. Helmet use is mandatory for e-bike riders in European countries. In France, e-bike riders are required to wear helmets, and they also need to wear reflective clothing if they are riding at night.

  

  In most Canadian jurisdictions, helmet use for e-scooter operators is mandatory with the exception of Ontario where it is only mandatory for riders under 18 years of age (Ontario Ministry of Transportation, 2024b). In Alberta helmet use is merely recommended. In all the Australian states, helmet use is mandatory as is the case in several European countries. In Norway and Sweden, helmet use is mandatory for riders under 15 years of age. Meanwhile, in Spain, helmet use is subject to regulation on a municipal level. Wearing reflective clothing for nighttime riders of e-scooters is mandatory in seven European countries (Bulgaria, Croatia, Cyprus, France, Greece, Italy and Lithuania).
- **Use of lights, reflectors and bells.** E-bikes are required to be equipped with headlights and reflective taillights in three Canadian jurisdictions (BC, AB, MB). A horn is required for e-bikes in Alberta while in Prince Edward Island, either a horn or bell is required. For e-scooters, a horn or bell is required in Ontario, Prince Edward Island and some municipalities in Alberta (Ontario Ministry of Transportation, 2024b; PEI Transportation and Infrastructure, 2023).

- **Brakes.** Some provinces in Canada specify whether e-bikes or e-scooters need to be equipped with working brakes. Others do not outline whether brakes are required. A survey of e-scooter customers in Germany revealed that only one-third of respondents knew what type of braking system was in place for the last micromobility vehicle they rented. In addition, most were unaware of which hand-lever controlled which brake (Siebert et al., 2021).
- **Maximum motor power.** In each of Canada's jurisdictions, there is a limit of 500 watts for maximum motor power for e-bikes. In the Yukon, there is a limit of 750 watts for class 3 e-bikes, and this may be a function of the different types of terrain, different issues related to road infrastructure, and harsher winters. The maximum power limit for e-scooter motors in Canada is also 500 watts. In Europe, maximum motor power ranges from 250 watts in Sweden and the Czech Republic to 1000 watts in Finland, Estonia and Lithuania.
- **Maximum weight.** A maximum weight limit of 120 kgs has been established for e-bikes in Ontario and Prince Edward Island (Ontario Ministry of Transportation, 2024a; PEI Transportation and Infrastructure, 2023). For e-scooters, the following weight limits have been set for Canadian jurisdictions:
  - Quebec (36 kg)
  - Ontario & Prince Edward Island (45 kg)
  - Newfoundland & Labrador (55 kg)

  Elsewhere, few jurisdictions have weight limits for e-scooters, but they are rather varied ranging from 25 kg in Denmark and Ireland to 45 kg in Tasmania.
- **Battery power, maintenance & storage.** This is a significant issue surrounded by growing concern since lithium-ion batteries are typically utilized in these devices and can be a fire hazard under certain conditions, notably extreme temperatures, vibration, and being subject to impact. In British Columbia and Ontario, the motor and battery of e-bikes must be covered and/or insulated (Government of British Columbia, 2024a; Ontario Ministry of Transportation, 2024a). Legislation regarding e-scooter battery placement and protection does not appear to be as detailed. However, there have been calls to increase regulations and create standards for lithium-ion batteries in the United States. This has been due to the extreme fire hazard they pose coupled with several deaths and injuries of e-bike users, specifically in New York (Preston, 2024), as a result of modifications and storage issues. In particular, these batteries are very sensitive to temperature, moisture and vibrations, and batteries come in varying qualities.

The prevalence of e-bike users who modify their devices to increase their speed, which may include strapping a second lithium-ion battery, unprotected, to their bike has made this issue an important safety concern.

Usage regulations & legislation

Several jurisdictions have regulations in place for micromobility users which describe who can utilize these devices and under what conditions such as minimum age of riders and the use of safety equipment. Regulations governing behaviours are also established to mitigate risks through the use of maximum speeds, prohibitions on alcohol and drug use, and restricting the use of distraction-related devices such as earbuds / headphones, and cell phones. Restrictions also exist with respect to carrying passengers.

- **Minimum age.** Minimum ages for e-bike riders range from 12 in Alberta to 16 in several other Canadian jurisdictions. There is no minimum age for e-bike riders in New Brunswick (EUNORAU Canada, 2024). For jurisdictions such as British Columbia with a two-tiered system, light e-bike riders must be at least 14 years of age while standard e-bike riders need to be at least 16 years (Government of British Columbia, 2024a).

  There is more variance in Canada for minimum age regulations for e-scooter riders since some of these programs have been implemented at the municipal level. In Winnipeg, Halifax and Quebec, the minimum age for e-scooter riders is 14 while it is 18 in Edmonton and Lethbridge. An e-scooter rider's age may limit where they are allowed to ride. For example, in Belgium, persons under 16 years of age may only use e-scooters on private property or in places such as pedestrian areas open to bicycles.

- **Maximum speed.** The maximum speed limit for e-bikes in Canada is 32 km/h as specified by Federal government regulations, now repealed but still in force until replaced by provinces and territories. Class 3 e-bikes in the Yukon can travel up to 45 km/h. Transport Canada also has oversight with respect to modifications, however, these regulations only apply up to the point of the first retail sale. After the first point of sale and e-bikes have been purchased, there is no oversight for speed or modifications. As a consequence, post-purchase modifications are being performed without any mechanisms to track by whom or how they are performed, or whether they are indeed safe. In Europe and Australia, maximum speeds are more often restricted to 25 km/h. This may be a result of their larger cycling populations and greater prevalence on the road as well as their longer history of cycling as a common mode of transport.

  Similarly, e-scooters in Canada are designed to travel at a maximum speed of 32 km/h. In many European countries and Australian states, there is a speed limit of 25 km/h for e-scooters.

- **Alcohol & drug use.** There are prohibitions against alcohol and drug use for e-bikes in the Federal Criminal Code of Canada in the statutes involving motorized vehicles or conveyances. E-bikes are considered low-speed motorcycles, and criminal impaired driving statutes apply to these vehicles because they are motorized, even if this is not specifically referenced in various e-bike rules in jurisdictions across Canada. Federal laws apply to all jurisdictions in Canada. There is an 80 mg% breath alcohol concentration (BAC) limit for e-bike riders in Austria compared to a 0 BAC limit in Ireland.

Legislation for alcohol or drug use among e-scooter riders in Canada is not always clearly explained on either government or vendor websites. Some websites may refer the reader to Canada's criminal impaired driving laws. In Spain, there is a BAC limit of 50 mg% for e-scooter riders, 30 mg% for new riders, and 0% for those under 18 years of age.

A British survey of e-scooter riders revealed that one-quarter of participants admitted to riding an e-scooter after consuming alcohol. It is suggested that one of the more effective deterrents to counter impaired operation of these vehicles may result from social rejection of this behaviour, similar to how alcohol use among drivers of passenger vehicles became socially unacceptable (Burt & Ahmed, 2023).

- **Bans on the use of devices causing distraction.** Riding an e-bike while wearing earbuds or headphones or using a cell phone is prohibited in Quebec as per its bicycle legislation. Bans on device use for e-scooter riders in Canada are not as common. Cell phone use by e-scooter riders in Sylvan Lake, Alberta is banned (Town of Sylvan Lake, 2017).
- **Passengers.** In Alberta and Quebec, carrying passengers on an e-bike is prohibited unless there is seating provided for passengers. In New Brunswick, kid trailers can be attached to e-bikes (E-Bike Canada, 2024). E-scooter operators in Canada and other countries are not allowed to carry passengers.

Summary

There is a desire among some stakeholders that Federal and provincial governments move to codify definitions of e-bikes and e-scooters and establish licensing schemes (CBC News, 2024; Fatal Collision Review Committee, 2024). Key objectives would include creating a consistent framework for use, providing clarity with respect to approved devices as well as when, where and by whom (i.e., the minimum age of riders) they can be used. This move could help to increase road safety by better protecting micromobility riders as well as other road users.

The maximum power and weight restrictions for e-bikes and e-scooters appear to be more conservative in Europe and Australia as compared to North America. In particular, there appears to be greater distinctions between different classes of devices. Typically devices with heavier weights and faster speeds are more restricted in that they more often require licensing and vehicle registration.

There continues to be confusion with respect to where devices can be used, and this might be due in part to inconsistent requirements across jurisdictions combined with the desire of users to ride where they feel safest. It appears that, at a minimum, restrictions regarding when and where e-scooters can be used may need to be publicized more. As evidence of the need to fill this gap, although riding on sidewalks is prohibited in Edmonton, 22% of survey respondents did not know they were prohibited from doing so (City of Edmonton, 2020).

In terms of mandating the use of safety equipment, requiring e-bike riders to wear helmets is more common than mandating e-scooter riders to do so. On the other hand, more jurisdictions require e-scooter riders than e-bike riders to wear reflective clothing. Some mobility device providers have engaged in outreach programs to educate e-scooter riders by means of hosting information sessions and sending out educational emails. In Ottawa, providers' staff members have met with customers in a public setting to reinforce safe riding behaviour and to inform customers about local regulations (Neuron, 2023, Bird, 2023). In light of the variations in riding locations, and the increasing extent to which multiple modes of transportation share infrastructure, the importance of safe speeds and

helmets, along with visibility in the form of reflectors and/or reflective clothing for riders, as well as the use of horns or bells is evident. Education about these protections and how riders can benefit from them should be a foundational element of education for all road users.

There are also legislative gaps in terms of which accessories are required for e-bikes and e-scooters. Many government and vendor websites do not explicitly state whether headlights, taillights, reflectors or bells/horns are required on e-bikes and e-scooters. Weight limits for e-bikes are not clearly defined despite the fact heavier vehicles put pedestrians and riders of lighter bicycles at risk.

Few jurisdictions elaborate on seasonal restrictions of e-scooter use. In Canada with wide variation in weather conditions and temperatures that can be extreme, greater attention to this issue is warranted. Education is needed to increase awareness among users regarding when it is safe to ride, and among active transportation users and drivers to know when to expect to see these devices on the road. On one hand, it would be expected that with colder or wet weather riders would naturally choose to self-regulate, particularly because batteries lose their power once the temperature drops. But in light of increasingly random weather patterns such as snow in May or warm temperatures in late November, guidance may be helpful, particularly because of the potential fire hazards associated with lithium batteries in wet and extreme conditions, guidance on this issue can help keep road users safe. With respect to shared e-scooter services, this is less of an issue since pilot projects or vendor contracts with cities may only last a few months.

Education is essential for raising awareness among users about safe riding conditions, and for informing active transportation users and drivers about when they can expect to encounter these devices on the road.

In addition, there is a concerted and pressing need to develop strategies to manage riders who fail to comply with usage regulations and legislation. Speed, impairment and distraction are often contributing factors. Strategies are needed to mitigate these risks and bring clarity as to whether highway traffic act and criminal code statutes in place for motorized vehicles equally apply to these new mobility modes powered by lithium-ion batteries.

Knowledge gaps & opportunities

E-bikes and e-scooters are becoming more prevalent on roadways in Canada. The use of these devices has increased because they are a more affordable, more efficient, and more convenient option for many road users. They are also more environmentally-friendly, which adds to their appeal. These devices are most often a preferred micromobility option, particularly for short trips for work or leisure in urban locations and more often among younger and male road users. Finding no-cost parking is quite a lot easier with designated areas, and riders also avoid additional costs associated with registration, licensing and gas.

Yet many questions remained unanswered. Collaborative work across jurisdictions can help bring consistency to the management of these devices on Canada's roads. Sharing experiences to date can provide insight into optimal safety practices, as well as streamline educational strategies. This approach can also help to enhance data collection about these devices to facilitate research and answer important questions about safety. Some opportunities to help address gaps and build a national framework for these devices, as well as guide the implementation and use of them in the Canadian context are shared below for consideration.

Establish a provincial/territorial working group comprised of government representatives, industry partners and other key stakeholders. A key objective of this working group is to discuss and review differences in regulatory and legislative frameworks to identify commonalities and differences, providing insight into existing strengths and weaknesses. This is a necessary first step to bring consistency to the management of these devices and optimize the use of safe implementation strategies. Another essential objective of this initiative is to develop robust data collection strategies to accelerate understanding of the risks associated with these devices and create a national picture of micromobility in Canada. This information is paramount to establish a foundation for the development of optimal implementation and risk mitigation strategies. Finally, collaboration in the form of a working group can help inform research initiatives, facilitate comparisons, and optimize knowledge creation to accelerate the safe implementation of these devices.

Review Federal regulations to strengthen definitions of permitted devices which can be brought into Canada and used on our roads. A majority of e-bikes, and to a lesser extent, e-scooters are purchased online from manufacturers. In fact, China is the predominant manufacturer of e-bikes sold and used globally, accounting for an estimated 93% of e-bike sales (Fishman & Cherry, 2016). As

such, the inspection of devices coming into the country is challenging and often limited as a function of staffing and capacity of Federal inspectors. This means devices that fail to comply with regulations unfortunately make it onto Canada's roads.

To this end, the lithium-ion batteries used in e-mobility devices can pose a serious risk to riders. To illustrate, e-bikes and e-scooters have been an increasingly common sight in New York City, with diverse riders relying on these devices to get to work as well as complete local errands and outings. The number of lithium-ion battery fires has been on the rise and in 2023 there were 267 fires resulting in 18 deaths and 150 injuries based on reports from the New York Fire Department (FDNY). In fact, their statistics revealed the number of e-mobility device fires was almost nine times greater than incidents reported in 2019 which was the last year during which no deaths occurred (Preston, 2024).

Similarly, the Consumer Products Safety Commission (CPSC) received reports related to 208 incidents involving e-mobility devices overheating or catching fire. The incidents occurred in 39 different states in the US during the period January 1, 2021, and November 28, 2022. These incidents resulted in at least 19 fatalities involving electronic scooters and bikes, and hoverboards (Health Canada, 2023).

At present, the regulation for these devices is divided with Transport Canada regulating some e-mobility devices, and Health Canada regulating some products which contain lithium-ion batteries. It is positive that Transport Canada and Health Canada are working cooperatively on this issue (Health Canada, 2024). However, given the immense risks posed by these batteries, it is critical that standards be imposed to prevent poor quality and unsafe batteries entering the country.

In the US, standards for lithium-ion batteries are currently voluntary, but some industry representatives suggest they should be mandatory, as they are for other products like electrical outlets. Consumer Reports is a proponent of this initiative, and they have further supported legislation which would create mandatory safety standards for lithium-ion batteries in e-mobility devices that was working its way through Congress (Preston, 2024). This move was based, in part, on a Consumer Reports investigation in December 2022 which revealed the lack of regulations for lithium-ion battery regulations put people at risk of injury or death (Preston, 2024).

Encourage education to promote the safe use of devices. At present, general knowledge and awareness about the appropriate use of these devices is decidedly low. No doubt some of the confusion about permitted usage and requirements for these devices stems from differences in regulation and legislation across jurisdictions. Moreover, these devices are generally associated with strong beliefs regarding where devices can be used, with very different perspectives being

grounded in perceptions about safety, which may not be correct. There are also important distinctions between approaches to personal use and shared use devices and it is important for users to recognize these differences.

Education is the shared responsibility of provincial and municipal governments coordinated with industry, stakeholder groups and advocates. The Canadian Electric Bicycle Association (CEBA) has been extremely busy responding to demands for information about these devices across a wide spectrum of issues. It has been increasingly challenging for them to keep up addressing an ever-expanding list of topics and requests, and still, more work is needed. Most recently, CEBA was requested to develop and deliver training with respect to safety practices associated with lithium-ion batteries, having received numerous requests from firefighters. Investment in educational tools is essential to ensure e-mobility devices are well integrated into the road network and riders are able to feel safe on the road when using them.

Support the enforcement of road rules to reduce risks for all road users. Enforcement tools and strategies are needed to ensure riders can ride safely on roads and these devices do not pose a threat to other road users, notably pedestrians and cyclists. An important enforcement issue in need of urgent attention is the modification of devices to permit faster speeds that exceed safety standards. Common modifications that enable devices to exceed regulated limits include adjusting motor settings or removing speed limiters. Excessive speed plays a substantial role in e-bike fatalities (Fatal Collision Review Committee, 2024). Risks are significant when modified devices are driven on sidewalks and in bike lanes designed for much slower traffic. As such, strategies are needed to prevent the modification of devices entering Canada as well as tools for law enforcement to respond to the risk they pose on the roads.

Alcohol and drugs were also present in at least some e-bike rider fatalities described previously. This is a concerning issue because data summarizing other characteristics of riders associated with these incidents indicates some drivers had a history of other traffic violations and did not possess a valid licence. This suggests that e-bikes and e-scooters may be an alternative mode of transportation for at least some impaired drivers who have previously lost their licence and are not permitted to drive a motor vehicle. Similarly, the presence of alcohol and drugs in e-bike and e-scooter riders may also suggest that some riders are utilizing devices as an alternative to driving a vehicle home after a night out consuming alcohol.

As such, efforts are needed to discourage and prevent alcohol and drug use among riders. Police services must also be made aware of the prevalence of this issue and receive training about mobility devices so that appropriate enforcement strategies can be designed to deter the use of impairing substances among riders. Some jurisdictions have attempted to mitigate this issue by limiting hours of use for shared service devices. However, this does little to address the issue among riders of privately-owned devices.

Similarly, distraction is another risk associated with e-bike and e-scooter riders. Efforts to discourage the use of distracting devices is much needed and police services also require training and tools to deal with this issue effectively.

Pursue research to fill gaps in knowledge and data collection / coding to answer key questions and inform policy decisions and safety frameworks. The lack of knowledge about these devices results in considerable uncertainty with respect to the creation of sound regulations or policies regarding their use. In the absence of knowledge, the implementation of these devices is fraught with risks. Left unchecked, these risks may ultimately result in a complete ban prohibiting the use of these devices altogether, particularly if substantial numbers of injuries or fatalities occur as their prevalence becomes more widespread.

At present, knowledge about the role and risks of these devices on Canadian roads is lacking, in part, as a result of inconsistent and inadequate data collection. There are data gaps in the coding of devices in collision reports and trauma centre data sets, and this is due in part to variations in definitions. A review of available data undertaken as part of an e-bike inquest conducted by the Fatality Analysis Review Committee of the Office of the Coroner in the City of Ottawa revealed that police-reported data, Ministry of Transport data sets, public health data, trauma centre data, and provincial administrative health data did not utilize a standard definition of e-bikes (Fatality Collision Review Committee, 2024). Moreover, data about these devices in collisions involving injury or death was not consistently collected. To ensure quality data are available and usable to answer key questions, clear definitions of and codes for different types of e-bikes are essential.

Despite current data gaps, TIRF's National Fatality Database containing data collected from medical examiners and coroners across the country revealed a total of 17 e-bike fatalities that could be identified in fatal crashes in Ontario between 2012 and 2020. Many of the persons killed were riding an e-bike were male and aged 45 years or older. Most often the rider was ejected from the e-bike while riding on a public road. More than half of these fatalities occurred in Fall and Winter months, more than half (53%) of fatalities with toxicology results were positive for drugs, and a large majority of those whose driver's licence status was known were suspended, revoked or they had never had a licence (TIRF, 2024).

Looking at fatalities across Canada, there were 29 e-bike fatalities in Canada between 2012 and 2021. Again, most fatalities involved males with the largest proportion being aged 45 to 64 years, and the remaining deaths involving those aged 25 to 44 years, aged 65 or older, or less than 25 years. More than half (18) of these riders were wearing a helmet although this factor was not known in all cases. Alcohol and drugs were present in a minority of cases, with the presence of drugs being somewhat more common, however testing rates were decidedly low. The largest proportion of collisions occurred between July and September followed by April to June. Much smaller proportions occurred during Fall and Winter (October to March) (TIRF, 2024).

Similarly, there were 387 e-bike injury cases reported in Canada between 2011 and 2022 which were captured in the Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP) database. An analysis of trends revealed a significant annual increase which has occurred since 2011. A majority of these incidents involved male riders and the age cohort most frequently injured was 50 to 64 years. Almost all of these cases (94%) involved the e-bike rider and two-thirds (65%) resulted from road collisions. Although most of these riders wore a helmet, these collisions resulted in injuries to the upper and lower extremities, head, face and neck, trunk of the body, and spine (Public Health Agency of Canada, 2024).

In order to increase understanding of the role of these devices in collisions and factors contributing to crash risk, some degree of consistency or standardization is needed across provincial crash report forms as well as trauma centre data collection tools. Moreover, the ease of querying these data sets

is critical to facilitate research and guide decision-making. In other words, simple references to these devices in the narrative of reports is insufficient to facilitate analysis or research.

There is also a need for mechanisms to facilitate local data collection with respect to incidents not involving injury or death; in particular collisions with pedestrians, fixed objects or related hazards such as open car doors. This can provide guidance and direction to identify safe riding locations and determine whether riding on designated paths, sidewalks, protected bike lanes or roadways offer the most protection for all types of road users.

Local data collection can help identify safe riding locations for mobility riders and determine whether riding on designated paths, sidewalks, protected bike lanes or roadways offer the most protection for all types of road users.

In addition, it is equally important to be able to distinguish between shared service versus personal use devices in these incidents. This is an important distinction, not only because the physical structure of shared service versus personal use devices can differ in important ways, but also because the rules regarding users, riding locations and mandated safety features or requirements are also quite distinct. As a consequence, the safety concerns associated with these different types of devices can vary substantially and concerns related to shared device use may be dissimilar to those associated with personal use devices.

Improvements in data collection can greatly identify risks associated with these devices that are currently unknown. This is necessary to greatly accelerate the safe adoption of these devices and increase mobility for Canadians. At the same time, these improvements can provide insight into the prevalence of use of these devices which can inform investments in infrastructure improvements.

Identify qualifications for vendors who provide shared services or sell devices. As a final consideration, government, industry and other key stakeholders should discuss the feasibility and necessity of establishing mandatory requirements or voluntary guidelines regarding who may offer shared services or sell e-mobility devices to Canadians. At present, this exists to some degree with municipalities selecting vendors to provide shared services at the local level. This practice also offers appropriate quality assurance measures as service providers perform maintenance on devices and ensure those available to the public are safely managed.

However, no such mechanisms are associated with privately owned devices. Indeed, past the point of first sale, responsibility for privately owned devices is the purview of owners. Moreover, a large proportion of cycling shops selling e-bikes do not offer servicing of these devices, and worse yet, may not have technicians on staff trained in the handling of lithium-ion batteries. As evidence of the risk associated with these devices, some retail shops will not keep devices requiring maintenance in their shops overnight due to the fire hazard they pose. In these cases, the policy caveat emptor applies and the onus is entirely on consumers to inform themselves and ensure retail shops are qualified to provide service.

Equally concerning, a majority of sales of e-bikes occur online, meaning there may not be a retail shop involved, and consumers may be purchasing these devices directly from manufacturers. In these cases, owners have nowhere to turn when maintenance is needed, and reputable retail shops are less inclined to offer service to devices they did not sell, particularly if they are not familiar with the brand or model of e-bike or lithium-ion battery.

Educate consumers about insurance implications of e-bikes & e-scooters. Insurance coverage with respect to mobility devices is distinct depending on whether they are shared service or personal use devices. Vendors offering shared services have their own insurance coverage which they must carry in accordance with service contracts with municipalities.

Conversely, individual owners are responsible for insurance on personal use devices. Despite the similarities between these two transportation modes, there are important distinctions in terms of how they are managed under insurance policies. With respect to personal use devices, e-bikes and e-scooters are generally not included in auto insurance policies related to collisions and injury because they are not deemed to be motorized vehicles. In some instances, these devices may be included under homeowner's insurance as property insured against theft or damage resulting in replacement or repairs. However, given the substantial cost of e-bikes, some insurers may either exclude e-bikes from typical coverage, limit the amount of coverage available, or offer a separate policy for these devices because they can be quite costly. In Canada, a limited number of companies have offered this special e-bike insurance, whereas in the United States more companies offer such policies, and the extent of coverage offered is based on the cost of the e-bike (Friskney, 2024).

As a consequence, when riders are involved in collisions, they generally do not have any coverage or adequate coverage for property damage, injuries or deaths, meaning costs associated with at-fault collisions are excluded.

To this end, while owners are not obliged to have insurance for e-bikes, there are a variety of insurance options available depending on various factors and approaches adopted by individual insurers. Generally speaking, there are four main types of policies that offer e-bike coverage which are homeowner, personal liability umbrellas or specialized e-bike policies and to a much lesser extent, auto. Types of coverage considerations for owners include theft and vandalism, property damage, personal liability, personal injury and uninsured or under-insured motorist options (Western Financial Group, 2024).

Insurance coverage with respect to e-scooters is even more limited as these vehicles are much less likely to be included under the definition of motor vehicle meaning they are often excluded from auto insurance coverage. As a consequence, while riders may have some limited coverage within homeowner or personal liability policies, in the event of an at-fault collision, riders are more likely to be on the hook for damages (Porado, 2024).

In light of this diversity and differences with respect to how e-bikes and e-scooters are insured, *greater awareness* of this issue is needed both among shared service riders as well as personal use riders.

E-bike & e-scooter riding safety tips

Before you ride

- **Conduct a pre-ride check.** Before starting your trip ensure the brakes are working properly, the tires are adequately inflated, there is no visible damage, and the battery has enough charge.
- **Wear protection.** Helmets play an important role in prevention of traumatic brain injuries, which are rare but can occur with e-scooter use. For e-scooters, knee pads, elbow pads, wrist guards, and gloves can add an extra layer of safety, cushioning the blow from falls and scrapes.
- **Be visible.** Wear bright, reflective clothing, especially if riding at night. Use lights and reflectors to ensure you are seen.
- **Avoid distractions.** Don't use your mobile phone while riding or be distracted by other means.
- **Ride sober.** Impairment increases the risk of an incident and injury. Alcohol and drugs impair judgment, balance, and reaction times, making riding unsafe. Consider that an adult riding an e-scooter with a small child passenger in front is very unsafe. If they crash, the child could be projected into whatever the e-scooter collided with. There is also the added risk of the adult impacting with the child. The child ends up assuming the role of an airbag (Rutherford, 2024).
- **Avoid bad weather.** Wet or icy roads make riding risky, reducing tire grip and making it easier to lose control, skid, and crash.

When you ride

- **Start slow.** Practice riding in a safe place if you are new to riding and at first avoid high speeds or travelling down steep hills. Make sure you are comfortable operating the throttle, steering, braking, and dismounting.
- **Observe the path.** While riding, constantly be on the lookout for common roadway and roadside objects. Curbs, manhole covers, storm grates, and light rail or railroad tracks are common fall hazards.
- **Ride solo.** Riding with a passenger can affect the scooter's balance and control, making incidents more likely.
- **Ride single file.** If space is restricted, ride single file. Some cities allow riding side by side while in others it may not be permitted.
- **Watch traffic.** Ride in the direction of traffic, keeping a safe distance from motor vehicles. Avoid riding in a vehicle's blind spot. Avoid riding between large vehicles and the sidewalk, especially when the vehicle is turning.
- **Obey the rules of the road.** Stop at stop signs and red lights, obey speed limits, yield to pedestrians, and signal turns. Use a bell to alert pedestrians or other road users when passing. Ride in a manner that is predictable to other road users. If you're somewhere new or unfamiliar, check any local traffic rules.
- **Watch for pedestrians.** Slow down when pedestrians are near and park out of their walking path.
- **Avoid sidewalks.** Even if there are no official regulations banning e-bikes and e-scooters from sidewalks, always use bike lanes or roads.

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Appendix A: Known e-bike fatalities in Canada: 2012-2021

Known E-Bike Fatalities in Canada: 2012-2021

Age group	Sex	Crash year	Crash month	Time of crash	Road type	# of vehs	Pos	Ejected	Helmet worn	Alcohol present	Surv driv cond	Drugs pres	Cannabis present	Driver lic susp
45-64	M	2012-2016	July-Sept	1500-1759	Other public	2	Driv	Fully ejected	Yes	Yes	Distract	No	0	Unk
65+	M	2012-2016	July-Sept	Unk	Unk	1	Driv	Unk	Unk	Not tested	N/a	Not tested	Not tested	Unk
25-44	M	2012-2016	Apr-Jun	2100-2359	Other public	2	Driv	Fully ejected	Yes	0	Normal	Yes	Yes	Unk
65+	M	2012-2016	Apr-Jun	Unk	Unk	1	Driv	Fully ejected	Unk	Not tested	N/a	Not tested	Not tested	Unk
65+	M	2012-2016	Jan-Mar	1500-1759	Other public	3	Driv	Fully ejected	Yes	0	Distract	No	0	No
65+	M	2012-2016	Jan-Mar	1500-1759	Other public	2	Driv	Not ejected	No	0	Normal	Yes	0	Unk
45-64	M	2017-2021	Oct-Dec	1800-2059	Priv prop	2	Driv	Unk	Yes	0	Normal	Yes	Yes	Unk
45-64	M	2017-2021	Oct-Dec	Unk	Other public	1	Driv	Not ejected	Unk	0	N/a	Yes	0	Unk
45-64	M	2017-2021	Oct-Dec	Unk	Other public	1	Driv	Unk	Unk	Not tested	N/a	Not tested	Not tested	Unk
25-44	M	2017-2021	July-Sept	0-259	Other public	2	Driv	Fully ejected	Yes	0	Other	No	No	Unk
45-64	M	2017-2021	Jan-Mar	Unk	Other public	1	Driv	Fully ejected	Unk	Not tested	N/a	Not tested	Not tested	
65+	M	2017-2021	July-Sept	1500-1759	Other public	2	Driv	Not ejected	Yes	0	Normal	No	No	No
45-64	M	2017-2021	Apr-Jun	900-1159	Other public	2	Driv	Fully ejected	Yes	Not tested	Normal	Not tested	Not tested	No

Age group	Sex	Crash year	Crash month	Time of crash	Road type	# of vehs	Pos	Ejected	Helmet worn	Alcohol present	Surv driv cond	Drugs pres	Cannabis present	Driver lic susp
65+	M	2017-2021	Oct-Dec	600-859	Other public	2	Driv	Fully ejected	Yes	Not tested	Normal	Not tested	Not tested	No
45-64	M	2017-2021	Apr-Jun	600-859	Other public	2	Driv	Fully ejected	Yes	0	Distracted	Yes	Yes	Yes
25-44	M	2017-2021	July-Sept	Unk	Other public	1	Driv	Unk	Unk	Not tested	N/a	Not tested	Not tested	Unk
45-64	M	2017-2021	Apr-Jun	1500-1759	Other public	1	Driv	Fully ejected	Yes	0	N/a	Yes	Yes	Yes
45-64	M	2017-2021	Jan-Mar	600-859	Other public	2	Driv	Fully ejected	Yes	Not tested	Normal	Not tested	Not tested	No
45-64	M	2017-2021	Jan-Mar	2100-2359	Other public	2	Driv	Unk	Unk	Yes	Unk	Yes	Yes	No
45-64	M	2017-2021	July-Sept	1800-2059	Other public	2	Driv	Fully ejected	Yes	Yes	Normal	Yes	No	Yes
25-44	F	2017-2021	Oct-Dec	1800-2059	Other public	2	Driv	Fully ejected	Yes	Not tested	Normal	Not tested	Not tested	No
25-44	M	2017-2021	July-Sept	2100-2359	Other public	2	Driv	Fully ejected	Yes	Yes	Normal	Yes	No	Yes
45-64	M	2017-2021	July-Sept	900-1159	Other public	1	Driv	Fully ejected	Unk	Not tested	Unk	Not tested	Not tested	Unk
65+	M	2017-2021	Apr-Jun	1800-2059	Other public	1	Driv	Fully ejected	No	Not tested	Unk	Not tested	Not tested	Unk
25-44	M	2017-2021	Apr-Jun	900-1159	Other public	1	Driv	Fully ejected	Yes	Not tested	Unk	Not tested	Not tested	Unk
25-44	M	2017-2021	Apr-Jun	1800-2059	Other public	1	Driv	Unk	No	Not tested	Not tested	Not tested	Not tested	Unk
25-44	F	2017-2021	July-Sept	900-1159	Hwy	2	Driv	Fully ejected	Yes	0	Not tested	No	No	Unk
<25	M	2017-2021	July-Sept	300-559	Hwy	2	Driv	Unk	Yes	0	Not tested	Not tested	Not tested	Unk

Age group	Sex	Crash year	Crash month	Time of crash	Road type	# of vehs	Pos	Ejected	Helmet worn	Alcohol present	Surv driv cond	Drugs pres	Cannabis present	Driver lic susp
25-44	M	2017-2021	July-Sept	1200-1459	Hwy	2	Driv	Unk	Yes	0	Other	Yes	Yes	Unk
65+	M	2017-2021	July-Sept	1500-1759	Other public	2	Driv	Not ejected	Yes	0	Normal	No	No	No
45-64	M	2017-2021	Apr-Jun	900-1159	Other public	2	Driv	Fully ejected	Yes	Not tested	Normal	Not tested	Not tested	No
65+	M	2017-2021	Apr-Jun	1800-2059	Other public	1	Driv	Fully ejected	No	Not tested	Unk	Not tested	Not tested	Unk
25-44	M	2017-2021	Apr-Jun	900-1159	Other public	1	Driv	Fully ejected	Yes	Not tested	Unk	Not tested	Not tested	Unk
25-44	M	2017-2021	Apr-Jun	1800-2059	Other public	1	Driv	Unk	No	Not tested	Not tested	Not tested	Not tested	Unk
25-44	F	2017-2021	July-Sept	900-1159	Hwy	2	Driv	Fully ejected	Yes	0	Not tested	No	No	Unk
<25	M	2017-2021	July-Sept	300-559	Hwy	2	Driv	Unk	Yes	0	Not tested	Not tested	Not tested	Unk
25-44	M	2017-2021	July-Sept	1200-1459	Hwy	2	Driv	Unk	Yes	0	Other	Yes	Yes	Unk

Additional descriptive information with respect to the 29 fatally injured operators is that one or more individuals:

- were struck hit by a car door;
- were distracted;
- were improperly wearing a helmet;
- had a history of drug abuse;
- refused medical treatment at the scene of the crash and died a few days later;
- had the speed regulator on the e-bike disabled;
- were driving at an estimated 70 km/h;
- had multiple driver's licence suspensions;
- struck a pedestrian; and,
- were victims of a hit & run.

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