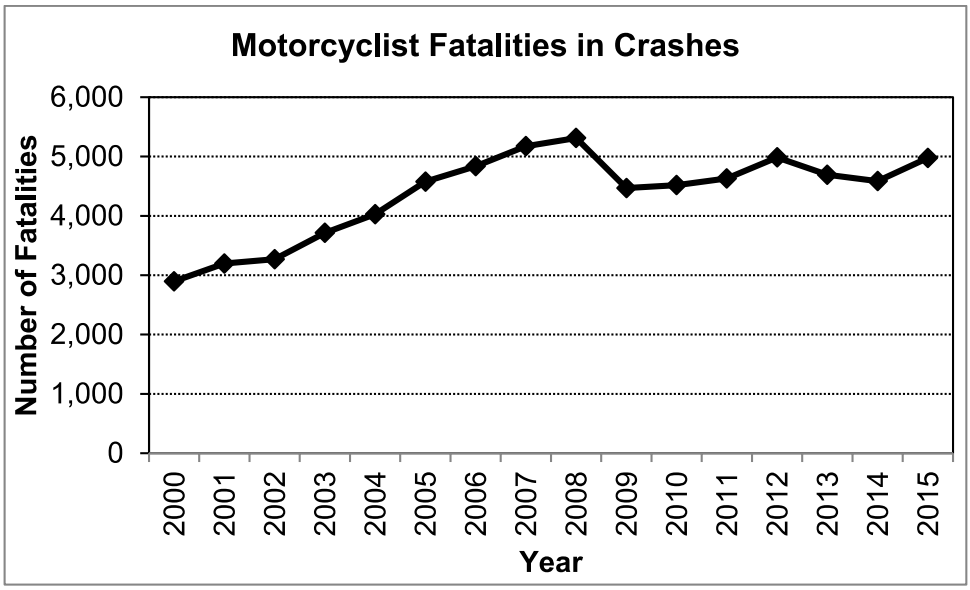
5. Motorcycle Safety

Overview

A motorcycle is inherently more difficult to operate than a passenger vehicle because it requires more physical skill and strength. The relationship of motorcycle speed and stability is also a critical consideration when riding a motorcycle, as the stability of a motorcycle is relative to speed. As speed increases, the motorcycle becomes more stable, requiring less effort from the operator to maintain its balance, even as it becomes less maneuverable. At very low speeds, the motorcycle becomes less stable, requiring greater effort from the operator to balance it.

A motorcycle offers the rider little protection in a crash. Crash data confirm this observation. NHTSA estimates that per vehicle mile traveled, motorcyclists are about 29 times more likely than passenger car occupants to die in traffic crashes. Motorcyclists are killed at a rate of 25.38 per 100 million vehicle miles traveled (VMT) as compared to 0.89 fatalities per 100 million VMT for passenger cars (NCSA, 2017).

Trends. Motorcycling has become increasingly popular over the last 10 years even as total vehicle miles traveled has declined. Along with this growth in popularity is a corresponding increase in crashes and fatalities involving motorcyclists. From 2000 to 2008, the crash data show the number of motorcyclists killed in crashes increased by 83% and the number of injured increased by 66%. In 2008, motorcyclist fatalities increased for the 11th consecutive year to 5,312, a level not seen since 1980 (NHTSA, 2009). After 2008, motorcyclist fatalities decreased substantially to 4,469 in 2009. The most recent data show that in 2015, there were 4,976 fatalities, an 8% increase from the 4,594 motorcyclists killed in 2014 (NCSA, 2017). Motorcyclists accounted for 14% of total motor vehicle related fatalities during 2015 (NCSA, 2017).



Source data: NCSA (2017)

In 2015, 41% of motorcyclist fatalities and almost half of all motorcyclist injured occurred in single-vehicle crashes (NCSA, 2017). About half (52%) of all fatalities occurred on weekdays, and 57% of fatalities occurred during daylight hours (NCSA, 2017). Ninety-one percent of motorcyclists killed and 85% of those injured were males, and passengers comprised 6% of motorcycle fatalities (NCSA, 2016).

One trend that is emerging is an increase in fatalities and injuries among older motorcyclists over the past 10 years. In 2015, 71% of the motorcyclists killed in crashes were 30 or older and 54% were 40 or older, compared to 2006, when 68% of the motorcyclists killed were 30 or older and 47% were 40 or older (NCSA, 2017). Similarly, while the number of motorcyclists involved in injury crashes has increased among all age groups, injuries among motorcyclists 50 and older have increased at the fastest rate. Motorcyclists 50 and older were estimated to account for 29% to 30% of motorcyclists injured nationally during 2014 and 2015, compared with 19% during 1998 and 1999 (FARS data).

Speeding is more prevalent in fatal crashes involving motorcycle operators than among other types of motor vehicle operators. Thirty-three percent of all motorcycle riders involved in fatal crashes in 2015 were speeding, compared to 19% of passenger car drivers (NCSA, 2017). Motorcyclists involved in fatal crashes had worse prior driving records than other passenger vehicle drivers, including more DWI convictions, speeding convictions, and suspensions or revocations (NCSA, 2017). Additionally, 27% of the motorcycle riders involved in crashes in 2015 did not have valid motorcycle operator licenses (NCSA, 2017). In 2015, 27% of the motorcycle riders killed in crashes had BACs of .08 g/dL or higher (NCSA, 2017). Forty percent of fatally injured motorcyclists were not wearing helmets (NCSA, 2017), although the percentage varies from State to State.

Other trends in motorcycle safety relate to the types of motorcycles being produced and purchased. While the number of registrations for all types of motorcycles increased from 2000 to 2005, registrations for supersport motorcycles, which are built on racing bike frames and reach speeds of nearly 190 mph, have climbed even faster. Whereas combined registrations for all motorcycle styles were 51% higher in 2005 than in 2000, supersport registrations were 83% higher (IIHS, 2007). Fatalities are three to four times higher among registered supersport owners as well (IIHS, 2007; Teoh & Campbell, 2010). Fatally injured supersport-style motorcycle riders were about twice as likely as standard/cruiser riders to have been speeding and half as likely to have been alcohol-impaired, after accounting for rider age and gender. These results suggest that the types of risks taken may vary in association with the style of bike chosen (Teoh & Campbell, 2010). Supersport riders also tend to be younger. In 2005, the average age was 27 among those fatally injured while riding these bikes, compared to an average age of 44 for cruiser and standard motorcycles (IIHS,
2007).

Another emerging trend is the increased use of low-powered cycles such as mopeds, electric-assist bicycles, and scooters. State laws defining and regulating these vehicles vary, making it difficult to track trends. While these are different vehicles in terms of their speed and power capabilities (most States classify these vehicles based on multiple criteria including maximum speed, generally 20 to 30 mph), countermeasures aimed at motorcycles are likely to also apply to

low-powered cycles. However, it should be noted that riders of low-powered cycles may face different safety problems than motorcycle riders.

Strategies to Improve Motorcycle Safety

There are various existing strategies to improve motorcycle safety but few have been extensively reviewed in published research. Some of the strategies that have been identified are that all motorcycle riders should wear motorcycle helmets that meet Federal Motor Vehicle Safety Standard (FMVSS) 218 and clothing that provides both protection and visibility. Motorcycle riders should be properly trained and licensed. They should be alert and aware of the risks they face while riding; in particular, they should not be impaired by alcohol or drugs. These and other strategies are discussed in the National Agenda for Motorcycle Safety (NAMS), a comprehensive, collaborative, and multidisciplinary blueprint for motorcycle safety (NHTSA, 2000a). The recommendations of the NAMS were prioritized in 2013 (NHTSA, 2013). See also the NAMS Implementation Guide (NHTSA, 2006a), NHTSA's Motorcycle Safety Program Plan (NHTSA, 2006b), the U.S. DOT Action Plan to Reduce Motorcycle Fatalities (U.S. DOT, 2007), and the Centers for Disease Control and Prevention's Motorcycle Safety Guide (CDC, 2011). In addition, a review of State Motorcycle Safety Program Technical Assessments summarizes program recommendations, implementations, and barriers to implementation from nine State motorcycle safety program technical assessments conducted by NHTSA (Baer & Skemer, 2009).

The most demonstrable objectives for improving motorcycle safety are to increase helmet use and reduce alcohol-impaired motorcycle riding. These objectives are difficult to accomplish. Universal helmet laws are highly effective in assuring that virtually all motorcycle riders use helmets, but they also are politically difficult to enact and retain. Strategies based only on communications and outreach to promote helmet use and reduce impaired motorcycling appear to be no more successful with motorcycle riders than with other drivers.

Another objective is to increase other motorists' awareness of motorcyclists by increasing the visibility of motorcyclists and educating drivers on the importance of sharing the road with motorcycles. Daytime running lights for motorcycles improve motorcycle conspicuity. Most motorcycles on the road have headlights that turn on automatically when the engines are started (Raborn et al., 2008, Strategy 11.1 D2). In addition, 23 States require daytime headlight use for all motorcycles manufactured since 1980 (and Pennsylvania requires daytime headlight use for motorcycles manufactured since 1986; MSF, 2014). Modulating headlights, which cause the headlight to move from high- to low beam rapidly, also increase motorcycle visibility (Olson, Halstead-Nussloch, & Sivak, 1979), but integration of these devices into the motorcycle fleet has been slow.

A similar way to increase improve motorcycle conspicuity is to manipulate the front-light configuration. In a 2012 study by Cavallo and Pinto, results showed that daytime running lights on cars create "visual noise" that interferes with the lighting of motorcycles and affects their visual conspicuity. As a potential solution, Pinto, Cavallo, and Saint-Pierre (2014) tested three front-light configurations in a daytime environment that included cars using day running lights. They found that while adding more lights to the configuration did not improve conspicuity over a typical single front-light configuration, changing the color of that light from white to yellow

resulted in significantly higher detection (74% vs. 54%).These findings suggest that lighting has a role promoting motorcycle conspicuity.

Vehicle technologies such as antilock brakes also have the potential to enhance motorcycle safety (Bayly, Regan, & Hosking, 2006). For example, two studies by IIHS found that motorcycles with antilock brakes had a lower fatal crash involvement than motorcycles without antilock brakes (Teoh, 2011, 2013).

Resources

Many environmental factors can also affect motorcycle safety. Slippery roadway surfaces and markings, surface irregularities and debris, unpaved shoulders, and unforgiving roadway barriers all can be dangerous. These issues are not included in this guide because State Highway Safety Offices have little or no authority or responsibility for them. Also, this guide does not include administrative or management countermeasures such as traffic safety data systems and analyses, program planning and assessments, State and community task forces, or comprehensive multi-pronged community traffic safety strategies. See National Cooperative Highway Safety Research Report 500, Volume 22 Guide for Addressing Collisions Involving Motorcycles, for a thorough discussion of environmental and other strategies: www.trb.org/Publications/Public/Blurbs/A_Guide_for_Addressing_Collisions_Involving_Motorc_160626.aspx

For a broad set of resources for State safety agencies and on-going research efforts:

- Government Accountability Office's Report to Congressional Committees – www.gao.gov/assets/660/650037.pdf
- The Community Guide's Motorcycle Helmets: Universal Helmet Laws – www.thecommunityguide.org/findings/motor-vehicle-injury-motorcycle-helmets-universal-helmet-laws

NHTSA's web pages:

- Motorcycles – www.nhtsa.gov/road-safety/motorcycles; one.nhtsa.gov/Safety/Motorcycles
- Research and Evaluation – www.nhtsa.gov/research-data; one.nhtsa.gov/Research/Behavioral-Research
- Behavioral Safety Research Reports – ntlsearch.bts.gov/tris/ntlc/nhtsa/index.shtm

Motorcycle Safety Countermeasures

Countermeasures to improve motorcycle safety are listed in the table below. The table is intended to provide a rough estimate of each countermeasure's effectiveness, use, cost, and time required for implementation. Effectiveness is shown using a five-star rating system:

- Countermeasures that receive ★★★★ or ★★★★★ have been determined to be effective.
- Countermeasures that receive ★★★ are considered promising, and likely to be effective.
- Countermeasures that receive ☆ or ☆☆ have NOT been determined to be effective, either because there is limited or no high quality evidence (☆) or because effectiveness is undetermined based on current evidence (☆☆).

States, communities and other organizations are encouraged to use ★★★, and especially ★★★★ or ★★★★★, countermeasures, and to exercise caution when selecting ☆ or ☆☆ countermeasures, as these countermeasures do not have conclusive evidence on their effectiveness. When deploying a new or emerging countermeasure with unproven effectiveness, it is valuable to include an evaluation of the countermeasure in connection with its use.

Further details about the symbols and terms used are included after the table. Effectiveness, cost, and time to implement can vary substantially from State to State and community to community. Costs for many countermeasures are difficult to measure, so the summary terms are very approximate.

Each countermeasure to improve motorcycle safety is discussed individually in this chapter. Full descriptions are included for ★★★, ★★★★ and ★★★★★ countermeasures. Brief descriptions are included for ☆ and ☆☆ countermeasures. Further details about the ☆ and ☆☆ countermeasures are included in Appendix A5 to this report.

1. Motorcycle Helmets

Countermeasure	Effectiveness	Cost	Use	Time
1.1 Universal Coverage State Motorcycle Helmet Use Laws	★★★★★	$	Medium	Short
1.2 Motorcycle Helmet Use Promotion Programs	☆	Varies	Low to Medium	Varies
1.3 Motorcycle Helmet Law Enforcement: Noncompliant Helmets	☆	$	Unknown	Medium

2. Alcohol Impairment

Countermeasure	Effectiveness	Cost	Use	Time
2.1 Alcohol-Impaired Motorcyclists: Detection, Enforcement, and Sanctions	★★★	Varies	Unknown	Varies
2.2 Alcohol-Impaired Motorcyclists: Communications	☆	$$	Medium	Medium

3. Motorcycle Rider Licensing and Training

Countermeasure	Effectiveness	Cost	Use	Time
3.1 Motorcycle Rider Licensing	☆	$	High	Medium
3.2 Motorcycle Rider Training	☆☆	$$	High	Varies

4. Communications and Outreach

Countermeasure	Effectiveness	Cost	Use	Time
4.1 Conspicuity and Protective Clothing	☆	Varies	High	Medium
4.2 Motorist Awareness of Motorcyclists	☆	Varies	High	Medium

Effectiveness:

★★★★★- Demonstrated to be effective by several high-quality evaluations with consistent results

★★★★- Demonstrated to be effective in certain situations

★★★- Likely to be effective based on balance of evidence from high-quality evaluations or other sources.

☆☆- Effectiveness still undetermined; different methods of implementing this countermeasure produce different results

☆- Limited or no high-quality evaluation evidence

Effectiveness is measured by reductions in crashes or injuries unless noted otherwise. See individual countermeasure descriptions for information on effectiveness size and how effectiveness is measured.

Cost to implement:

$$$: requires extensive new facilities, staff, equipment, or publicity, or makes heavy demands on current resources

$$: requires some additional staff time, equipment, facilities, and/or publicity

$: can be implemented with current staff, perhaps with training; limited costs for equipment or facilities

These estimates do not include the costs of enacting legislation or establishing policies.

Use:

High: more than two-thirds of the States, or a substantial majority of communities
Medium: from one-third and two-thirds of States or communities
Low: fewer than one-third of the States or communities
Unknown: data not available

Time to implement:

Long: more than 1 year
Medium: more than 3 months but less than 1 year
Short: 3 months or less

These estimates do not include the time required to enact legislation or establish policies.

1. Motorcycle Helmets

1.1 Universal Coverage State Motorcycle Helmet Use Laws

Effectiveness: ★★★★★	Cost: $	Use: Medium	Time: Short

Motorcycle helmets are highly effective in protecting motorcycle riders' heads in a crash. Research indicates that helmets reduce motorcycle rider fatalities by 22 to 42% and brain injuries by 41 to 69% (Coben, Steiner, & Miller, 2007; Cummings, Rivara, Olson, & Smith, 2006; Deuterman, 2004; Liu, Ivers, Norton, Blows, & Lo, 2008; NHTSA, 2003; NHTSA, 2006a). A Cochrane Collaboration review of 61 studies concluded that risk reductions were on the high end of the ranges mentioned above, with higher quality studies indicating that the protective effect of helmets was about a 42% reduction in risk of fatality in a crash and 69% for risk of a head injury in a crash. This review found that there was insufficient evidence to determine the effect on neck or facial injuries, or the effects of various types of FMVSS 218 compliant helmets on injury outcomes (Liu et al., 2008). Others have found no evidence that helmets increase the risk of neck injuries (Brewer et al., 2013; Potts, Stutts, Pfefer, Neuman, Slack, & Hardy, 2008, Strategy E1; NHTSA, 2000a; Philip et al., 2013; Ulmer & Preusser, 2003).

State universal coverage helmet-use laws are effective at increasing helmet use. In 2013, observed compliant helmet use was 89% across States with universal helmet laws that cover all riders, and 48% across States with no law or laws covering only young riders (Pickrell & Choi, 2015). A systematic review of U.S. motorcycle helmet laws found that States with universal coverage laws: (1) had motorcycle helmet use rates 53 percentage points higher than States with partial coverage or no law; (2) had 29% fewer deaths; and (3) had lower fatality rates per registered motorcycle and per vehicle mile traveled (Guide to Community Preventive Services, 2013).

Nationally in 2015, DOT-compliant helmet use was 61% (Pickrell & Li, 2016). Use of noncompliant helmets increased from 5% in 2014 to 11% in 2015, while helmet non-use decreased slightly from 31% in 2014 to 29% in 2015 (Pickrell & Li, 2016).

Use: The first universal helmet law was enacted in 1966. Universal laws were in effect in 47 States and the District of Columbia by 1975. After Federal penalties were eliminated in 1975 for States failing to have a universal law, about half the States repealed their laws. Several States have enacted or repealed helmet laws since then. The IIHS (2016) summarizes the helmet law history in each State.

As of 2016, 19 States, the District of Columbia, Puerto Rico, the U.S. Virgin Islands, and Northern Mariana Islands that had helmet laws covering all riders (GHSA, 2016; IIHS, 2016). Three States (Illinois, Iowa, and New Hampshire) did not have motorcycle helmet laws. Guam and most other States had laws covering only riders under a specified age, typically 18 or 21 (GHSA, 2016; IIHS, 2016). The motorcycle helmet laws of 23 States also apply to all low-powered cycles. Twenty-Five States and the District of Columbia have motorcycle helmet laws that cover some low-powered cycles, typically those with engine displacements under 50cc (IIHS, 2016).

Effectiveness: Studies of helmet use among motorcyclists indicate that universal helmet use laws are effective in increasing helmet use, which reduces injuries, decreases hospital admissions and treatment costs, and lowers insurance claims. Studies in States that enacted universal helmet laws observed use rates of 90% or higher immediately after the laws became effective, compared to 50% or lower before the laws (Ulmer & Preusser, 2003, Section II). States that repealed universal helmet laws observed the opposite effect, as use rates dropped from above 90% to about 50% (Kyrychenko & McCartt, 2006; Preusser, Hedlund, & Ulmer, 2000, Section V; Ulmer & Preusser, 2003, Sections IV and V). Reenactment of a universal law in Louisiana (after a cycle of repeals and reenactments since 1968) resulted in an increase in use among riders involved in crashes, from 42% before reenactment to 87% following (Gilbert, Chaudhary, Solomon, Preusser, & Cosgrove, 2008).

The Community Preventive Services Task Force conducted a systematic review of 69 studies (through August 2012) evaluating motorcycle helmet laws in the United States. It found that universal coverage motorcycle helmet laws consistently increased helmet use and decreased injuries and deaths associated with motorcycling. The Task Force concluded that universal coverage laws were substantially more effective than partial coverage laws or no law (Guide to Community Preventive Services, 2013).

The U.S. General Accountability Office (GAO) reviewed 46 methodologically sound studies of State helmet laws published before 1990. GAO concluded that motorcycle rider fatality rates were 20 to 40% lower with universal helmet laws (GAO, 1991; Ulmer & Preusser, 2003, Section II). Studies since 1990 confirm these results (Cummings et al., 2006; Houston & Richardson, 2008; Kyrychenko & McCartt, 2006; Morris, 2006; Ulmer & Northrup, 2005; Ulmer & Preusser, 2003, Section II).

Some States have helmet laws that only cover young riders. Helmet use is generally low in these States (GAO, 1991), and non-comprehensive laws do not translate into meaningful reductions in young rider fatalities rates (Brooks et al., 2010; Houston, 2007). Additionally, Weiss, Agimi, and Steiner (2010) compared the risk of traumatic brain injury among youth in States with limited-age helmet laws and States with universal helmet laws. They found a 37% increase in risk of traumatic brain injury requiring hospitalization for youth in States with partial coverage helmet laws compared to States with universal helmet laws. A reduction in fatality rates among all ages was estimated for partial coverage laws compared to no law by Houston & Richardson (2008), but the effect was much smaller (7% to 8%) than that for universal coverage (22% to 33%). Moreover, when Florida eliminated the requirement that all motorcycle riders 21 and older wear helmets, there was an 81% increase in motorcyclist fatalities (Ulmer & Northrup, 2005). Fatalities even increased among riders under 21 who were still covered by the helmet law.

Hospital admissions and treatment costs have also increased following repeal of universal helmet laws (Derrick & Faucher, 2009; GAO, 1991). Almost half of all motorcyclists admitted to hospitals lacked sufficient health care insurance or were covered by government services, so the public ultimately shares many of these costs, as well as a greater long-term burden of care (Derrick & Faucher, 2009; GAO, 1991). In addition, an analysis of insurance claims data found that when Michigan's helmet law was amended from a universal coverage law to a partial

coverage law, claims increased by more than 22% compared with control States (HLDI, 2013). The Community Preventive Services Task Force found in their systematic review of 22 studies that universal coverage motorcycle helmet laws resulted in significant economic benefits (Guide to Community Preventive Services, 2013). The studies show that universal coverage laws provide greater safety and cost benefits than laws that cover only a specific age group or riders having a certain amount of insurance.

Costs: Once legislation requiring universal helmet use has been enacted, implementation costs are minimal. The inevitable controversy surrounding the legislation will help to publicize the new law extensively. Motorcycle helmet laws can be enforced during regular traffic patrol operations because helmet use is easily observed.

Time to implement: Although a universal helmet use law can be implemented as soon as the law is enacted, enacting such a law is a complex and time-consuming process, and may require the involvement of a "champion."

Other issues:

- **Opposition to motorcycle helmet laws:** Any effort to enact a universal helmet law can expect immediate, well-coordinated, and highly political opposition (NHTSA, 2003). Helmet law opponents claim that helmet laws impinge on individual rights. They also claim that helmets interfere with motorcycle riders' vision or hearing, though research shows that these effects are minimal (NHTSA, 1996). See Jones and Bayer (2007) for a history of opposition to helmet laws in the United States. Derrick and Faucher (2009) also discuss national policy, organized opposition, and helmet law changes over the past four decades.
- **Noncompliant helmets:** Some riders in States with universal helmet laws wear helmets that do not comply with FMVSS 218 (Pickrell & Liu, 2014). See the discussion in Appendix A5, Section 1.3.

1.2 Motorcycle Helmet Use Promotion Programs

Effectiveness: ☆	Cost: Varies	Use: Unknown	Time: Varies

A few States with or without universal motorcycle helmet-use laws promote helmet use through communications and outreach campaigns. NHTSA has developed helmet use promotion brochures, flyers, and public service announcements suitable for television and radio that are available online. Raborn et al. (2008) describes elements that should be included in a campaign should one be undertaken.

Effectiveness Concerns: *There appear to be no formal evaluations of the effect of helmet use promotion programs in States without universal helmet laws (Potts, Stutts, Pfefer, Neuman, Slack, & Hardy, 2008).*

Further information about the known research, potential effectiveness, costs, use, and time to implement is available in Appendix A5, Section 1.2.

1.3 Motorcycle Helmet Law Enforcement: Noncompliant Helmets

Effectiveness: ☆	Cost: $	Use: Unknown	Time: Medium

This countermeasure involves legislation and enforcement of laws that require motorcyclists to wear helmets that comply with FMVSS 218. For compliant helmet laws to be effective, they must be enforced, publicized, and adequately funded. NHTSA prepared a video clip for motorcyclists and law enforcement demonstrating how to identify compliant and noncompliant helmets, and how to choose a helmet that fits properly (NHTSA, 2006b). NHTSA also produced a brochure on how to identify noncompliant helmets (NHTSA, 2004). States have access to this video for their own outreach campaigns.

Effectiveness Concern: *The effectiveness of an enforcement program on noncompliant helmet use has not been evaluated.*

Further information about the known research, potential effectiveness, costs, use, and time to implement is available in Appendix A5, Section 1.3.

2. Alcohol Impairment

2.1 Alcohol-Impaired Motorcyclists: Detection, Enforcement, and Sanctions

Effectiveness: ★★★	Cost: Varies	Use: Unknown	Time: Varies

Alcohol impairment is a substantial problem for motorcyclists, even more than for drivers of other motor vehicles. In 2015, 27% of motorcycle riders involved in fatal crashes had BACs of .08 or higher, which is higher than the rate for passenger car drivers (21%) and light-truck drivers (20%) (NCSA, 2017). By age, the proportion of riders who had BACs of .08 or higher was higher among fatally injured 35- to 49-year-old riders (37% for riders 35 to 39, 34% for riders 40 to 44, 36% for riders 45 to 49; NCSA, 2017). An additional 7% of motorcycle riders in fatal crashes had at least some measurable level of alcohol in their blood (BAC .01 to .07 g/dL). Fatally injured motorcycle riders with BAC levels .08 g/dL or higher were less likely to wear helmets than were sober riders – 51% vs. 65%, respectively (NCSA, 2017). In 2015, 42% of riders killed in single-vehicle crashes had BACs of .08 or above, and on weekend nights, this figure climbed to 63% (NCSA, 2017). The 2013-2014 National Roadside Survey similarly found that 5.0% of motorcycle riders on weekend nights had BACs of .08 or above, as compared to 1.4% of passenger vehicle drivers (Ramirez et al., 2016).

Motorcyclists are included in and affected by the comprehensive strategies to reduce alcohol-impaired driving discussed in detail in Chapter 1. However, some law enforcement and sanction strategies may be especially useful for motorcyclists, while others may be less effective.

Law enforcement officers on traffic patrol use characteristic driving behaviors, or cues, to identify drivers who may be impaired by alcohol. Some of the cues for motorcycle riders, such as trouble maintaining balance at a stop, are different from those for cars and trucks. Stuster (1993) identified and validated 14 cues useful for identifying alcohol-impaired motorcycle riders. NHTSA prepared a brochure, a law enforcement training video, and a pocket detection guide discussing the cues (NHTSA, 2000b). The cues for motorcycle riders are part of the SFSTs training given to all law enforcement officers.

Vehicle impoundment or forfeiture can be an effective deterrent to drinking and driving for all drivers (see Chapter 1, Section 4.3). It may be even more effective for motorcyclists. Research by Becker, McKnight, Nelkin, and Piper (2003) confirmed earlier findings that many motorcyclists do not find traditional impaired-driving sanctions such as fines and license suspension to be effective deterrents (although self-reported beliefs may not reflect actual effectiveness of these other sanctions). However, motorcyclists tended to be highly concerned for the safety and security of their motorcycles.

These findings suggest a potentially effective strategy to reduce alcohol-impaired motorcycling: high-visibility enforcement using officers trained in identifying impaired motorcycle riders and other motor vehicle drivers, with offender sanctions including vehicle impoundment or forfeiture. This strategy would treat motorcyclists on an equal footing with other vehicle drivers in impaired-driving enforcement and publicity, but it may be controversial and therefore difficult to enact or enforce. However, a Washington State law that allows officers to impound

motorcycles for impaired riding was not found to cause unforeseen problems with law enforcement officers or with towing companies (McKnight, Billheimer, & Tippets, 2013).

Use: Thirty-two of 43 responding States reported that they have programs for law enforcement on how to detect impaired motorcyclists or enforce laws related to operating motorcycles while impaired (Baer et al., 2010). NHTSA (2006a) provides resources for law enforcement and State programs on the detection of impaired riding, including examples of State programs that distribute the NHTSA cue cards and brochures to law enforcement (Illinois), provide a web-based seminar for officers (Minnesota), and regularly establish high-visibility law enforcement presence at major rider events (Ohio, Wisconsin).

Effectiveness: Some agencies have reported some success in using the cues for identifying alcohol-impaired motorcycle riders, but no evaluation data on the extent of their use are available (Potts, Stutts, Pfefer, Neuman, Slack, & Hardy, 2008, Strategy B3). Although there is limited evidence of the effects of enforcement and sanctions on impaired motorcycle riding, sobriety checkpoints and saturation patrols have demonstrated effectiveness in reducing impaired driving and crashes generally. See Chapter 1 for more information on enforcement strategies and other tools.

Costs: Law enforcement training costs are low and training material is available. Enforcement itself can be carried out during regular traffic patrol and as part of all impaired-driving enforcement programs. A major campaign including alcohol-impaired motorcyclists may require additional costs for publicity.

Time to implement: Law enforcement training can be conducted quickly. A major campaign will require 4 to 6 months to plan and implement.

Other issues:

- **BAC limits:** BAC levels as low as .05 g/dL caused some detectable levels of impairment, primarily in reaction time, among experienced riders in tests on controlled courses (Creaser et al., 2007). Puerto Rico passed a law in 2007 lowering the BAC limit for motorcyclists to .02.
- **Drugs other than alcohol:** Drugs other than alcohol can impair motorcycle riders. Potentially impairing drugs include over-the-counter and prescription medications as well as illegal drugs. The 2007 National Roadside Survey reported that 31.9% of nighttime weekend motorcycle riders who provided oral fluid and/or blood samples tested positive for drugs (illegal drugs or medications), as compared to 16.5% of passenger car drivers (Lacey et al., 2009b). The extent to which various drugs impair driving performance or contribute to crashes is not well understood, however, for either four-wheeled vehicles or for motorcycles. Furthermore, individual differences in metabolism of drugs and level of impairment, as well as multiple-drug use complicate the understanding of drug impairment on motor vehicle drivers (Compton, Vegega, & Smither, 2009). (See Compton et al.'s 2009 Report to Congress on drug-impaired driving for a discussion of current knowledge and recommendations for improving States data and records systems and statutes.) Law enforcement should consider drugs as potential impairing agents for

motorcycle riders just as for other vehicle operators. See also Chapter 1, Section 7 on drug-impaired driving.

- **Targeted enforcement:** As with other crash problems, better identification of problem areas (either impaired riding or impaired riding crashes) and targeting enforcement to such locations, events, or times could improve enforcement effectiveness.

2.2 Alcohol-Impaired Motorcyclists: Communications and Outreach

Effectiveness: ☆	Cost: $$	Use: Medium	Time: Medium

This countermeasure involves communications and outreach campaigns directed at drinking and riding. Although States typically implement these campaigns, they can also be conducted by local riding groups.

Effectiveness Concerns: *A literature search found no evaluations of the safety effectiveness of any drinking and riding campaigns.*

Further information about the known research, potential effectiveness, costs, use, and time to implement is available in Appendix A5, Section 2.2.

3. Motorcycle Rider Licensing and Training

3.1 Motorcycle Rider Licensing

Effectiveness: ☆	Cost: $	Use: High	Time: Medium

The goal of licensing is to ensure that motorcycle riders have the minimum skills needed to operate motorcycles safely (NHTSA, 2000a). All 50 States, the District of Columbia, and Puerto Rico require motorcycle riders to obtain a motorcycle operator license or endorsement before they ride on public highways (MSF, 2012). Most States will waive the skills test, and sometimes the knowledge test, for motorcyclists who have completed approved motorcycle rider training courses, if the student passes the knowledge and skills tests administered at the conclusion of the course.

Effectiveness Concerns: *Although this countermeasure is widely used, the effectiveness of current licensing and testing on crashes and safety has not been evaluated.*

Further information about the known research, potential effectiveness, costs, use, and time to implement is available in Appendix A5, Section 3.1.

3.2 Motorcycle Rider Training

Effectiveness: ☆☆	Cost: $$	Use: High	Time: Varies

This countermeasure involves rider education and training courses provided by States, rider organizations (for example, some ABATE and Gold Wing groups), manufacturers (Harley-Davidson), the U.S. Military, and others. This training can be required for all motorcycle operators or those under a specified age.

Effectiveness Concerns: *This countermeasure is widely used. Its effectiveness has been examined in several research studies. Although there have been some positive research findings, the balance of evidence regarding countermeasure effectiveness remains inconclusive.*

Further information about the known research, potential effectiveness, costs, use, and time to implement is available in Appendix A5, Section 3.2.

4. Communications and Outreach

4.1 Communications and Outreach: Conspicuity and Protective Clothing

Effectiveness: ☆	Cost: Varies	Use: High	Time: Medium

This countermeasure involves communications and outreach campaigns promoting the use of protective clothing and measures that increase rider conspicuity, such as clothing and auxiliary devices. Measures that may increase rider conspicuity include wearing brightly colored clothing, clothing that incorporates retro-reflective materials, and/or white- or bright- colored helmets (for increased visibility during day or night). Additional solutions include the use of continuous headlights, auxiliary head and brake lights, and flashing headlights.

Effectiveness Concerns: *This countermeasure is widely used, but it has not been extensively studied. There is some evidence that certain approaches may lead to limited positive outcomes; however, there is insufficient evaluation data to determine the extent of effectiveness.*

Further information about the known research, potential effectiveness, costs, use, and time to implement is available in Appendix A5, Section 4.1.

4.2 Communications and Outreach: Motorist Awareness of Motorcyclists

Effectiveness: ☆	Cost: Varies	Use: High	Time: Medium

This countermeasure involves communications and outreach campaigns to increase other drivers' awareness of motorcyclists. Typical themes are "Share the Road" or "Watch for Motorcyclists." Some States build campaigns around "Motorcycle Awareness Month," often in May, early in the summer riding season. Many motorcyclist organizations, including MSF, SMSA, the Gold Wing Road Riders Association, and State and local rider groups, have driver awareness material available. Some organizations also make presentations on driver awareness of motorcyclists to driver education classes.

Effectiveness: *Although this countermeasure is widely used, no evaluations of the effectiveness of campaigns to increase driver awareness of motorcyclists are available.*

Further information about the known research, potential effectiveness, costs, use, and time to implement is available in Appendix A5, Section 4.2.

Motorcycle Safety References

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