

February 10, 2020

## Motorcyclist Advisory Council Recommendations to the Secretary of Transportation and the Federal Highway Administration

### Motorcyclist Advisory Council (MAC)

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Secretary Chao,

The Motorcyclist Advisory Council was reestablished by the FAST Act on 2015, Section 1426. Under that section, the MAC is responsible for providing advice and recommendations concerning infrastructure issues related to motorcyclist safety including

1. barrier design;
2. road design, construction, and maintenance practices, and the
3. architecture and implementation of intelligent transportation system technologies.

The MAC has created the selected recommendations to address the above issues of concern for motorcyclists. Our intention is to make motorcycling safer through the implementation of the recommendations.

In the U.S., motorcyclists represent more than 14% of traffic fatalities<sup>1</sup>, while motorcycles represent about three percent of registered motor-vehicles and less than one percent of vehicle miles traveled<sup>2</sup> (VMT). If zero fatality plans are to be achieved, safety issues involving motorcyclists will have to be both recognized and addressed.

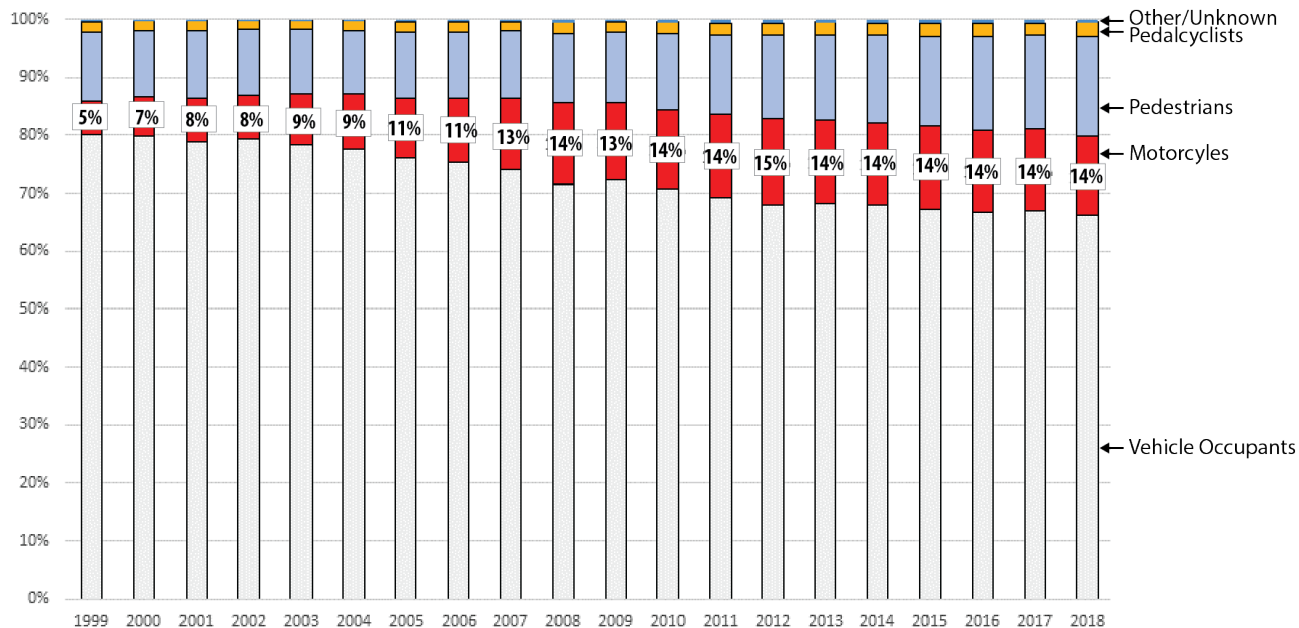
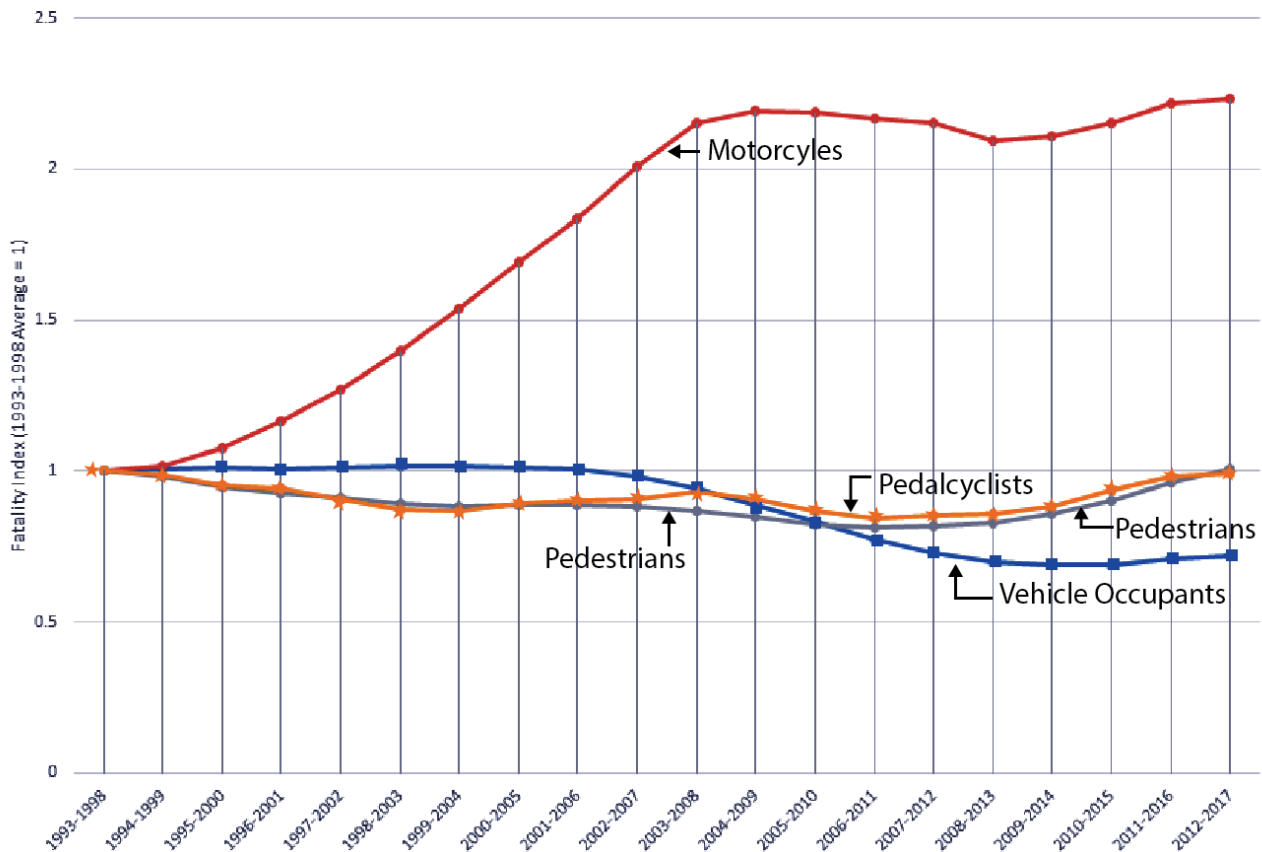


Figure 1: U.S. Highway Fatalities by road user 1999-2018 ( <https://www-fars.nhtsa.dot.gov/Main/index.aspx>)



With the continued efforts by US DOT, motor-vehicle (passenger cars, pickups, SUVs, etc.) fatalities have decreased during the past two decades. Unfortunately, motorcyclist fatalities have increased significantly in the same period.

Figure 2: U.S. Highway Fatality Index, 5 year moving average, 1991 - 2017. The increase in rider fatalities from the grouping 1993-1998 to the grouping 2004-2009 correlates with the increase in motorcycle sales in the U.S. during that timeframe (<https://www.quora.com/Are-the-number-of-motorcycle-riders-up-or-down-compared-to-say-since-1980>)

Unlike other motor-vehicles, most motorcycles are single-track vehicles that have unique steering and stability characteristics, which may be differently affected by roadway design and pavements. For example, roadway conditions such as potholes, milled pavement, edge drop, etc., may introduce more immediate and significant negative impacts on motorcycles, when compared to other motor-vehicles. In the event of a crash, motorcyclists are often separated from the motorcycle and directly exposed to roadside structures, including barriers. To continue improving motorcycle safety, we must improve the infrastructure which motorcycles and other motor-vehicles share.

In 2019, MAC conducted a Motorcycle Staffing and Resources Survey to understand how different states account for motorcycle safety in the areas of roadway engineering, safety analysis, and technology. The survey was distributed to American Association of State Highway and Transportation Officials (AASHTO) Safety committee. Contained herein are recommendations from the Motorcyclist Advisory Council (MAC). These recommendations are the result of informational presentations from subject matter experts and discussions conducted at public MAC meetings held on

- 05 December 2017,

- 07 June 2018,
- 12 December 2018,
- 15 August 2019
- 10 December 2019

and from work performed by committee members outside of official meetings after the first meeting December of 2017.

Our recommendations will address each of the areas under our charter as well as recommendations that address barriers to the implementation of the charter-specific recommendations. To that end, each recommendation will specify the problem faced by motorcyclists, the recommendation itself, any relevant data that supports our recommendation or, in place of data, a recommendation for research to explore solutions to the problem.

Additionally, we sought to include recommendations for the implementation of our proposed solutions where we have them. Lastly, we will specify if our recommendations address the motorcyclist themselves or other vehicle operators where appropriate. For example, a recommendation for providing lower barrier protection on a standard guardrail addresses a crash that may only involve the motorcyclist while a recommendation to post signage prohibiting left turns would address other vehicles turning into the path of a motorcyclist.

### **Barrier design**

**Problem:** Barriers designed to protect those in passenger vehicles and larger commercial vehicles rarely take motorcyclists into account and as a result, a motorcyclist impacting a barrier risks more severe injury than if they impacted the object the barrier was guarding against.<sup>3</sup> These recommendations will primarily address the motorcyclist rather than the other vehicle.

**Recommendation:** There are several existing countermeasures to mitigate the impact of a motorcyclist with an existing inadequate or dangerous barrier. We recommend that the Federal Highway Administration evaluate the existing options for their applications in the U.S. as well as identify situations where no treatment has been developed to address a barrier that poses a risk to motorcyclists. The MAC has identified three of these options below but our list is in no way exhaustive.

When evaluating these barrier or barrier treatment options, FHWA should consider several factors. First and foremost being how effectively the treatments mitigate the risk of injury to the motorcyclist, second should be where these treatments should be implemented. For example, curves are an area where motorcyclists are particularly vulnerable and where barriers are likely to be installed. Another factor to consider is the cost and ease of implementation as states are far more likely to make use of treatments that are relatively cheap and easy to install.

1. Secondary rail systems or guardrail continuous protection systems are an existing barrier treatment that is designed to prevent the motorcyclist from sliding under an existing guardrail and into a support post. This is often achieved by fitting a plastic or metal rail below the existing rail, which places a horizontal surface between the motorcyclist and the vertical support post.
2. Impact mitigation devices that can be installed on existing support posts can reduce impact deceleration and force while also being easier to install in curved road sections than secondary rails.
3. Systems to mitigate motorcyclist impact while in the upright position must be considered as well. Not all impacts between a motorcyclist and a barrier occur while the motorcyclist has already fallen and is sliding towards a barrier. Additionally, fall hazards must be considered as motorcyclists may be ejected from their vehicle over a barrier and falling a significant distance such as when a crash takes place on a bridge or overpass. Systems to address this are being researched and were presented to the MAC by Nathan D.

Schulz, M.S.C.E. We recommend FHWA furthers this research to develop an effective barrier treatment for upright motorcyclist impacts.

**Data:** This issue is well documented by the European Road Assessment Programme Motorcycle Safety Review Panel in their report “Barriers to Change, Designing Safe Roads for Motorcyclists” which is cited above and is clearly supported by the research. The report in turn cites:

“Published research has concluded that hitting a crash barrier is a factor in 8-16 per cent of PTW deaths (Brailly, 1998; Domhan, 1987). Riders are 15 times more likely to be killed than a car occupant in this type of collision (Williams, 2004) and injuries can be up to five times more severe than if a rider had hit the rigid object that the barrier was guarding against (Ellmers, 1997; Brailly, 1998).”

**Implementation recommendation:** Wherever possible, we encourage FHWA to facilitate the testing, development, and adoption of these barrier treatments, or new barrier designs. Wherever possible, FHWA should work to disseminate relevant guidance to states to address these recommendations.

### **Road design**

**Problem:** The unique characteristics and behavior of motorcycles are not properly considered in road design manuals and guidance. In many design manuals or guidance documents, the word motorcycle is often completely absent or in some cases, appears only a few times. Just as there are design criterion created specifically for cars and trucks and bicycles and pedestrians and ADA, if vision zero is to be achieved, there are times where design criterion will need to be set to accommodate motorcycles and motorcyclists. These recommendations will primarily address the motorcyclist rather than other vehicles.

**Recommendation:** There are several potential solutions to this problem. We recommend that research into a motorcycle design vehicle be conducted and following that, research to determine which design cases are appropriate use for this motorcycle design vehicle.

Additionally, we recommend that research into using motorcycle tires for friction testing be conducted and applied in friction testing where appropriate.

Due to the unfamiliarity with motorcycles, we recommend that manuals, design guides, and training include specific modules intended to elevate awareness of motorcycle related design practice.

Lastly, we recommend that motorcycles be adopted as a minimum reference vehicle design where appropriate in design guidance.

**Data:** Despite the over-representation of motorcycle fatalities on U.S highways, a review of the most recent MUTCD shows that motorcycles are only referenced four times in the entire document:

- a table on page 106,
- motorcycle-specific plaques on page 123 (W8-15, W8-15P, W8-16),
- motorcycle HOV signage on page 353, and
- motorcycles allowed signage on page 260.

Likewise, a review of highway design manuals shows a similar lack of consideration for motorcycles:

- The Montana Road Design Manual mentions motorcycles once.
- The CalTrans Highway Design manual mentions motorcycles only 4 times.

Review of other states' highway design manuals shows a similar lack of attention paid to motorcyclists; motorcyclists are not on the mind of the highway engineer.

**Implementation recommendation:** We believe FHWA must work with the American Association of State Highway and Transportation Officials to review design manuals and guides for topics that should be expanded to include motorcycle-specific language and guidance. Wherever possible, FHWA should work to disseminate relevant guidance to states to address these recommendations.

### **Construction and maintenance practices**

**Problem:** Two wheeled motorcycles use a gyroscopic effect to keep them upright so road surface condition and friction, particularly while leaning in a curve, has a far greater effect on a motorcycle than a four wheeled vehicle. There are many examples of construction and maintenance practices that may be unpleasant or frustrating for passenger vehicles but pose a risk of severe injury or death to motorcyclists. Some of these simply require crews to be aware of and follow existing guidance, others have solutions that are not common practice, some conditions may simply warrant improved signage to warn motorcyclists of the risk, and others will require further research to find an appropriate solution. Below we list those conditions and practices of road construction and maintenance and the specific risk each of them pose to motorcyclists. This list is not exhaustive but rather a limited list of those conditions and practices the MAC believes must be a high priority to address. These recommendations primarily address the motorcyclist rather than other vehicles.

1. Pothole maintenance- Potholes can cause a motorcyclist to lose control and crash.
2. Open milled road surfaces- Longitudinal grooving can cause a motorcycle to wobble, and at high speeds can be particularly dangerous.
3. Raised manhole covers- Similar to potholes, hitting a raised manhole cover will most likely cause a crash.
4. Steel plates- Steel plates are usually raised and have very limited friction especially when wet.
5. Uneven pavement conditions- Drop offs and lips created during paving can cause the motorcyclist to lose control and crash.
6. Gravel or debris on roadway- Can cause motorcyclists to lose required friction on the road causing loss of control while braking and cornering.
7. Traffic barrel sight criteria- Large construction barrels can hide a motorcyclist from view and create visibility issues.
8. Chip sealers- The loose aggregate left on the road surface can cause loss of friction.

9. Excessive over band crack-fillers and joint sealants- Crack fill has limited friction and can be very slippery when the road is wet or hot.
10. Low friction pavement markings- Pavement markings have inherently less friction when wet or worn.
11. Traffic actuated signal detection systems that do not detect a motorcycle- The smaller size and less metal of a motorcycle can cause signal detector to not recognize motorcycles. Several states have passed laws allowing motorcyclists to treat these malfunctioning traffic signals as four-way stops after a given period of time.

**Recommendation:**

Not everyone is a motorcyclist. Road agencies need to be educated to the unique operating requirements and risks motorcyclists have on low friction and poor pavement conditions.

1. Pothole maintenance- Fill potholes as quickly as possible. Every state should have an easily accessible contact number or website for the public to make timely reports of maintenance issues. Road agencies should have a maintenance and communication plan in place to quickly repair road damage.
2. Open milled road surfaces- Traffic should not be allowed to run on high speed roads that have been milled. Lane closures can be limited to night time maintenance and construction operations to limit traffic delay. If this is not possible warning signs must be deployed advising of this condition.
3. Raised manhole covers- Traffic should not be allowed to run on roads with raised manhole covers. This condition is especially dangerous at night. If this is not possible warning signs must be deployed advising of this condition, and tapers should be applied around the covers.
4. Steel plates- Steel plates must be a temporary condition and must have warning signs for this condition. A friction material should also be applied to the plate.
5. Uneven pavement conditions- Any uneven pavement condition should be mitigated so motorcyclists do not ride on an uneven surface. If this is not possible a taper must be applied to the pavement drop or rise and warning signs must be deployed.
6. Gravel or debris on roadway- This condition should be mitigated as soon as possible and warning signs must be deployed in areas that are at risk of this condition.
7. Traffic barrel sight criteria- Grabber cones could be deployed in place of barrels or a slimmer barrel should be designed.
8. Chip sealers- Sealing operations must have warning signs for this condition and loose aggregate must be swept off the roadway as soon as tar has set.



9. Excessive over band crack-fillers and joint sealants- Road crews should not apply seal wider than 4 inches and applicators should be shut off before moving to the next crack to avoid over application. Roads with excessive cracks may need alternate or a more permanent fix.
10. Low friction pavement markings- Pavement marking suppliers should be required to provide friction numbers for all the pavement markings. Road agencies should choose those with higher friction ratings. There should be more research and testing of materials for increased friction.
11. Traffic actuated signal detection systems that do not detect a motorcycle- Policy and procedures should be in place that all signal detectors must detect motorcycles.

**Data:** Some of these issues do not yet have exhaustive data on the risks posed to motorcyclists, as part of our recommendations we urge FHWA to address this lack of data and the challenges in collecting it. That said, the members of the MAC have collective motorcycling experience of over 200 years in addition to the professional experience, expertise, and interaction with the motorcycling community that merited our selection by FHWA to serve on the MAC. These combined experiences have informed our concerns on many of these issues, from our own personal riding and professional experience as well as the motorcycling community represented by the world's largest motorcycling organization, we strongly believe these all represent risks to motorcyclists on the nation's roads.

**Implementation recommendation:** FHWA should work with AASHTO and other relevant organizations to revise guidance and training documents to call special attention to the problem areas above that disproportionately affect motorcyclists. Wherever possible, FHWA should work to disseminate relevant guidance to states to address these recommendations.

### **Architecture and implementation of intelligent transportation system technologies**

**Problem:** The advent of Intelligent Transportation Systems (ITS), Smart Infrastructure, and other connected vehicle technologies holds the potential for significant improvements to the nation's highway transportation network. The importance of ITS technology is only further magnified by the development of Advanced Driver Assistance Systems and Automated Vehicle technology as ITS will have a critical role in the interaction between all road users and the infrastructure around them. In addition, ITS will be a powerful new tool for transportation planning and traffic engineering. Motorcyclists must be addressed in each of these cases as technology that either cannot detect motorcycles or simply categorizes them in a larger group such as passenger vehicle, other, or vulnerable road user will fail to provide the full safety benefits to motorcyclists.

In this case, the problems facing motorcyclists relating to ITS are still potential problems as this technology is still being developed. To that end, the MAC's recommendations under this area seek to ensure motorcyclists receive the full benefit of this technology by requiring any of these systems to detect and recognize motorcycles not simply as another vehicle on the road but specifically as motorcycles.

**Recommendation:** We believe these advanced systems have considerable potential to reduce motorcyclist fatalities and injuries, if motorcycles are included in design requirements. Any ITS technology must be required to be developed with motorcycles as a specific vehicle class, and address motorcycles with specific written policies, guidelines, and procedures to ensure the

unique operation behavior and vehicle characteristics of motorcycles are taken into account during development, testing, and deployment of ITS technology. This recommendation does not lend itself to being clearly for the motorcyclist or other driver but rather for the infrastructure technology itself. This recommendation has the potential to address crashes involving only the motorcycle as well as those involving other vehicles.

**Data:** As these technologies are still in the development phase with few cases of ITS technology being deployed throughout the nation, the MAC is relying on the work of the National Transportation Safety Board to inform our recommendation. The NTSB recommended the following in its September 11, 2018 report titled 'Select Risk Factors Associated with Causes of Motorcycle Crashes'

*To the Federal Highway Administration: Work with the National Highway Traffic Safety Administration to incorporate motorcycles in the development of performance standards for connected vehicle-to-infrastructure systems. (H-18-37).<sup>4</sup>*

### **Recommendations that address other issues relevant to the Motorcyclist Advisory Council's charter**

**Problem:** Inaccurate Vehicle Miles Traveled data for motorcyclists leads to inaccurate risk exposure data being used to understand motorcyclist safety. Improved motorcycle VMT sensing/counting can lead to a better prioritization of motorcycle-specific highway designs/redesigns. This recommendation only addresses motorcyclists.

**Recommendation:** We recommend that FHWA and NHTSA continue and prioritize research to address this problem.

**Data:** This is an issue recognized by both U.S. DOT as indicated by NHTSA's Motorcycle Safety 5-Year Plan in which, identifying rider risk exposure as a challenge area and possible solutions are discussed.<sup>5</sup>

**Problem:** States are often lacking a specific official responsible for motorcyclist safety. This is of critical importance as many of our recommendations must be implemented by state officials and without a designated official responsible for motorcyclist safety, we believe there will be little incentive or motivation to address our recommendations. These recommendations will address motorcyclists rather than other vehicles.

**Recommendation:** We recommend that FHWA work with state officials to designate those responsible for motorcyclist safety to receive, distribute, and implement recommendations and guidance throughout their state.

**Data:** As part of the work of the MAC, we conducted a survey of state traffic safety engineers to determine how many states had a designated official responsible for motorcyclist safety. This survey was analyzed by Dr. Lee and the results inform our recommendation here.

**Implementation recommendation:** Legislation mandated the appointment of state officials responsible for pedestrian and bicyclist safety. There is an opportunity for FHWA to provide guidance to states encouraging them to create such a designation for motorcyclist safety, absent a future legislative mandate.

## **Conclusion**

The members of the MAC are confident that our recommendations, if implemented, will have a measurable impact on motorcyclist safety. It is clear from our work that motorcyclists are too often an afterthought when designing, constructing, and maintaining the nation's roadways. These recommendations are a step towards ensuring motorcyclists and motorcyclist safety are properly taken into account when creating or revising design documents, providing guidance for state officials, and reassessing common practices during construction and maintenance as well as developing the future of transportation with intelligent transportation systems.

The members of the MAC will continue to be available to clarify any aspect of our recommendations and hope to be of assistance if necessary to implement and disseminate these recommendations to any interested or relevant parties.

The opportunity to participate in this council and help the motorcycling community is one we have all taken seriously and is one that is a personal concern for each of us, we are grateful to have had this opportunity.

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- Mr. Joel Provenzano, MAC Vice Chairperson, Florida Department of Transportation (FL)
- Mr. Michael Canchola, Kentucky Department of Transportation (retired) (KY)
- Dr. Chanyoung Lee, University of South Florida, Center for Urban Transportation Research (FL)
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- Dr. Shane McLaughlin, Virginia Tech Transportation Institute (VA)
- Dr. Craig Shankwitz, Western Transportation Institute at Montana State University (MT)
- Ms. Fay Taylor, Ohio Department of Transportation (retired) (OH)

<sup>1</sup> <https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812780>

<sup>2</sup> <https://www.bts.gov/content/us-vehicle-miles>

<sup>3</sup> <https://roadsafetyfoundation.org/project/barriers-change-designing-safe-roads-motorcyclists/> <sup>4</sup> <https://ntsb.gov/news/events/Documents/MC-study-Abstract.pdf>

<sup>5</sup> [https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/13507-motorcycle\\_safety\\_plan\\_050919\\_v8-tag.pdf](https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/13507-motorcycle_safety_plan_050919_v8-tag.pdf)