

November 2012

MOTORCYCLE SAFETY

Increasing Federal Funding Flexibility and Identifying Research Priorities Would Help Support States' Safety Efforts



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Why GAO Did This Study

According to NHTSA, per vehicle mile traveled in 2010, motorcyclists were about 30 times more likely to die in a traffic crash than passenger car occupants. States have implemented various strategies to address the factors contributing to motorcycle crashes and fatalities, and NHTSA has assisted these efforts through guidance, grants, and research. GAO reviewed: (1) what is known about the cost of motorcycle crashes; (2) the factors that contribute to motorcycle crashes and fatalities, and strategies states are pursuing to address these factors; and (3) the extent to which NHTSA assists states in pursuing strategies that address these factors. GAO reviewed studies, analyzed documents and data from NHTSA and other sources, and interviewed officials in the U.S. Department of Transportation (DOT) and 16 states as well as representatives of various stakeholder organizations. GAO selected states that were geographically diverse and that had varying fatality rates, laws and policies, and ridership levels.

What GAO Recommends

Congress should consider expanding the strategies for which NHTSA's motorcyclist safety grants can be used to give states more flexibility in how to use these funds. In addition, GAO recommends that NHTSA identify research priorities for motorcycle safety that address gaps in knowledge about the effectiveness of state strategies, particularly those strategies it has identified as high priority or promising. DOT officials agreed to consider this recommendation and provided technical comments, which GAO incorporated as appropriate.

View [GAO-13-42](#). For more information, contact Susan Fleming at (202) 512-2834 or flemings@gao.gov.

MOTORCYCLE SAFETY

Increasing Federal Funding Flexibility and Identifying Research Priorities Would Help Support States' Safety Efforts

What GAO Found

GAO estimated that the total direct measurable costs of motorcycle crashes—costs that directly result from a crash and that can and have been measured—were approximately \$16 billion in 2010. However, the full costs of motorcycle crashes are likely higher because some difficult-to-measure costs—such as longer-term medical costs—are not included. Victims and their families, as well as society—including employers, private insurers, healthcare providers, government, and others—bear these costs. The National Highway Traffic Safety Administration (NHTSA) estimated that society bears about three-quarters of the measurable costs of *all* motor vehicle crashes. Society's share of the costs of motorcycle crashes may be similar or higher, in part because injuries from these crashes are generally more severe than those from other motor vehicle crashes.

Various factors contribute to motorcycle crashes and states pursue a range of strategies to address them. These factors include alcohol impairment; speeding; lack of a license, training, or riding skills; and lack of motorist awareness of motorcycles. Another factor, lack of helmet use, does not affect the likelihood of a crash but increases the risk of a fatality when a crash occurs. State strategies include: licensing approaches, training programs, enforcement of alcohol impairment and speed limit laws, efforts to improve motorcyclist safety awareness and motorist awareness, and helmet-use laws. Laws requiring all motorcyclists to wear helmets are the only strategy proved to be effective in reducing motorcyclist fatalities, but some opposition to such laws exists, and only 19 states currently have them. According to NHTSA, proven approaches used in some other highway safety efforts, such as combining strong enforcement with public education, may hold promise for improving motorcycle safety.

NHTSA helps states develop and implement motorcycle safety strategies through various efforts. It has provided states with guidance, outreach, and training which according to state officials, has improved their ability to address motorcycle safety. From fiscal years 2006 to 2012, NHTSA awarded \$45.9 million in motorcyclist safety grants to states; Congress has allowed these funds to be used for motorcyclist training and motorist awareness efforts only. However, major studies on motorcycle safety issues have recommended a range of additional strategies for reducing crashes and fatalities, some of which NHTSA has identified as a high priority for states to pursue. These strategies include increasing helmet use and motorcyclist safety awareness, and educating police about motorcycle safety in order to strengthen enforcement. NHTSA and state officials noted that expanding the allowable uses for the grants would better enable states to use such strategies. NHTSA has conducted research—totaling \$7.3 million in the last 5 fiscal years—to identify new and evaluate existing state strategies. For example, one new study will identify factors and programs that may be related to higher rates of helmet use in states that do not require all motorcyclists to wear helmets. NHTSA does not have a current plan to guide its motorcycle safety research efforts but intends to develop one by spring 2013. Given its limited funding for research, such a plan provides an opportunity for NHTSA to identify research priorities, based on gaps in knowledge about the effectiveness of motorcycle safety strategies and the types of strategies it has identified as a high priority or promising for states to pursue.

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Abbreviations list

BAC	blood alcohol concentration
CDC	Centers for Disease Control and Prevention
FARS	Fatality Analysis Reporting System
FHWA	Federal Highway Administration
MAP-21	Moving Ahead for Progress in the 21st Century Act
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Act: A Legacy for Users

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United States Government Accountability Office
Washington, DC 20548

November 14, 2012

The Honorable John Rockefeller
Chairman
Committee on Commerce, Science, and Transportation
United States Senate

The Honorable Patty Murray
Chairman
The Honorable Susan Collins
Ranking Member
Subcommittee on Transportation, Housing and Urban Development, and
Related Agencies
Committee on Appropriations
United States Senate

The Honorable Tom Latham
Chairman
The Honorable John W. Olver
Ranking Member
Subcommittee on Transportation, Housing and Urban Development, and
Related Agencies
Committee on Appropriations
House of Representatives

In 2010, an estimated 95,000 motorcycle crashes occurred in the U.S. and 4,423 of these crashes were fatal.¹ Motorcyclists are involved in fatal crashes at higher rates than drivers of other types of motor vehicles, both per registered vehicle and vehicle miles traveled. In 2010, while motorcycles accounted for only about 3 percent of all registered vehicles, they were involved in about 15 percent of all fatal vehicle crashes. Not only can motorcycle crashes result in injury to or death of the victims, but they can impose costs for medical treatment, property damage, and loss of productivity. Various factors, such as alcohol impairment, have been identified as contributing to the occurrence of such crashes, while others,

¹The vast majority of these fatal crashes involved two-wheeled motorcycles. In addition to two-wheeled motorcycles, the broad definition of “motorcycles” used here includes mopeds, three-wheel motorcycles, off-road motorcycles, and other motored-cycles (such as mini-bikes, motor scooters, and pocket motorcycles).

particularly the lack of helmet use, affect the likelihood of a fatality when a crash occurs. States have responsibility for developing and implementing strategies—such as training programs for motorcyclists and laws requiring helmet use—to address motorcycle safety. The National Highway Traffic Safety Administration (NHTSA) is the federal agency that assists states in pursuing strategies to address the factors contributing to motorcycle crashes and fatalities through various activities, including providing guidance, outreach, and training, administering grants, and sponsoring research.

We conducted this work for the Senate and House Committees on Appropriations.² The Chairman of the Senate Committee on Commerce, Science, and Transportation also requested that we conduct such a study. In this report, we:

1. determine what is known about the costs of motorcycle crashes;
2. identify factors that contribute to motorcycle crashes and to fatalities when crashes occur, and strategies states are pursuing to address these factors; and
3. examine the extent to which NHTSA assists states in pursuing strategies that address these factors.

To determine what is known about the costs of motorcycle crashes, we reviewed studies on these costs, including the amount and types of costs that crashes impose and who pays those costs. Because existing cost estimates either only covered specific types of costs or pertained to all vehicle types, we developed an estimate of the total direct measurable costs³ of motorcycle crashes in 2010. We used data developed in a 2002 NHTSA study, which provided estimates of direct measurable costs of all motor vehicle crashes in 2000 for various categories of costs, such as medical costs and costs associated with loss of market productivity (lost

²A direction to perform this work is contained in S. Rept. No. 112-83, p. 66, 211th Cong. (2011), the conference report that accompanied the Consolidated and Further Continuing Appropriations Act, 2012. H.R. Rept No. 112-284, p. 286, 211th Cong., (2011) directed that our report be filed with both the Senate and House Committees on Appropriations.

³Direct measurable costs are those costs directly resulting from a crash that can and have been measured.

wages).⁴ To arrive at our estimate of costs specifically for motorcycle crashes in 2010, we used inflation indices to convert NHTSA's cost estimates to 2010 dollars and 2010 motorcycle crash data to extricate costs attributable solely to motorcycle crashes. To identify the factors that contribute to motorcycle crashes and fatalities and strategies that states are pursuing to address these factors, we conducted interviews with officials from NHTSA, the Federal Highway Administration (FHWA), the Centers for Disease Control and Prevention (CDC), the National Transportation Safety Board (NTSB), and stakeholder organizations involved in motorcycle safety, including the American Association of Motor Vehicle Administrators, the Governors Highway Safety Association, the National Association of State Motorcycle Safety Administrators, the Motorcycle Safety Foundation, and the American Motorcyclist Association. We also conducted interviews with and reviewed documentation from state officials responsible for motorcycle safety in 16 states. We selected these 16 states to include a range of fatality rates, varying types of motorcycle safety laws and policies, varying levels of motorcycle ridership, and geographic diversity.⁵ We analyzed data from NHTSA's Fatality Analysis Reporting System (FARS) for calendar years 1991 to 2010 to identify characteristics of fatal crashes. In addition, we conducted a literature review to obtain information about the factors that contribute to motorcycle crashes and fatalities and determine the extent of knowledge about the effectiveness of motorcycle safety strategies used by states. We included in our review studies that we identified based on certain selection criteria, including those authored or provided to us by

⁴L. Blincoe et al, *The Economic Impact of Motor Vehicle Crashes, 2000* (Washington, D.C.: National Highway Traffic Safety Administration, 2002).

⁵These 16 states are Arizona, California, Colorado, Florida, Idaho, Iowa, Maryland, Mississippi, Missouri, New Hampshire, New Jersey, New York, Texas, Utah, Washington, and Wisconsin. For five of these states—Florida, Iowa, Maryland, Texas, and Wisconsin—we interviewed additional agencies and organizations responsible for motorcycle safety, including the applicable NHTSA region, state agencies responsible for motorcycle licensing and training; state and local law enforcement agencies; and motorcycle advocacy groups. We did not include states' motorcycle safety efforts related to road infrastructure or emergency response in our review.

federal and state agencies and organizations we interviewed and other studies published in the last 10 years.⁶

To examine the extent to which NHTSA assists states in pursuing strategies that address factors contributing to motorcycle crashes and fatalities, we reviewed the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU),⁷ the Moving Ahead for Progress in the 21st Century Act (MAP-21),⁸ relevant portions of the United States Code, and federal regulations to determine NHTSA's responsibilities and authority related to motorcycle safety. We reviewed documentation and interviewed officials in NHTSA headquarters and regional offices to determine what NHTSA has done to identify and promote motorcycle safety strategies for use by states, including guidance, outreach, and training; providing grants; and conducting research. We obtained views of state officials we interviewed on NHTSA's efforts and determined the extent to which these efforts address research gaps we identified as well as high priority motorcycle safety strategies identified by NHTSA, the Motorcycle Safety Foundation, NTSB, CDC, and the Transportation Research Board.

We conducted this performance audit from October 2011 to November 2012 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient and appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives. Further details on our scope and methodology can be found in appendix I.

⁶To assess the effectiveness of motorcycle helmet laws, we included older studies because many changes in helmet laws occurred and were evaluated more than 10 years ago. In some cases, we also included studies published more than 10 years ago when there was limited or no research about that strategy in the last 10 years. In such cases, we considered the extent to which factors may have changed over time that could affect the relevance of their findings.

⁷Pub. L. No. 109-59, 119 Stat. 1144 (2005).

⁸Pub. L. No. 112-141, 126 Stat 405 (2012).

Background

Motorcycle crashes are more likely to be fatal than other types of vehicle crashes. Of the estimated 5.4 million motor-vehicle crashes that occurred in the U.S. in 2010, less than 1 percent resulted in at least one fatality, while almost 5 percent of the 95,000 motorcycle crashes in 2010 resulted in at least one fatality. When a crash occurs, motorcycle riders are much more vulnerable than passengers of other vehicles. Unlike a motorcyclist, a passenger vehicle occupant is protected by the car's metal frame and generally by a seat belt (as required by law), and usually airbags for the front seats.⁹ As a result, according to NHTSA, motorcyclists were about 30 times more likely to die in a traffic crash than passenger car occupants per vehicle mile traveled in 2010.¹⁰

Figure 1: Example of a Crash Involving an Automobile and Motorcycle



Source: CDC.

⁹As we discuss in more detail later in this report, helmets and other protective gear do offer some protection.

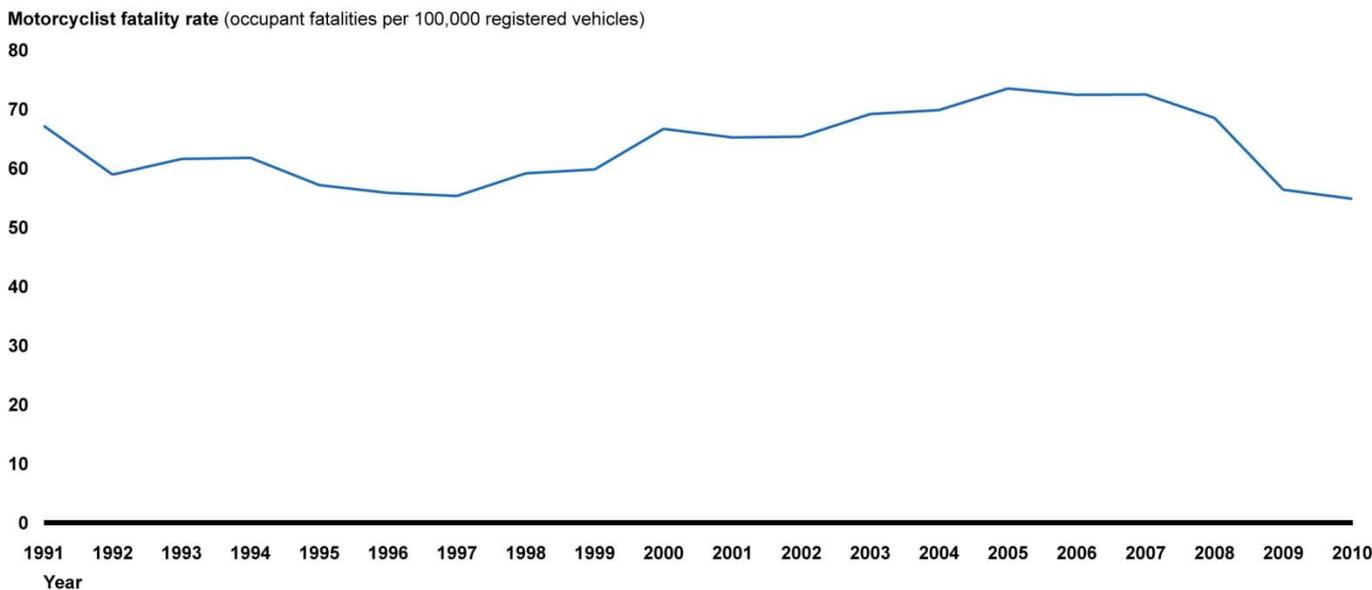
¹⁰U. S. Department of Transportation, National Highway Traffic Safety Administration. *Traffic Safety Facts: 2010 Data, Motorcycles*. DOT HS 811 639 (Washington, D.C.: 2012).

Over the last two decades, the number of fatalities of passenger vehicle occupants as a result of crashes has decreased, while the number of motorcyclist fatalities has increased. From 1991 to 2010, fatalities of passenger vehicle¹¹ occupants dropped from 30,776 to 22,187, while motorcyclist fatalities rose from 2,806 to 4,502—a 60 percent increase.¹² Much of the increase in motorcyclist fatalities is related to an increase in motorcyclists on the road. From 1991 to 2010, motorcycle registrations in the U.S. increased from about 4.2 million in 1991 to 8.2 million in 2010—a 97 percent increase. When looking at the number of fatalities per registered vehicle for motorcycles, fatality rates have declined over the last few years (see fig. 2).

¹¹Fatalities include only traffic fatalities. Passenger vehicle fatalities include drivers and passengers of passenger vehicles. We have defined passenger vehicles as passenger cars and light trucks and vans. Motorcyclist fatalities include drivers and passengers of motorcycles.

¹²The number of motorcyclist fatalities peaked at 5,312 in 2008, then decreased to 4,469 in 2009 and rose slightly to 4,502 in 2010. Based on preliminary data for 2011, the number of motorcyclist fatalities is expected to remain about the same as in 2010.

Figure 2: Motorcyclist Fatality Rate per 100,000 Registered Motorcycles, 1991 to 2010



Sources: GAO analysis of FHWA and FARS data.

Because motorcycle enthusiasts are a diverse group of people, motorcycle crashes and fatalities affect a wide demographic. Men still make up an overwhelming proportion of riders, but ridership among women is increasing. With regard to age, motorcyclist fatalities are not concentrated among younger riders. As older riders who rode in their youth increasingly return to motorcycling, fatalities among older motorcyclists have increased. From 2001 to 2010, riders 35 and older constituted more than half of all motorcyclist fatalities. That proportion has steadily increased from just over 50 percent in 2001 to 66 percent in 2010. In fact, the largest number of fatalities in 2010 was in the 45-54 age group.

NHTSA, states, and, to some extent, local governments, have a role in improving motorcycle safety. NHTSA aims to reduce deaths, injuries, and economic losses resulting from motor vehicle crashes, including motorcycle crashes, through the efforts of its headquarters and 10 regional offices. NHTSA does so primarily through grants to state governments meant to support state and local safety programs. As part of that effort, NHTSA headquarters conducts research on motorcyclist behavior and safety strategies and provides guidance, outreach, and training to states. NHTSA headquarters is also responsible for evaluating those programs, collecting data, and promulgating regulations. NHTSA's

regional offices monitor states' spending and provide assistance to states' motorcycle safety programs.

Each state must have a highway safety program that is approved by the Secretary of Transportation and in accord with uniform guidelines issued by the Secretary.¹³ Under these guidelines, states are expected to develop a centralized motorcycle safety program, among other things, and to implement projects to reach the goals and objectives that reflect their states' demographics and needs. States' motorcycle safety programs should include:

- a motorcycle licensing system that provides among other components, educational information and penalties for violations of licensing requirements;
- a state motorcycle rider education program;
- safety communication campaigns; and
- data on the frequency and types of motorcycle crashes in their state.

Also, each state should ensure that programs addressing impaired driving include an impaired-motorcyclist component.

Congress has also taken steps to support states' efforts. In 2005, SAFETEA-LU established a \$25 million motorcyclist safety-grant program to encourage states to adopt and implement programs to reduce the number of crashes involving motorcyclists. States received the first year of these grants at the end of fiscal year 2006.¹⁴ To be eligible to receive this grant, a state had to meet certain criteria, including implementing a statewide training program for motorcycle riders and an awareness program for motorists.¹⁵ Funds granted under the program could be used for motorcyclist training and motorist awareness programs, such as improving training curriculums, delivering training, recruiting or retaining motorcyclist safety instructors, and establishing and conducting public awareness and outreach programs. States were not required to provide

¹³23 U.S.C. § 402(a), as amended by MAP-21, § 31102, 126 Stat., 734-739.

¹⁴SAFETEA-LU, § 2010, 119 Stat., 1535, repealed by MAP-21, § 31109(g).

¹⁵All states have been eligible to receive these grants each year, except for Alabama and Mississippi (only eligible in 2009), South Carolina (ineligible in 2006, did not apply in 2007 and 2008, eligible and received grants in 2009 and 2010), and the District of Columbia (has never applied).

matching funds. Additionally, states could use the State and Community Highway Safety Grant Program for motorcycle safety efforts, if those efforts are included in their state highway safety plan. This grant program provides highway safety program funds for states through a formula based on each state's population and public road miles.¹⁶

In July 2012, the President signed MAP-21 into law, amending section 405 of title 23, United States Code, to establish National Priority Safety Program grants, including motorcycle safety grants formerly authorized by SAFETEA-LU section 2010.¹⁷ MAP-21 authorized continuing funding for these grants,¹⁸ at about half the SAFETEA-LU funding level, through the end of fiscal year 2014. States may continue to use their State and Community Highway Safety Grant funding for motorcycle safety efforts.

The Costs of Motorcycle Crashes to Society and Individuals Are Significant

Studies indicate that the costs of motorcycle crashes are significant, but have only estimated specific types of these costs. We conducted our own analysis, using data from a 2002 NHTSA study on the costs of all motor vehicle crashes as well as some additional data, and estimate that the direct measurable costs of motorcycle crashes—those costs that directly result from a crash and that can and have been measured—were approximately \$16 billion in 2010. However, accurately determining the full costs is difficult because some—such as long-term medical costs and intangible costs related to emotional pain and suffering—are difficult to measure. Thus, the full costs of motorcycle crashes are likely higher than our estimate. Victims and their families as well as society—including employers, private insurers, healthcare providers, government, and others—bear these costs. NHTSA estimated that society bears about three-quarters of the measurable costs of all motor vehicle crashes. Society's share of the costs of motorcycle crashes may be similar or higher, in part because injuries from these crashes are more severe.

¹⁶See 23 U.S.C. § 402, discussed above.

¹⁷MAP-21, § 31105, 126 Stat., 741-755, codified as positive law at 23 U.S.C. § 405(a)(1)(E). The terms and requirements for motorcyclist safety grants under 23 U.S.C. § 405 are substantially similar to those under SAFETEA-LU § 2010. NHTSA classified motorcycle safety as a National Priority Program Area under 23 C.F.R. § 1205.3 for purposes of administering the highway safety grant program under 23 U.S.C. § 402(c), and reflecting the role of § 402 as a second source of funding for motorcycle safety programs. See, also, 23 C.F.R. § 1205.4.

¹⁸MAP-21, § 31101(a)(3), 126, Stat. 732-733.

Overall Costs Are Substantial, but Some Cost Elements Are Difficult to Measure

Studies we identified on the costs of motorcycle crashes indicate that the costs are significant, but the studies estimated only specific types of direct measurable costs. Direct measurable costs are those costs directly resulting from a crash that can and have been measured. One study, conducted by CDC and Pacific Institute for Research and Evaluation, estimated three categories of costs associated with motorcycle crashes: medical costs, costs associated with the loss in market productivity (lost wages), and costs associated with the loss in household productivity (costs of hiring someone to perform household tasks). The study estimated that the total for these cost categories for all motorcycle crashes nationwide in 2005 was \$12 billion.¹⁹ A number of the studies we identified estimated only the motorcycle crash victims' medical costs. One such study estimated that the total hospital charges for the initial treatment of motorcyclists injured in traffic crashes in Florida in 2010 was \$348 million.

Lacking a comprehensive study of the costs of motorcycle crashes, we conducted our own analysis and estimate that the direct measurable costs of motorcycle crashes in 2010 were about \$16 billion. To develop our estimate, which is a rough approximation of these costs, we began with a 2002 NHTSA study that provided a comprehensive examination of the direct measurable costs of all types of motor vehicle crashes in 2000, estimating nine categories of costs (see table 1).²⁰ We used data developed in the 2002 NHTSA study, which provided estimates for each of these cost categories across various levels of injury severity. We updated these cost estimates to 2010 values by adjusting for inflation. We then applied the updated motor vehicle crash cost estimates to NHTSA's 2010 data on motorcycle crash incidence, which included a breakdown of crashes by severity classifications. This provided our aggregate estimate

¹⁹Naumann RB, Dellinger AM, Zaloshnja E, Lawrence BA, and Miller TR, "Incidence and total lifetime costs of motor vehicle-related fatal and nonfatal injury by road user type, United States, 2005," *Traffic Injury Prevention*, vol. 11, no.4 (2010).

²⁰L. Blincoc et al, *The Economic Impact of Motor Vehicle Crashes* (Washington, D.C.: NHTSA, 2002). NHTSA estimated the costs of all motor vehicle crashes—not just those involving motorcycles—to be \$230 billion in 2000 (or \$280 billion in 2010 dollars).

of the cost of motorcycle crashes in 2010.²¹ (See app. I for further description of our methodology.) NHTSA is in the process of updating its motor vehicle crash cost estimates and, as part of that effort, plans to separately calculate the direct measurable costs associated with motorcycle crashes.²²

Table 1: Types of Direct Measurable Motor Vehicle Costs Estimated in 2002 NHTSA Study

Type of cost	Description
Medical	Costs of all medical treatments, including those during ambulance transport. It includes costs of emergency room, inpatient costs, follow-up visits, physical therapy, rehabilitation, prescriptions, prosthetic devices, and home modification.
Emergency services	Costs of police and fire department response services.
Loss in market productivity	Total lost wages of the victim.
Loss in household productivity	Costs associated with lost productive household activity, valued at the market price for hiring another person to accomplish the same tasks.
Insurance administration	Administrative costs of processing insurance claims and defense attorney costs.
Workplace	Costs of workplace disruption that are due to the loss or absence of an employee.
Legal	Legal fees and court costs of civil litigation resulting from crashes.
Travel delay	Value of travel time delay for all road users as a result of a crash.
Property damage	Value of vehicles, cargo, roadways and other items damaged in a crash.

Source: NHTSA, Economic Impact Report, 2002.

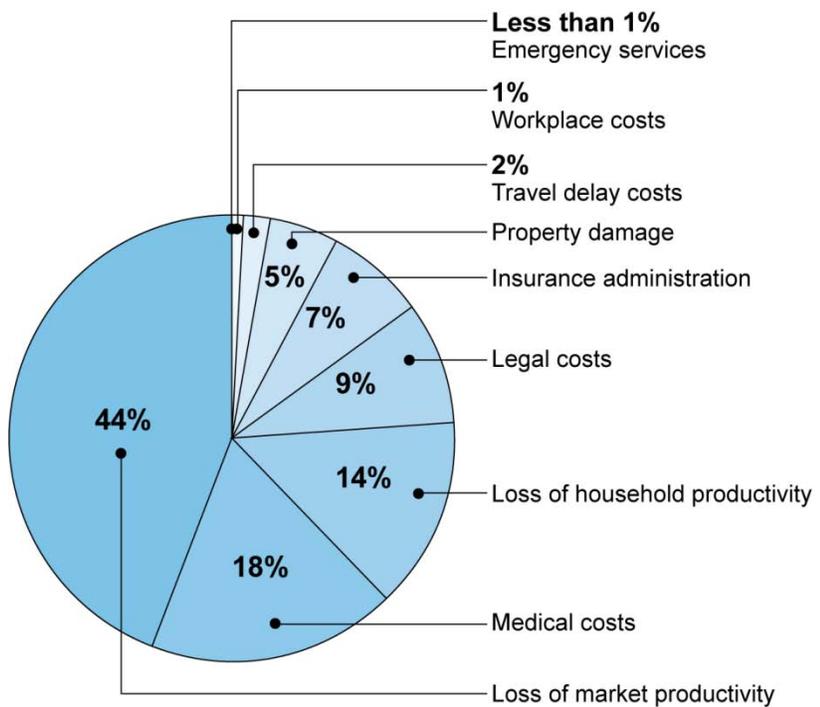
Our estimated \$16 billion in direct measurable costs of motorcycle crashes can be broken down according to the nine different types of costs identified by the NHTSA study. As shown in figure 3, loss in market productivity was the largest cost element, constituting 44 percent of the estimated total direct measurable costs. This category is followed by

²¹Various factors account for differences between our cost estimate of \$16 billion and the previous estimate produced by CDC and the Pacific Institute for Research and Evaluation of \$12 billion. Our estimate covers the nine types of direct measurable costs developed in the 2002 NHTSA study, whereas CDC and the Pacific Institute for Research and Evaluation estimate covers only three types of costs, as noted above. Given that medical and productivity costs constitute almost 80 percent of all costs (see fig. 1), our estimate is very similar to theirs as 80 percent of \$16 billion is about \$12 billion. Furthermore, CDC's estimate accounted for unreported crashes whereas ours did not, and its estimate was in 2005 dollars and ours is in 2010 dollars. Accounting for all of these differences, the two estimates are somewhat consistent.

²²NHTSA's current effort to update its crash cost estimates will provide a more accurate estimate of motorcycle crash costs and will consider various environmental costs, such as congestion costs. NHTSA plans to issue its report in spring 2013.

medical costs (18 percent), household productivity costs (14 percent), legal costs (9 percent), and insurance administration costs (7 percent). The remaining 8 percent is divided among workplace costs, travel delay costs, and costs resulting from property damage.

Figure 3: Distribution of Estimated Direct Measurable Costs of Motorcycle Crashes, 2010



Source: GAO analysis.

In addition to our overall estimate that the direct measurable costs of motorcycle crashes were about \$16 billion in 2010, we found that crash costs varied dramatically based on injury severity. In 2010, 82,000 motorcyclists were injured in motorcycle crashes, and these injuries ranged from minor to very severe; the direct measurable costs for non-fatal crashes ranged from \$2,500 for the most minor injury to about \$1.4

million for the most severe injury, on average.²³ As noted previously, in 2010, 4,502 motorcyclists died in motorcycle crashes. The average cost for a fatal crash was estimated to be about \$1.2 million. That a fatality can cost less than the most severe injury is partly because severe injuries can result in total incapacitation. Some victims, such as those with severe brain injuries, cannot be productive and require ongoing care and medical expenses.

Although prior studies and our analysis suggest that the costs of motorcycle crashes are significant, it is difficult to determine the full costs with accuracy because some types of costs are difficult to measure. For example, the treatment for serious injury can be long and costly, but follow-up analyses are conducted only for a few years to calculate long-term medical costs. Also, other costs of long-term injury consequences such as change in employment and living status cannot be fully measured. Moreover, intangible costs—such as emotional pain and suffering of the victim and family members resulting from a changed quality of life of the victim—are also significant but are difficult to measure in financial terms. Thus, the full costs of motorcycle crashes are likely higher than our estimate because we could not account for such difficult to measure costs. Also, we did not account for the costs of unreported crashes.

Individuals as well as Society Bear the Costs of Motorcycle Crashes

Victims and their families bear many of the direct measurable costs of motorcycle crashes. They may pay medical expenses that are not covered by insurance, suffer the loss of income of the victim and lost productivity at home, incur the costs of family members caring for the victim, and suffer losses for property damage not covered by insurance. Because motorcycle accidents are often severe, victims might not return to work for some time or not at all. According to a 2006 NHTSA study based on a survey of motorcycle crash victims who entered inpatient

²³This represents lifetime costs associated with a crash. However, this might be an underestimate for very serious injuries as calculations of long-term medical costs rely on follow-up analyses of these costs for only 2 to 3 years post-injury.

rehabilitation, of those employed at the time of the crash, 51 percent were no longer employed at the time of discharge.²⁴

In addition to victims and their families, other members of society—employers, private insurers, healthcare providers, government, and others—bear a significant amount of the direct measurable costs of motorcycle crashes. Both state and federal governments pay some of these costs through Medicaid and other assistance programs. Private insurers often bear significant costs for covered treatment—which are largely paid through their customer base. Healthcare providers—such as hospitals—may bear some unpaid charges. The victims’ co-workers and employers may need to temporarily work overtime or hire and train new employees to cover the work of lost employees and other administrative costs of personnel changes. Even road users can be affected if travel delays result during the emergency response to and cleanup of the crash.

NHTSA’s 2002 study, based on data on all motor vehicle crashes in 2000, estimated that three-quarters of the direct measurable costs appear to be borne by society. Although NHTSA’s analysis of the societal burden associated with crashes was based on all types of motor vehicle crashes, there is some evidence that society’s share of costs for motorcycle crashes may be similar or even higher, for example:

- Motorcyclists have a greater likelihood of a more severe injury in a crash compared to other motorists. Based on a 2008 NHTSA study, about 43 percent of motorcyclist crash victims suffered moderate to critical injuries when involved in a crash.²⁵ In contrast, based on NHTSA’s 2002 study, less than 8 percent of all motorists suffered from such injuries in a crash.²⁶ As previously noted, direct measurable costs increase substantially with the degree of accident severity.

²⁴Ted Miller et al, *Rehabilitation Costs and Long-Term Consequences of Motor Vehicle Injury* (Washington, D.C.: NHTSA, 2006). A total of 237 motorcycle crash victims were surveyed. Length of stay in inpatient rehabilitation ranged from 10 to 71 days.

²⁵Lawrence J. Cook et al, *Motorcycle Helmet Use and Head and Facial Injuries, Crash Outcomes in CODES-Linked Data*, DOT HS 811 2008 (Washington, D.C.: National Highway Traffic Safety Administration, 2008). Moderate to critical injuries are injuries that fall in the maximum abbreviated injury scale categories 2 to 5, and these proportions were calculated from a NHTSA 2008 study, which evaluated combined data from 18 states on 89,086 motorcycle crashes and 104,472 motorcyclists between 2003 and 2005.

²⁶Data on all motorists is for the year 2000.

Furthermore, according to a 2008 report by the Pacific Institute for Research and Evaluation, for each category of injury severity, government cost per crash is higher on average for motorcycle crash victims than for all motor vehicle crash victims.²⁷

- Motorcyclists may insure against fewer risks than their motor vehicle driver counterparts. According to a 2003 report by the Pacific Institute for Research and Evaluation conducted for NHTSA, legal and lender insurance requirements force most motorists to insure against a broad range of risks, but the requirements for motorcycle insurance coverage are usually less stringent.²⁸ In particular, the study found that, for the insurance companies included in the study, only 15 percent of motorcycle insurance policies in 1999 included personal injury protection or coverage of the motorcyclist's own medical expenses, while 98 percent of the insurance policies for other vehicles included these types of coverage. Our review did not identify any more recent studies on this topic. However, we did identify estimates, provided by Florida state officials that, in 2010, 51 percent of the costs of motorcyclist hospitalizations and emergency department visits in their state were not covered by commercial insurance. Also, we identified a 1999 study of uninsured vehicles in California that found that 66 percent of motorcycles were uninsured compared with only 19 percent for automobiles.²⁹ To the extent that motorcyclists have less insurance coverage than other motor vehicle drivers, a greater proportion of medical costs associated with motorcycle crashes may need to be paid from public funds.

With respect to difficult-to-quantify costs, determining the share paid by victims and their families versus society is difficult. NHTSA's estimates of

²⁷Ted Miller et al, *Cost of Crashes to Government, United States, 2008*. (Washington, D.C.: Pacific Institute for Research and Evaluation, 2008). For different severity of injuries, total government cost on average ranged from \$5,200 to \$30,000 for motorcycle crashes and from \$3,500 to \$21,000 for all motor vehicle crashes. For fatalities, the cost was the same for motorcycles and all motor vehicles. For the no-injury category, the cost was higher for all motor vehicles than for motorcycles.

²⁸The study analyzed data collected from insurance companies that specialize in motorcycle insurance and the nation's five largest motor vehicle insurers. See Ted R. Miller and Bruce A. Lawrence., *Motor Vehicle Insurance in the United States: A 1998-1999 Snapshot with Emphasis on Motorcycle Coverage, Final Report to the National Highway Traffic Safety Administration* (Washington, D.C.: National Highway Traffic Safety Administration, 2003).

²⁹Robert O. Bernstein, *California Uninsured Vehicles as of June 1, 1997*, Policy Research Bureau, California Department of Insurance (1999).

the shares of all motor vehicles crash costs borne by individuals and society only covered direct measurable costs, and society's share of the difficult-to-quantify costs of motorcycle crashes is unclear. For example, while victims and their family are likely to bear most, if not all, of the intangible or nonfinancial costs in terms of emotional pain and suffering resulting from loss in quality of life of the victim or from psychic repercussions of victim's injury, society may pay a significant portion of the victims' long-term rehabilitation costs. A 2006 NHTSA study found that inpatient rehabilitation costs for motorcycle injuries averaged \$13,200 per patient for the year 2002 (\$16,000 in 2010 dollars) and that almost 20 percent of this was paid by public funds.³⁰ A 1988 study pointed out that since many insurance policies typically do not cover long-term rehabilitation or nursing home needs, most of these additional charges are paid for by public funds, such as through Medicaid.³¹

States Are Addressing Some of the Factors That Contribute to Crashes and Fatalities through Various Strategies, but Effectiveness Is Unclear

Various factors—including alcohol impairment; speeding; lack of a license, training, or riding skills; and lack of motorist awareness of motorcycles on the road—contribute to motorcycle crashes; another factor, lack of helmet use, contributes to the likelihood of a fatality when a crash occurs. States pursue a range of strategies to address these factors, including licensing approaches, training programs, law enforcement, efforts to improve motorcyclist safety awareness and motorist awareness, and helmet-use laws. Laws requiring all motorcyclists to wear helmets are the only strategy proven to be effective in reducing fatalities, but only 19 states have such laws. The effectiveness of the other strategies in reducing motorcycle crashes and fatalities is unclear because research has been limited and results of studies have been mixed or uncertain. However, according to NHTSA officials, approaches that have been proven to be effective in some other highway safety efforts—such as combining strong enforcement with public education to reduce driver alcohol impairment generally—may hold promise for improving motorcycle safety.

³⁰Ted Miller et al, *Rehabilitation Costs and Long-Term Consequences of Motor Vehicle Injury*.(Washington, D.C.: NHTSA, 2006).

³¹Frederick P. Rivara et al, "The Public Cost of Motorcycle Trauma," *Journal of the American Medical Association*, vol. 260. no..2 (1988).

Various Factors Contribute to Motorcycle Crashes and Fatalities

Factors Contributing to a Crash

Various factors contribute to the likelihood that a motorcyclist will crash. Often, a combination of factors can work together to increase the likelihood.³² While the extent of evidence concerning each factor's importance varies, the four factors identified most frequently by the federal officials, selected state officials, and stakeholder organizations that we spoke to were alcohol impairment; speeding; lack of a motorcycle license, training, or skills; and lack of motorist awareness of motorcyclists.³³

Alcohol impairment is associated with a large portion of fatal motorcycle crashes. In 2010, 28 percent of motorcycle drivers involved in fatal crashes had a blood alcohol concentration (BAC) of 0.08 grams per deciliter—the legal limit in all states for operating a vehicle—or higher. This is compared to 23 percent of drivers of passenger vehicles.³⁴ A BAC level at or above this limit impairs the judgment of motorcyclists, making

³²While these factors affect the likelihood that an individual will experience a crash, exposure—the time and miles motorcycles are driven on the road and the number of motorcycles on the road—affects the overall number of crashes and fatalities in each state. Weather and the length of the riding season, which vary from state to state, influence the amount of time motorcyclists spend riding.

³³These factors were also identified in the following reports on motorcycle safety issues and strategies: National Highway Traffic Safety Administration, *Countermeasures That Work: A Highway Safety Countermeasure Guide for State Highway Safety Offices. Sixth Edition*. DOT HS 811 444. (Washington, D.C.: NHTSA, 2011); Motorcycle Safety Foundation and National Highway Traffic Safety Administration, *National Agenda for Motorcycle Safety* (Washington, DC.: NHTSA, 2000); Transportation Research Board/National Cooperative Highway Research Program, *NCHRP Report 500: Guidance for Implementation of the AASHTO Strategic Highway Safety Plan, Volume 22: A Guide for Addressing Collisions Involving Motorcycles*. (Washington, D.C.: Transportation Research Board, 2008); Governors Highway Safety Association, *by State: 2011 Preliminary Data*. (Washington, D.C.: Governors Highway Safety Association, 2012). Some of these reports identify additional factors. In particular, the *National Agenda for Motorcycle Safety* identified a range of human, social, vehicle, and environmental factors affecting the likelihood of crashes and the severity of crash outcomes.

³⁴Estimates of the percentage of drivers with BAC levels greater than 0.08 grams per deciliter with their 95 percent confidence intervals (CI) are for motorcycle drivers 27.8 percent (95 percent CI of 26.1 percent to 29.4 percent) and for drivers of passenger vehicles, 22.8 percent (95 percent CI of 22.3 percent to 23.4 percent). See appendix I for more information about these estimates.

them more likely to engage in risky behaviors such as speeding. Some studies have also found that motorcyclists who are intoxicated are less likely to wear helmets.³⁵ In addition to judgment, alcohol also affects the riding skills of the motorcyclist. A NHTSA study assessing the effects of alcohol on rider performance showed that motorcyclist riding performance was significantly impaired at a BAC level of 0.08, and somewhat impaired at a lower BAC level of 0.05.³⁶ Drug impairment was also cited by some state officials as a factor contributing to crashes.³⁷

Speeding is a major factor contributing to motorcycle crashes, according to federal and state officials and stakeholder groups we interviewed. NHTSA has estimated that more than a third of motorcyclist fatalities involve speeding. However, quantifying the contribution of speeding to crashes and fatalities is a challenge, because information about the speed of the motorcycle at the time of the crash often is unreliable. Officials in two states told us that certain sections of highways are popular sites for speeding by motorcyclists. According to the Insurance Institute for Highway Safety, riders of the increasingly popular “supersport” motorcycles, which can reach higher speeds than other motorcycles,³⁸ tend to be younger than 30 and are more likely to be involved in crashes where speed was a factor.

Lack of a motorcycle license, training, or skills were cited by federal and state officials and stakeholders as significant factors associated with crashes and fatalities. Licensing programs measure the readiness of motorcyclists to drive safely and can encourage or require that beginning

³⁵Carley Sauter et al, “Increased Risk of Death or Disability in Unhelmeted Wisconsin Motorcyclists,” *Wisconsin Medical Journal*, Vol. 104 , No. 2 (2005), pp. 39-44. Timothy Pickrell and Marc Starnes, *An Analysis of Motorcycle Helmet Use in Fatal Crashes*, National Highway Traffic Safety Administration (Washington, D.C. 2008). Thomas S. Dee, “Motorcycle helmets and traffic safety,” *Journal of Health Economics*, vol. 28 (2009), pp. 398-412.

³⁶Creaser, J. I. et al. *Effects of Alcohol on Motorcycle Riding Skills*. (Washington, D.C., NHTSA, 2007).

³⁷A 2007 survey of alcohol and drug use by drivers found about twice the prevalence of drug use by motorcyclists as passenger vehicle drivers. See John H. Lacey et al, *A 2007 National Roadside Survey of Alcohol and Drug Use by Drivers, Drug Results* (Washington, D.C.: National Highway Traffic Safety Administration, 2009).

³⁸Supersport motorcycles are built on a racing bike frame and can reach speeds of nearly 190 miles per hour.

riders take training prior to receiving a license. Twenty-two percent of motorcycle riders involved in fatal crashes in 2010 were driving their vehicles without a valid motorcycle license, compared to 12 percent for passenger vehicles. Agency officials in eight of the states we covered in our review reported that some crashes occur as a result of riders departing from their lane, making improper turns, or following the vehicle in front too closely. Such riding behaviors may be because of lack of skill or experience. In addition, agency officials in 10 states reported that older motorcyclists returning to motorcycling after years of not riding have contributed to crashes in their state. Some of these officials explained that many of these older motorcyclists have maintained their motorcycle licenses for a number of years because they are automatically renewed, their riding skills have decreased, and they are not required to demonstrate their skills when returning to riding. This is a possible explanation for the previously mentioned statistics on fatalities among older “returning” riders.

Lack of motorist awareness of motorcyclists is a major factor contributing to crashes, according to many of the federal and state officials and stakeholders we interviewed. In 2010, 54 percent of all motorcyclist fatalities were the result of multi-vehicle crashes. A main problem cited by some of those who noted this factor is that drivers make a left turn without noticing an oncoming motorcyclist coming from the opposite direction. Distracted driving can contribute to this problem. According to NHTSA officials, there are no studies to support the extent to which motorists are at fault in two-vehicle crashes with motorcycles because, in part, fault is very challenging to definitively determine. Related to this issue, motorcyclists who do not wear bright colors can be less conspicuous to drivers.

Some additional, less frequently cited factors can also contribute to the likelihood of a motorcycle crash. According to NHTSA officials, judgment is an overriding factor that affects the likelihood of crash involvement. Lack of good judgment about actions related to safety can lead to driving a motorcycle while under the influence of alcohol, speeding, or aggressive driving. In addition, the design and function-of the motorcycle can affect the likelihood of a crash. According to the Insurance Institute for Highway Safety, anti-lock braking systems on motorcycles reduce the likelihood of a crash. Some have also cited road conditions as a main factor that can lead to a crash. Problems include uneven road surfaces and rural roads with narrow or no shoulders. According to FHWA officials, while roadway conditions do contribute to crashes, it is currently unknown

Factors Affecting the Severity
of Crash Outcomes

how frequently this occurs.³⁹ Other factors cited include encounters with wildlife (especially deer) and weather conditions.

Other factors that we identified do not affect the likelihood of a crash occurring but can affect the severity of injuries when a crash does occur.

Lack of helmet use, most notably, is an important factor contributing to an increased risk of fatality or serious brain injury when a motorcycle crash occurs. Several studies have estimated that helmet use reduces motorcyclist fatality risk, with reductions ranging from 34 to 39 percent.⁴⁰ Further, according to NHTSA, the latest studies have found that helmets reduce the incidence of motorcycle rider brain injuries by 41 to 69 percent.⁴¹ Head injuries account for a significant percentage of motorcyclist injuries resulting in fatality. NHTSA has estimated that helmets saved the lives of 1,550 motorcyclists in 2010.⁴² DOT has established standards for motorcycle helmets to ensure a certain degree of protection in a crash.⁴³ Use of helmets that are not compliant with these standards can pose a risk to riders, as wearing non-compliant helmets is associated with a higher likelihood of receiving a head injury when a crash occurs.

³⁹For further information on this issue and approaches used by state governments to deal with it, see Richard Schaffer et al, *Scan 09-04, Leading Practices for Motorcyclist Safety* (NCHRP Project 20 68A) (Washington, D.C.: National Cooperative Highway Research Program, 2011).

⁴⁰Williams Deutermann, *Motorcycle Helmet Effectiveness Revisited*, National Highway Traffic Safety Administration (Washington, D.C.: 2004). Thomas S. Dee, "Motorcycle helmets and traffic safety" *Journal of Health Economics*, vol. 28 (2009), pp. 398-412. Daniel C. Norvell and Peter Cummings, "Association of Helmet Use with Death in Motorcycle Crashes: A Matched-Pair Cohort Study," *American Journal of Epidemiology*, Vol. 156 (2002), No. 5, pp. 483-48.

⁴¹NHTSA, *Countermeasures That Work*, 2011.

⁴²CDC has reported that, in 2010, approximately \$3 billion in costs were saved as a result of helmet use in the U.S. and another \$1.4 billion could have been saved if all motorcyclists had worn helmets. See Centers for Disease Control and Prevention, "Helmet Use Among Motorcyclists Who Died in Crashes and Economic Cost Savings Associated With State Motorcycle Helmet Laws—United States, 2008-2010," *Morbidity and Mortality Weekly Report*, Vol. 61 No. 23 (2012), pp. 425-430.

⁴³Approved helmets must meet the DOT's Federal Motor Vehicle Safety Standard 218 which requires that helmets provide minimum levels of performance to protect the head and brain in the event of a crash.

Other factors can also affect the outcome of crashes. According to NHTSA officials, protective clothing can help prevent “road rash”⁴⁴ as a result of a crash, which, in extreme cases, can result in death. They noted, however, that little research has been performed on the effects of such clothing on injuries and fatalities. An important factor in victims’ survival after a crash is the availability of emergency services. CDC, a state agency, and an association cited crashes on rural roads as being especially treacherous, given the longer time required to get the victims to medical care.

Except for alcohol impairment and helmet use, the relative importance of these various factors contributing to crashes and fatalities is not well understood. Challenges to determining the contribution of these factors to crashes and fatalities include unavailable or unreliable information about key factors such as the speed of the vehicle, driver behavior, road conditions, and various precipitating factors. Also, factors can be interrelated, making it difficult to determine causal relationships and relative contributions to risk. Several studies currently under way are expected to provide much better information on the causes of motorcycle crashes.⁴⁵

States Have Implemented Various Strategies to Address These Factors

States use a range of strategies to address the factors that contribute to motorcycle crashes and fatalities. The importance of these factors varies among states, and accordingly, states pursue varying strategies—including some innovative ones—to address the factors that are of greatest importance to them. Furthermore, states vary in terms of fatality rates, ridership, and the length of the riding season, and therefore some may choose to carry out more extensive motorcycle safety efforts than others. However, at a minimum, all states that we included in our review had some type of motorcycle licensing and training program in place and

⁴⁴Road rash injuries, or road burn injuries, are painful scrapes and bruises that occur when motorcyclists are thrown or dragged by their motorcycles.

⁴⁵These include a crash causation study sponsored by FHWA, NHTSA, and the American Motorcyclist Association and two naturalistic studies of motorcyclists, one sponsored by NHTSA and one sponsored by the Motorcycle Safety Foundation. The crash causation study will investigate at least 280 crashes to determine causes and rider characteristics. The naturalistic studies will track a total of 260 motorcyclists, using equipment attached to their motorcycles that will acquire a broad range of data on routine riding behavior, as well as crashes and near-crash events. According to NHTSA officials, the results of these studies will become available in several years.

included motorcyclists in their overall efforts to enforce alcohol impairment and speed limit laws. Some strategies aim to prevent crashes and other strategies aim to reduce the severity of crashes when they occur (see table 2).

Table 2: Types of State Motorcycle Safety Strategies

Strategies to prevent crashes	Strategies to reduce the severity of crash outcomes
<ul style="list-style-type: none"> • Licensing • Training • Enforcing alcohol impairment and speed limit laws • Efforts to increase motorcyclist safety awareness • Efforts to increase motorist awareness of motorcyclists 	<ul style="list-style-type: none"> • Helmet laws • Enforcing use of DOT-compliant helmets • Promoting voluntary helmet use

Source: GAO.

Strategies for preventing crashes

Licensing. According to NHTSA, all states require motorcyclists to obtain a motorcycle license in order to ride.⁴⁶ Licensing programs aim to ensure that motorcyclists have the minimum knowledge and skills needed to operate a motorcycle safely. All of the 16 states that we covered in our review required a written test and demonstration of riding skills to obtain a license. Some states imposed additional requirements, particularly training requirements, for younger riders. Ten of the 16 states that we covered in our review require riders under a certain age to successfully complete a basic rider course before obtaining a motorcycle license. Two states that we covered—Texas and Florida—require all riders to successfully complete a basic rider course to be eligible for a motorcycle license.⁴⁷

Utah has an innovative approach to motorcycle licensing with a tiered-licensing system that was implemented in 2008. Utah provides four types of motorcycle licenses based on the size—or more specifically, the engine size—of the motorcycle motorcyclists test on. To obtain a license to operate a motorcycle with a certain engine size, and thus more or less

⁴⁶NHTSA, *Countermeasures That Work*, 2011.

⁴⁷Information on licensing requirements for the 16 states in our review is based on documentation on these states' programs and interviews with state officials.

power, motorcyclists must demonstrate their ability to ride that size of motorcycle during the licensing test.⁴⁸ The idea behind the program was to encourage new riders to learn to ride on smaller, lighter bikes before moving on to large, powerful motorcycles. Also, Utah officials told us that this strategy helps address the problem of riders testing on a motorcycle that was smaller than the one they intended to ride.

Some states that we included in our review have taken steps to increase the number of licensed riders. For example, 4 of the 16 states that we covered in our review—California, Maryland, Wisconsin, and Washington—have used databases to identify individuals with a registered motorcycle but no motorcycle license. Letters are then sent to these individuals describing the potential consequences of not obtaining a license. The officials that we interviewed said that these programs were somewhat successful in increasing the number of individuals with a motorcycle license.

Training. Motorcycle-training programs aim to provide motorcyclists with the knowledge and skills necessary to safely operate a motorcycle. Most states use the training curriculum developed by the Motorcycle Safety Foundation.⁴⁹ All of the states that we included in our review offer basic rider courses for new riders and advanced courses to encourage experienced riders to refresh their skills and learn advanced-riding techniques. Some states operate training programs while others rely on private contractors.

Some state officials that we interviewed described their training programs as being innovative. For example, New Hampshire offers a training course specifically for returning riders, which, as noted previously, can be a contributing factor in crashes and fatalities. According to state officials in New Hampshire, returning riders are a challenge because many have retained their motorcycle license during the period when they were not riding and they are not required to take additional training or testing before they begin riding again.

⁴⁸By engine size, we mean the engine capacity in cubic centimeters. Licenses are granted for motorcycles with an engine size of 90 cc or less, 249 cc or less, and 649 cc or less. Riders who pass the test on a motorcycle that is 650 cc or larger are not restricted.

⁴⁹The Motorcycle Safety Foundation is an internationally recognized not-for-profit foundation, supported by motorcycle manufacturers, that provides leadership to the motorcycle safety community through its expertise, tools, and partnerships.

In addition to developing training courses, states have used various strategies to encourage riders to take training. According to a Governors Highway Safety Association survey of state motorcycle programs conducted in 2007, at least 33 states offer a waiver for the riding-skills portion of the licensing test for individuals who complete a basic skills course. Some states have tried other strategies. For example, Wisconsin has purchased a mobile-training facility called the Transportable High-End Rider Education Facility that travels around the state to encourage motorcycle riders to take formal training, among other things. Likewise, Texas has purchased two trailers that are used to deliver training to riders in rural areas who do not have access to local training facilities. Officials in Wisconsin and Texas told us that they have received favorable reactions from motorcyclists when they take the trailers to motorcycle rallies and other events.

Enforcing alcohol impairment and speed limit laws. Enforcement strategies are designed to 1) identify motorcyclists who are not adhering to the states' laws and 2) increase law enforcement officers' awareness of laws and issues that affect motorcycle safety. All of the states that we included in our review include motorcycles in their overall alcohol-impairment and speed-limit enforcement efforts. For example, Maryland and Missouri have used helicopters for surveillance in areas that are known to be popular for speeding. Iowa and Florida target law enforcement efforts in areas identified as having a large number of crashes. However, less than half of the states included in our review mentioned specific enforcement strategies aimed at motorcyclists who are driving while impaired or speeding. Some states have developed materials to educate law enforcement officers on motorcycle specific issues, such as identifying impaired riders. States used a number of methods to educate law enforcement officers about issues related to motorcycle riding, including training courses, pamphlets, and reference guides listing motorcycle violations.

However, according to some state and law enforcement officials, enforcement efforts are limited because of state laws, limited resources, and complaints by motorcycle groups. Some states have "no chase" laws that prohibit officers from chasing speeding motorcycles to avoid accidents with other motorists. According to one NHTSA regional official, some states, such as Texas, do not allow sobriety checkpoints, so

detecting and stopping alcohol-impaired motorcyclists can be difficult.⁵⁰ Additionally, some state and law enforcement officials that we interviewed told us that states lack funding to train law enforcement officers on motorcycle-specific issues. As a result, officers may be hesitant to enforce laws related to motorcycles, because they may not be familiar with all of the specific requirements and may lack some of the training that would help them determine if a rider is complying with laws. Furthermore, some NHTSA regional, state, and law enforcement officials whom we interviewed said that states are often reluctant to focus enforcement on motorcyclists because of complaints by motorcycle groups that they are being unfairly targeted.

Efforts to increase motorcyclist safety awareness. These strategies aim to encourage motorcyclists to ride safely and take actions, such as wearing brightly colored clothing, to increase their visibility to other motor vehicle drivers. The strategies address a number of factors that contribute to motorcycle crashes and fatalities, including alcohol impairment, speeding, lack of rider conspicuity, and lack of licensing, training, and skills. Nearly all of the state officials that we interviewed described making such efforts, including using billboards, electronic messaging, and printed materials, or using contact among state motorcycle safety officials, law enforcement, and motorcyclists to encourage safety awareness among motorcyclists.⁵¹ Several state and law enforcement officials whom we interviewed emphasized that this contact can be particularly valuable in developing relationships with motorcyclists during rallies and other events, so that motorcyclists will be more receptive to safety messages. One state official, however, noted that some members of the motorcycling community are high risk takers and more resistant to safety messages.

During our interviews, some state officials identified some of their approaches as being innovative. For example, Florida produced a peer-to-peer video to convince motorcyclists to ride safely based on research that riders are more receptive to messages from their peers than from police or others. In addition, starting in 2008, Colorado kicked off its Live

⁵⁰At a sobriety checkpoint, law enforcement officers stop vehicles at a predetermined location to check whether the driver is impaired. According to the Governors Highway Safety Association, in 12 states sobriety checkpoints are not conducted because they are prohibited by law or the state lacks authority to conduct them.

⁵¹Promotion of helmet use is also intended to increase motorcyclist safety awareness. We will discuss this strategy below.

to Ride campaign. The campaign is a comprehensive safety program aimed at motorcyclists. Each year the campaign focuses on a different theme, such as the importance of training or riding unimpaired.

Efforts to increase motorist awareness of motorcyclists. Motorist awareness strategies educate and remind drivers of other motor vehicles to be aware of motorcycles on the road and to drive safely near motorcycles. Nearly all of the states that we included in our review reported having a strategy to increase motorists' awareness of motorcycles. Some states use informational campaigns that deliver messages, such as media messages and promotional materials (See fig. 4). These may be provided by NHTSA through its Share the Road campaign that reminds drivers to look out for motorcycles. All of the states in our review observe May as motorcycle safety month during which they use media to broadcast public awareness messages to remind drivers of other motor vehicles to look out for motorcyclists.

Figure 4: Example of a Poster Used to Encourage Motorist Awareness



Source: Florida DOT.

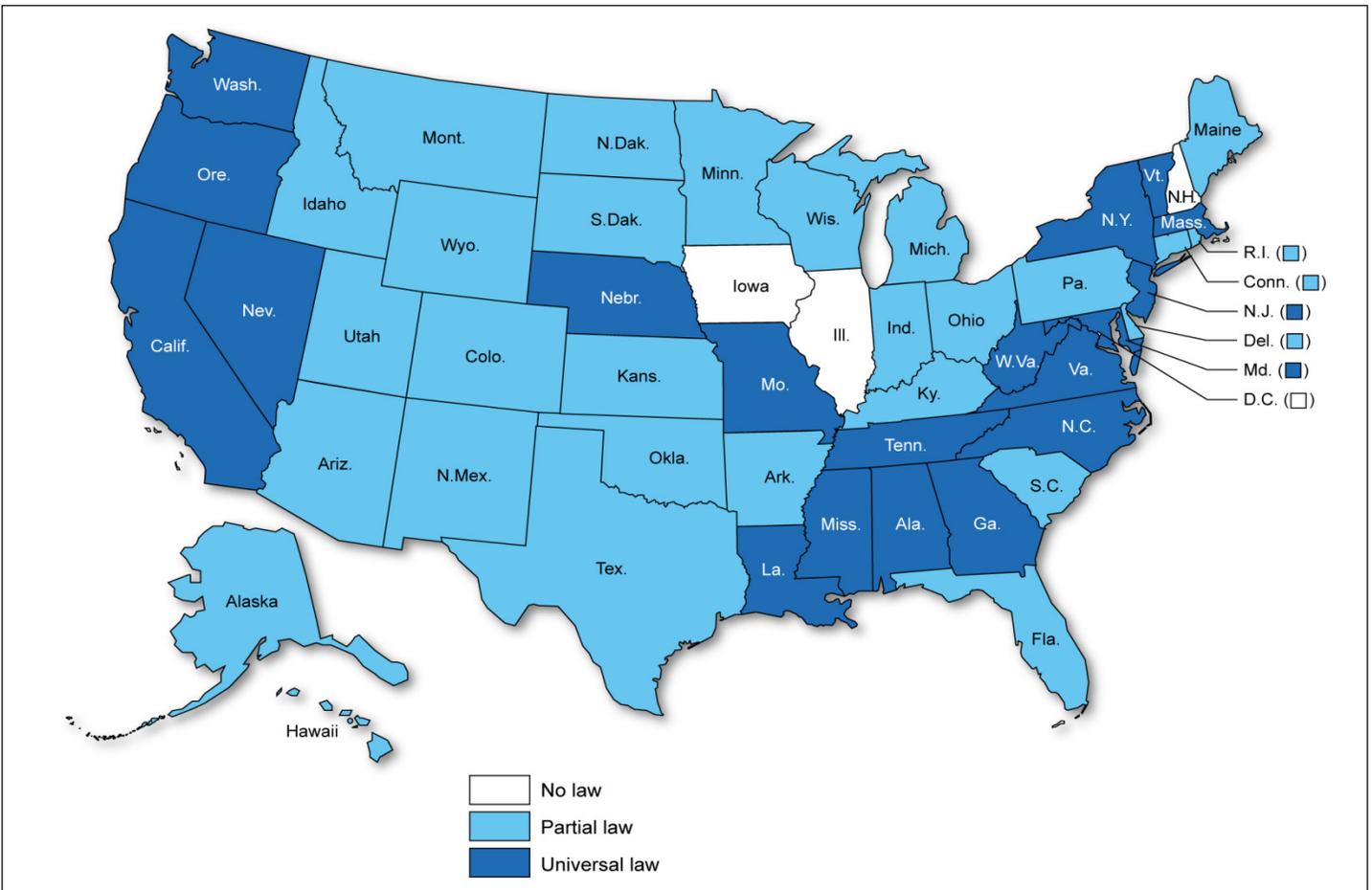
Strategies for reducing the severity of crashes

Some state officials identified some of their approaches as being innovative. For example, California and Texas use electronic billboards to display motorist awareness messages. Other states, such as Arizona and Wisconsin, partner with motorcyclist groups to teach students about motorcyclist awareness during driver education courses. In addition, while it is not mandatory to discuss motorcyclist awareness in drivers' education classes, California has updated its drivers' education handbook to include a discussion about motorcycles.

Helmet laws. States have one of two types of helmet laws: universal helmet laws (helmets required for all riders) or partial helmet laws (helmets required for certain riders, most often age 17 and under). Currently, according to the Insurance Institute for Highway Safety, 19 states have universal helmet laws and 28 states have partial helmet laws (see fig. 5). For example, California and New York have universal helmet laws requiring all riders to wear helmets while Arizona and Wisconsin have partial helmet laws that only require riders age 17 and under to wear helmets. Two states, Florida and Michigan, with partial helmet laws allow motorcyclists over the age of 21 to ride without a helmet if they have a certain level of medical insurance coverage.⁵² Three states—Illinois, Iowa, and New Hampshire— have no laws requiring helmet use by riders.

⁵²In Florida, motorcyclists over the age of 21 can choose not to wear a helmet if they carry \$10,000 in medical insurance coverage. Riders in Michigan who are over the age of 21 and have less than 2 years of experience or have passed a motorcycle safety course are not required to wear a helmet as long as they also have at least \$20,000 in medical insurance coverage per person including any rider.

Figure 5: Helmet Use Laws in the United States as of October 2012



Sources: Insurance Institute for Highway Safety and Map Resources.

In part due to controversy surrounding motorcycle helmet laws, states have a history of enacting and repealing them over the years.⁵³ According to the Insurance Institute for Highway Safety, no state has enacted a universal helmet law since Louisiana did in 2004. NHTSA and state

⁵³From 1992 to 1995, as part of an incentive package for states to pass laws requiring all riders to wear helmets, the Intermodal Surface Transportation Efficiency Act of 1991, Pub. L. No. 102-240, § 1031, 105 Stat. 1914, 1970, added 23 U.S.C. § 153 to require states to pass such laws or lose funds for highway construction. The helmet law requirement was repealed in 1995 (Pub. L. No. 104-59, § 205(e), 109 Stat. 568, 577) which was followed by repeal of helmet laws in a number of states.

officials whom we interviewed said that it was unlikely that any state with a partial helmet-use law or no helmet law would consider strengthening requirements for helmet use. In 2011, according to a recent report by the CDC, bills were introduced to change or repeal helmet laws in 10 of the 20 states that had universal helmet laws at the time,⁵⁴ and in 2012, Michigan changed its universal helmet law to a partial helmet law. Many government entities and safety organizations—like NHTSA, CDC, and the Motorcycle Safety Foundation—promote helmet use, citing its benefits. The CDC also cites the social and economic costs of motorcycle crashes and fatalities. However, some motorcycle groups, like the American Motorcycle Association, advocate helmet use but oppose mandating it. Some motorcycle groups maintain that these mandates violate motorcyclists' personal liberties and their right to assume the risk associated with riding without a helmet. They also point out that helmet laws do nothing to prevent crashes and that resources are therefore better spent on crash prevention efforts such as training and motorist awareness.

Enforcing use of DOT-compliant helmets. States with universal helmet laws face challenges in getting riders to wear DOT-compliant helmets. According to NHTSA's National Occupant Protection Use Survey conducted in 2011, 12 percent of riders in states with universal helmet laws used non-compliant helmets.⁵⁵ In states with universal helmet laws, some states have used innovative strategies to address this issue. For example, officials in California told us that they have developed a video that law enforcement officers distributed to motorcycle clubs across the state. The video takes an educational and informational approach to emphasize the importance of wearing a compliant helmet. Also, New York officials told us New York has used safety checkpoints to verify compliance with safe motorcycle-operating practices, including use of

⁵⁴Rebecca Naumann and Ruth A. Shults, Ph.D., "Helmet Use Among Motorcyclists Who Died in Crashes and Economic Cost Savings Associated With State Motorcycle Helmet Laws—United States, 2008-2010," *Morbidity and Mortality Weekly Report*, Division of Unintentional Injury Prevention, National Center for Injury and Prevention and Control, Centers for Disease Control and Prevention, June 15, 2012.

⁵⁵The National Occupant Protection Use Survey is the only survey that provides probability-based data on helmet use by motorcycle drivers and passengers in the U.S. and is conducted annually by NHTSA's National Center for Statistics and Analysis. The survey observes helmet use as it actually occurs at randomly selected roadway sites. See National Highway Traffic Safety Administration, *Traffic Safety Facts: Motorcycle Helmet Use in 2011—Overall Results* (Washington, D.C.: 2012).

compliant helmets. State officials told us that these checkpoints combine education with enforcement. Officers distribute information about safety practices but enforce state laws if violations are found.⁵⁶ A challenge that law enforcement officers face in states with universal helmet laws is that it can be difficult to identify and cite riders wearing non-compliant helmets. A Governors Highway Safety Association survey of state motorcycle programs found that in 2007, nine states with universal helmet laws provided training to law enforcement officers to help them identify non-compliant helmets.

Figure 6: Examples of Non-Compliant and DOT-Compliant Helmets



Source: NHTSA.

Note: DOT-compliant helmets have an energy-absorbing layer between the comfort liner and outer shell and include a chin strap with sturdy rivets; furthermore, they generally weigh about 3 pounds.

Promoting voluntary helmet use. In states that have a partial helmet law or no helmet law, finding ways to encourage riders to wear helmets can be challenging. According to the NHTSA survey mentioned above, in

⁵⁶The use of checkpoints is controversial. Officials in some states told us that they are prohibited from using checkpoints to enforce motorcycle laws.

2011, use of DOT-compliant helmets was much lower in these states than in states with universal helmet laws: 50 percent versus 84 percent. Officials in some states try to promote helmet use through education. For example, officials in Iowa—a state with no helmet law—told us that they host an annual conference for motorcycle riders to discuss motorcycle safety issues. One of the recent conference themes was centered on the use of proper protective gear, including helmets. Officials in several other states, however, told us that there was such strong sentiment from motorcyclists in their state about their right to choose whether to wear a helmet that they do not promote helmet use.

Effectiveness of Most Strategies Used by States Is Unclear

We found, based on our review of studies, that the effectiveness of most of the strategies used by states in reducing motorcycle crashes and fatalities is unclear. Although helmet laws are controversial and some states have repealed their universal helmet laws in recent years, such laws are the only strategy proven, by a number of studies, to be effective in reducing motorcyclist fatalities. The effectiveness of most other strategies on reducing motorcycle crashes or fatalities is uncertain or unknown because evidence is limited, mixed, or not of a high quality.⁵⁷ In identifying studies to include in our research review, we used selection criteria aimed at ensuring that we included only high quality studies that provided valid results.⁵⁸

Some newer strategies and strategies that have been proven to be effective in addressing other highway safety issues, such as teen driver safety, may hold promise for improving motorcycle safety. However, while

⁵⁷NHTSA and the Transportation Research Board of the National Academies have also reported on limitations of existing research on motorcycle safety strategies. See National Highway Traffic Safety Administration, *Countermeasures That Work*, (2011) and David F. Preusser, Allan F. Williams, James L. Nichols, Julie Tison, and Neil K. Chaudhary, National Cooperative Highway Research Program, Transportation Research Board, *NCHRP Report 622: Effectiveness of Behavioral Highway Safety Countermeasures*, (Washington, D.C.: Transportation Research Board, 2008).

⁵⁸We included studies that (1) were conducted in the U.S., (2) were peer-reviewed or prepared by or for federal or state agencies, (3) included an original analysis of data, using an experimental or quasi-experimental design, (4) addressed either motorcycle crashes or motorcycle fatalities as an outcome, and (5) were published in the last 10 years. In some cases, older studies were included if more recent studies of a particular strategy were not available. We did not include strategies related to road infrastructure, emergency response, or vehicle safety. For further details on our methodology, see app. I.

Strategies for Preventing Crashes

some of the states that we included in our review are trying innovative approaches, few of these states have conducted their own evaluations of these approaches. Some state officials noted that their state had not conducted evaluations of its motorcycle safety strategies because of resource constraints or the difficulty in carrying out such studies. Some state officials expressed concerns to us over gaps in knowledge about the effectiveness of motorcycle safety strategies. Some noted that this knowledge gap makes it difficult to decide how to target safety resources given state budget constraints.

Licensing. Although licensing is an important component of a state's motorcycle safety program and lack of a valid license by many motorcyclists is a problem, we found that limited research has been done on the effectiveness of specific types of licensing strategies on preventing motorcycle crashes or fatalities. Randomized controlled studies of Maryland's and California's efforts to increase motorcycle licensing by comparing vehicle registration and driver licensing files found that this method did increase the number of licensed motorcyclists in both states, but most (almost 90 percent) unlicensed motorcyclists remained unlicensed.⁵⁹ Also, the strategy did not appear to have an effect on crash risk.⁶⁰ We identified only one study that evaluated the effect of motorcycle licensing laws on motorcycle driver mortality in the United States. Results of this study, which covered the years 1997 through 1999, suggested that some stricter licensing requirements used by states, such as those that require a skill test for obtaining a permit, were associated with lower motorcyclist fatality rates compared to other states that did not have these requirements.⁶¹ NHTSA has noted in its 2011 *Countermeasures That Work* report, which summarizes current research on the effectiveness of various strategies for addressing major highway safety problems, that the

⁵⁹Braver et al, "Persuasion and licensure: A randomized controlled intervention trial to increase licensure rates among Maryland motorcycle owners," *Traffic Injury Prevention*, Vol. 8, No. 1, 2007, pp. 39-46; Braver et al, *Understanding and Addressing the Problem of Unlicensed Motorcycle Operators in Maryland* (2007); and Limrick and Masten, *Preliminary Evaluation of a Pilot Program to Increase Licensure Among Improperly Licensed California Motorcycle Drivers*, (October 2011).

⁶⁰Limrick and Masten, *Preliminary Evaluation*, 2011.

⁶¹G. McGwin, J. Whatley, J. Metzger, F. Valent, F. Barbone, L.W. Rue. "The effect of state motorcycle licensing laws on motorcycle driver mortality rates," *Journal of Trauma, Injury, Infection, and Critical Care*, Vol. 56, No. 2, Feb. 2004, pp. 415-419.

effectiveness of current licensing approaches on motorcycle crashes has not been evaluated.⁶²

According to NHTSA's *Countermeasures that Work* report, research has found that graduated licensing systems can be highly effective in reducing teen driver crashes and fatalities.⁶³ Based on these results, NHTSA has identified graduated driver's licensing as a promising strategy for motorcycle safety. Graduated driver's licensing is a three-phase system for beginning drivers, consisting of a learner's permit allowing driving only under supervision, an intermediate license allowing unsupervised driving with restrictions, and a full license. While 49 states have such systems in place for licensing to operate motor vehicles, according to NHTSA officials no state currently has such a system in place for licensing motorcyclists.

Training. Although motorcycle training is important for teaching riding skills needed to operate a motorcycle safely and a number of stakeholders we interviewed cited lack of training or skills as a factor contributing to crashes, results of studies on the effectiveness of motorcycle training programs in reducing crashes and fatalities are uncertain. For example, findings of a 2008 study that examined the effects of various alcohol and traffic policies—including mandatory rider education programs—on motorcycle safety in the continental U.S. from 1990 to 2005 suggested that mandatory rider education programs were associated with a significant reduction in non-fatal injury rates, but did not find these programs to influence fatality rates.⁶⁴ A 2007 study of

⁶²See NHTSA, *Countermeasures That Work*, 2011.

⁶³See NHTSA, *Countermeasures That Work*, 2011. We have also reported that research has shown graduated licensing systems to be associated with improved teen driver safety. See GAO, *Teen Driver Safety: Additional Research Could Help States Strengthen Graduated Driver Licensing Systems*, [GAO-10-544](#) (Washington, D.C.: May 27, 2010).

⁶⁴See M.T. French, G. Gumus, and J.F. Homer, *Public policies and motorcycle safety*. *Journal of Health Economics*, 28(2009) 831-838. Non-fatal injury data in this study are not available for all years from all states and are from different sources across states, and thus, results may be biased to the extent that the effect of these factors on measurement of injury rates is systematically correlated with policy changes over time.

motorcyclist training in Indiana⁶⁵ and a 1998 study of such training in California⁶⁶ both found that trained riders did not have lower crash rates than untrained riders. Various methodological limitations of evaluations, which we and others⁶⁷ have reviewed, make it difficult to determine the effectiveness of training programs.⁶⁸ In addition, effectiveness of training can vary across states, and even within states.

NHTSA has also reported that based on existing research, the effectiveness of motorcycle training is uncertain. According to NHTSA officials, the reason why studies have not been able to link basic motorcyclist training with crash involvement may be because the training often teaches riders how to operate their vehicle; it does not necessarily produce the good judgment that would lead to safe riding behavior. Also, the officials pointed out that studies of teen drivers have found that some teens actively choose to drive in an unsafe manner, contrary to their driver education.⁶⁹

Enforcing alcohol-impairment and speed-limit laws. Overall, there has been little research on the effectiveness of strategies focused on

⁶⁵P. Savolainen and F. Mannering, "Effectiveness of Motorcycle Training and Motorcyclists' Risk-Taking Behavior," *Transportation Research Record: Journal of the Transportation Research Board*, No. 2031, (Washington, D.C., 2007), pp. 52–58. The study found that beginning motorcyclists who took a basic training course were more likely to be involved in a motorcycle crash than those who did not take the course. The authors offered possible explanations including that riders who take the course might be less skilled than those who do not, or their risk perception might change from taking the course, or that the course might be ineffective.

⁶⁶J.W. Billheimer, "Evaluation of California Motorcyclist Safety Program," *Transportation Research Record: Journal of the Transportation Research Board*, vol. 1640, Transportation Research Board (1998), pp. 100–109. The study found no significant differences in crash rates between trained and untrained riders 6 months, 1 year, and 2 years after training.

⁶⁷See, for example, A. Daniello, H.C. Gable, and U.A. Mehta, "Effectiveness of Motorcycle Training and Licensing," *Transportation Research Record: Journal of the Transportation Research Board*, vol. 2140 (2009), 206–213; and J. Brock, A. Robinson, B. Robinson, and J. Percer, "Approaches to the Assessment of Entry-Level Motorcycle Training: An Expert Panel Discussion," *Traffic Safety Facts*. DOT HS 811 242.

⁶⁸For example, evaluations have 1) not accounted for important differences between individuals who take motorcycle training and those who do not, 2) not accounted for other factors that may have affected crash rates, and 3) relied on self-reported data.

⁶⁹We have previously reported that research on driver education has produced mixed results regarding its effectiveness in reducing crashes. See [GAO-10-544](#).

enforcement of alcohol-impairment or speed-limit laws on motorcycle safety specifically. However, according to NHTSA's report *Countermeasures that Work*, research has shown that enforcement and sanctions—such as sobriety checkpoints, extensive patrolling of certain locations for a set period of time, and impounding vehicles—are effective for reducing instances of impaired driving and crashes for motor vehicles generally. Also, automated enforcement—such as cameras that detect speeding and crossing red lights—has been shown to be effective in reducing crashes because of speeding and aggressive driving by all types of motor vehicles.⁷⁰ We identified six studies on motorcycles that met our selection criteria and examined the association between different types of laws and sanctions related to impaired driving or speeding and motorcyclist fatalities.⁷¹ These studies provided mixed levels of evidence on the effectiveness of these approaches. For example, findings from a 2003 study of alcohol impairment laws suggest that these laws are associated with lower overall motorcycle fatality rates,⁷² but findings from another study did not show this association.⁷³ An additional study examined the effect of state speed limits and found that speed limits on

⁷⁰Specifically, according to NHTSA, summary reviews of research conclude that red-light cameras reduce side-impact crashes and overall crash severity, but increase rear-end crashes. The reduction of side-impact crashes (the target group of crashes and of higher severity) are slightly offset by increases in rear-end crashes (which are generally of lower severity), thus, red-light cameras were found to be more effective at intersections with a higher ratio of side-impact to rear-end crashes. National Highway Traffic Safety Administration, *Countermeasures That Work*, 2011.

⁷¹Villaveces et al, "Association of alcohol-related laws with deaths due to motor vehicle and motorcycle crashes in the United States, 1980-1997," *American Journal of Epidemiology*, 2003; French et al, "Public policies and motorcycle safety," *Journal of Health Economics*, 2009; Houston and Richardson, "Motorcyclist fatality rates and mandatory helmet-use laws," *Accident Analysis & Prevention*, 2008; Houston and Richardson, "Motorcycle safety and the repeal of universal helmet laws," *American Journal of Public Health*, 2007; and Houston, "Are helmet laws protecting young motorcyclists?" *Journal of Safety Research*, 2007. The latter three studies by Houston use the same data over the same time period to examine the effect of universal helmet laws and other state policies on motorcyclist fatalities. These studies vary only in the type of analyses carried out, and in one case, the population examined (i.e., motorcyclists 15 to 20 years of age).

⁷² Villaveces et al, "Association of alcohol-related laws", 2003.

⁷³Houston and Richardson, "Are helmet laws protecting," 2008.

rural interstates were associated with lower rates of non-fatal motorcycle injuries.⁷⁴

NHTSA's *Countermeasures That Work* report states that some enforcement and sanction strategies to reduce alcohol-impaired driving may be especially effective for motorcyclists, while other strategies may be less effective. According to NHTSA officials, law enforcement activities for motorcycles are analogous to those for passenger vehicles, so high visibility enforcement, which has been shown to be effective for passenger vehicles, should work for motorcycles. High visibility enforcement combines intensive enforcement of a specific traffic safety law—such as using sobriety checkpoints to enforce the 0.08 BAC limit—with extensive communication, education, and outreach informing the public about the enforcement activity. We have previously reported that high visibility enforcement campaigns have been found effective in reducing two primary risk behaviors—not using safety belts and impaired driving—associated with fatal vehicle crashes.⁷⁵ NHTSA has also noted that vehicle impoundment as a sanction for impaired driving is a promising strategy based on a study that showed that motorcyclists are highly concerned about the safety and security of their motorcycles.

Efforts to increase motorcyclist safety awareness and motorist awareness of motorcyclists. Our research review did not identify any studies of the effectiveness of strategies to increase motorcyclist safety awareness that met our selection criteria. We also did not identify any studies of the effectiveness of strategies to increase other driver awareness of motorcycles that met our criteria.⁷⁶ NHTSA has also found, as noted in its *Countermeasures That Work* report, that these areas have not been evaluated. NHTSA officials told us that based on prior studies on efforts in other highway safety areas—such as efforts to increase seat belt use—to influence driver behavior through education alone, the

⁷⁴ French et al, "Public policies," 2009.

⁷⁵See GAO, *Traffic Safety: Improved Reporting and Performance Measures Would Enhance Evaluation of High-Visibility Campaigns*, [GAO-08-477](#) (Washington, D.C.: Apr. 25, 2008).

⁷⁶In 2011, NHTSA did sponsor several studies on the effect of daytime running lights on motorcycle conspicuity. See, for example, James Jenness et al, *Motorcycle Conspicuity and the Effect of Auxiliary Forward Lighting*, NHTSA (Washington, D.C.: 2011). However, since these studies dealt with enhancements to vehicles to improve safety, they were outside of our scope.

Strategies for Reducing the Severity of Crashes

effectiveness of motorcycle safety strategies using outreach and communications alone is likely to be low.

Helmet laws. In contrast to the lack of information on the impacts of strategies to prevent crashes, a number of studies have demonstrated that universal helmet laws are an effective strategy for mitigating the severity of crashes when they do occur. Such laws have been shown to be associated with lower motorcycle fatality rates. We identified nine studies that met our selection criteria and examined the association between motorcycle helmet laws and motorcyclist fatalities. All nine studies provided evidence that universal helmet laws significantly decrease the rate of motorcyclist fatalities,⁷⁷ for example:

- One nationwide study for 1975-2004 found that universal helmet laws were associated with at least a 22 percent reduction in motorcyclist fatalities.⁷⁸
- A study, using data from the 48 contiguous states for 1988 to 2005, found that state laws mandating helmets reduced fatalities by 27 percent.⁷⁹

Research has also shown universal helmet-use laws to effectively increase the rate of helmet use among motorcyclists. In states without universal use helmet laws or where such laws were repealed, helmet use rates were lower than in states with universal helmet-use laws. Studies

⁷⁷ M.T. French, G. Gumus, J.F. Homer, "Public policies and motorcycle safety," *Journal of Health Economics*. 28(2009); D.J. Houston and L.E. Richardson. "Motorcycle Safety and the Repeal of Universal Helmet Laws," *American Journal of Public Health*. Vol. 97, No.11. 2007; D.J. Houston. "Are helmet laws protecting young motorcyclists?" *Journal of Safety Research*. 38(2007); T.M. Pickrell and M. Starnes. "An Analysis of Motorcycle Helmet Use in Fatal Crashes," National Highway Traffic Safety Administration, Technical Report. DOT HS 811 011. (August 2008); C.C. Morris. "Generalized linear regression analysis of association of universal helmet laws with motorcyclist fatality rates," *Accident Analysis and Prevention*.38(2006); G. McGwin, et al, "The Effect of State Motorcycle Licensing Laws on Motorcycle Driver Mortality Rates," *The Journal of Trauma Injury, Infection, and Critical Care*. 56(2004); A. Villaveces et al, 2003; D.J. Houston and L.E. Richardson, "Motorcyclist fatality rates and mandatory helmet-use laws," *Accident Analysis and Prevention*. 40(2008); and T.S. Dee, "Motorcycle helmets and traffic safety," *Journal of Health Economics*. 28(2009) 398-412.

⁷⁸D.J. Houston and L.E. Richardson, "Motorcyclist fatality rates and mandatory helmet-use laws," *Accident Analysis and Prevention*. 40 (2008).

⁷⁹T.S. Dee, "Motorcycle helmets and traffic safety," *Journal of Health Economics*. 28 (2009) 398-412.

we reviewed of observed helmet use rates in four states that repealed their universal helmet laws estimated helmet use of 90 percent or higher when helmet-use laws were in effect, compared to 66 percent or lower following the repeals.

Enforcing Use of DOT-Compliant Helmets and Promoting Voluntary Helmet Use. We did not identify any studies of the effectiveness of enforcement efforts aimed at increasing the use of compliant helmets or of programs to promote motorcycle helmet use in states without universal helmet laws. NHTSA has also noted in its *Countermeasures That Work* report that these strategies have not been evaluated.

Sound evaluations of motorcycle safety strategies are challenging to carry out, a situation that may help explain why research on some strategies has been limited and why results of some studies have been mixed or uncertain. NHTSA officials told us that evaluating the effects on crashes and fatalities of strategies other than helmet laws has been challenging, particularly since there are fewer motorcycles than passenger cars or trucks. Also, the complexity of the relationship between various factors and existing strategies that may affect crashes and fatalities makes it difficult to isolate the effects of a single strategy. Although limited evidence exists on the effectiveness of particular strategies states are using for addressing motorcycle safety and the results of studies are sometimes mixed or uncertain, the use of a range of strategies is important. As we discuss in the next section, major studies on motorcycle safety issues and NHTSA have emphasized that states should approach motorcycle safety with a comprehensive range of strategies to address the various factors that contribute to crashes and fatalities.⁸⁰

⁸⁰See, in particular, Motorcycle Safety Foundation and National Highway Traffic Safety Administration, *National Agenda for Motorcycle Safety* (2000); Transportation Research Board/National Cooperative Highway Research Program, *NCHRP Report 500: Volume 22: A Guide for Addressing Collisions Involving Motorcycles* (2008); U.S. Department of Transportation, National Highway Traffic Safety Administration, *Uniform Guidelines for State Highway Safety Programs: Highway Safety Program Guideline No. 3- Motorcycle Safety*. Washington, D.C. (2006).

NHTSA Supports States' Motorcycle Safety Programs, but Funding Flexibility and New Research Priorities Would Enhance Efforts

NHTSA has provided guidance, outreach, and training to help states improve their motorcycle safety programs. Although NHTSA provides grants for states to use for these programs, Congress imposed limits on the grants, allowing states to use them only for motorcyclist-training and motorist-awareness activities. NHTSA has also conducted research on motorcycle safety strategies, but has not researched or developed plans to research certain strategies that it has identified as promising or a high priority for improving motorcycle safety.

NHTSA Has Provided Guidance, Outreach, and Training to States

NHTSA has provided states with a variety of guidance, including written guidelines and technical assistance that identifies and promotes strategies states can use to address the key factors contributing to crashes and fatalities. In particular, NHTSA's 2011 *Countermeasures That Work* report, discussed previously, provides states with information on various highway safety strategies available to them—including motorcycle safety strategies—and what is known about the effectiveness of these strategies. NHTSA intends this information to help states select safety strategies that have been proved effective through research or that have shown promise.⁸¹ In addition, NHTSA has:

- Issued guidelines for state highway safety programs that recommend that states adopt a comprehensive approach to addressing motorcycle safety.⁸² Strategies that the guidance encourages include those discussed in our report. Conducted assessments of individual state safety programs based on these guidelines, at the request of individual states.⁸³
- Developed model standards for states and curriculum developers to incorporate into motorcycle training courses.
- Developed guidelines for states regarding motorcyclist licensing, in cooperation with the American Association of Motor Vehicle

⁸¹National Highway Traffic Safety Administration, *Countermeasures that Work*, 2011.

⁸²National Highway Traffic Safety Administration, *Uniform Guidelines for State Highway Safety Programs: Highway Safety Program Guideline No. 3- Motorcycle Safety* (2006).

⁸³Since 2006, 15 states have had these assessments conducted.

Administrators,⁸⁴ and is working with the association to revise a manual that states can provide to motorcyclists receiving their licenses.

- Conducted campaigns on motorist awareness and impaired-riding prevention that make available marketing materials, such as radio advertisements and posters that states can use in their motorcycle safety programs.

NHTSA also partnered with the Motorcycle Safety Foundation and others to produce a key report, the *National Agenda for Motorcycle Safety*, in 2000 and has produced subsequent guidance based on this report.⁸⁵ The report contained 82 recommendations aimed at improving motorcycle safety, about half of which applied to states and communities.⁸⁶ In 2006, NHTSA produced a guide to provide states with specific steps for implementing the recommendations that applied to the state.⁸⁷ NHTSA is currently updating this guide. In 2010, in response to a National Transportation Safety Board 2007 recommendation, NHTSA prioritized the recommendations based on impact, cost, time, and obstacles and produced a set of 22 high priority recommendations, including 10 aimed at states and communities. The agency is in the process of developing an action plan for states based on these 10 recommendations.⁸⁸

⁸⁴National Highway Traffic Safety Administration, *A Guideline Document for Motor Vehicle Administrators On Motorcycle Operator Licensing* (2009).

⁸⁵Transportation Research Board/National Cooperative Highway Research Program, *National Agenda for Motorcycle Safety* (2000).

⁸⁶The other recommendations were made to national agencies, such as NHTSA, and organizations. These recommendations addressed research, program evaluation, data collection, regulation, motorcycle design and manufacture, and motorcycle operator insurance.

⁸⁷U.S. Department of Transportation, National Highway Traffic Safety Administration. DOT HS 810 680. *Implementation Guide: National Agenda for Motorcycle Safety*. Washington, D.C (2006).

⁸⁸The 10 recommendations, in order of priority, are to 1) use effective strategies to increase use of DOT-compliant helmets; 2) educate police and judges on motorcycle safety issues; 3) educate police on alcohol-related behavior of motorcyclists; 4) discourage mixing alcohol or other drugs with motorcycling; 5) provide training to all who need or seek it; 6) provide additional education/training on proper braking techniques; 7) merge rider education/training and licensing into one-stop operations; 8) encourage states to issue motorcycle endorsements immediately upon course completion; 9) encourage motorcyclists to increase conspicuity; and 10) communicate helmet use benefits and work toward greater voluntary use of DOT-compliant helmets.

In addition to guidance, NHTSA has provided outreach to states. According to NHTSA officials, staff in NHTSA's regions work with the states daily, helping them to identify highway safety problems and countermeasures, such as enforcing individual state laws or finding ways to increase helmet use. However, according to NHTSA officials, some motorcyclist advocacy groups have been critical when NHTSA has promoted helmet use. NHTSA regional officials told us that they do not actively seek the passage of universal helmet laws by states, but they do appear before state legislatures to discuss the benefits of helmet use, when invited to speak.⁸⁹ Some NHTSA regions have collaborated on motorcycle safety conferences. For example, in 2010, three regions held a conference for their states to discuss motorcycle safety issues. Additionally, NHTSA regional officials we met with told us that they periodically hold conference calls or meet with states in their respective regions to discuss motorcycle safety issues and share information.

Finally, NHTSA has provided motorcycle safety-related training courses for state officials and law enforcement agencies. One such course is for state highway safety staff responsible for setting up and managing state motorcycle-safety programs. This course is currently available electronically and, according to state officials, has provided insights and tools to help them better understand their responsibilities. NHTSA also developed and provided training on motorcycle safety for instructors at law enforcement training academies in 2011 and 2012. State law enforcement officials stated that this training helped educate law enforcement personnel on motorcycle safety and their role in reducing motorcycle crashes. NHTSA expects to deliver the law enforcement training electronically in fiscal year 2013 to increase its availability to law enforcement personnel.

In general, state and local officials told us that they were satisfied with the assistance they receive from NHTSA. Officials we interviewed in 11 of the 16 states we covered noted that NHTSA efforts—including guidance, outreach, and training—were helpful.

⁸⁹DOT, like all federal agencies, is prohibited from lobbying using appropriated funds without express congressional authorization. In addition, under 23 U.S.C. § 402(c), no state highway safety program may be approved by the Secretary if it requires the state to adopt or enforce adult safety helmet requirements.

NHTSA's Motorcyclist Safety Grants May Only Be Used for Training and Motorist Awareness Strategies

Although NHTSA provides funding to states through the Motorcyclist Safety Grant Program, the funding can only be used for limited purposes. As noted previously, this program, established under SAFETEA-LU, provides grants to states that can be used to support (1) motorcyclist training and (2) motorist awareness efforts. Specifically, states can use grant program funds to improve training curricula, deliver training, and recruit or retain motorcycle safety instructors, as well as for public awareness and outreach programs to improve motorist awareness. The new surface transportation legislation, MAP-21, continued the program with similar requirements, but at a reduced annual amount. States were awarded a total of \$45.9 million from fiscal years 2006 through 2012, including \$7 million in both fiscal years 2011 and 2012.⁹⁰ The funding awarded to individual states during these fiscal years ranged from \$100,000 to just over \$500,000, although most states were awarded from \$100,000 to \$200,000. Under MAP-21, the total grant amount exclusively authorized for motorcycle safety has been reduced by almost 50 percent, to roughly \$4 million annually.

To pursue strategies other than motorcyclist training and motorist awareness, states can use other sources of funding, including other federal grants. In particular, states have used some State and Community Highway Safety Grant Program funds for motorcycle safety efforts and, as noted previously, may continue to do so under MAP-21.⁹¹ According to NHTSA funding data, however, states used a small portion of this grant funding—about \$16.5 million of the total of \$1.13 billion states received (about 1.5 percent)—on motorcycle safety efforts from fiscal years 2006

⁹⁰Originally, \$25 million was authorized under SAFETEA-LU through fiscal year 2009. MAP-21 eliminated individual safety grant programs, including motorcycle safety, and incorporated them together under an overall highway safety program, as National Priority Safety Grants, at 23 U.S.C. § 405. Section 405 provides for a series of grants that are similar to other preexisting individual grant programs. The amounts an individual state received under SAFETEA-LU and that they will receive under MAP-21 are determined by formula and cannot exceed 25 percent of the amount a state receives under the State and Community Highway Safety grant program.

⁹¹See 23 U.S.C. § 402, discussed in footnote 13.

through 2011.⁹² Officials in five states told us that they are reluctant to use State and Community Highway Safety Grant funding within their state for motorcycle safety efforts because allocating such funding for motorcycle safety would reduce the amount available for their state's other highway safety program priorities, such as teen driver safety, aggressive and distracted driving, and safety belt enforcement. Officials in two states noted that competition for the use of these grant funds is rigorous; consequently officials would prefer not to use the moneys to fund some desired motorcycle safety activities, such as training police officers on motorcycle safety issues. Officials in another state indicated that although they do use these grant funds for motorcycle-related enforcement, they must prioritize their limited resources and cannot provide this funding at the level they believe is needed. Officials in one state said the state has elected not to use State and Community Highway Safety Grant funding for programs specifically targeted to motorcyclists.

States may also use state funding to pursue motorcycle safety strategies although this funding can also be limited. Officials in eight states told us that state resource constraints limit the ability to fund motorcycle safety activities in their states. Additionally, officials in two NHTSA regional offices as well as a highway safety association and an association representing state motorcycle-safety agencies told us that limited state funding for motorcycle safety efforts is a problem. In particular, they noted that obtaining funding for enforcement efforts is challenging for states. Some states do have dedicated funding available for motorcycle safety; however, much of this funding is devoted to training. State officials in 13 of the states that we included in our review told us that their motorcycle safety programs receive funding from fees for motorcycle-related registration or licensing, training, or penalties. For example, according to officials in Florida, New Hampshire, and Utah, amounts ranging from \$1 to \$5 from each motorcycle registration are directed toward training programs as well as other motorcycle safety purposes.

⁹²States have also used other NHTSA grant programs for motorcycle safety, such as the Safety Belt Grant Program and the Impaired Driving Program, but to a lesser extent. Based on NHTSA's funding data, states used about \$800,000 of the safety belt grant funds on motorcycle safety from fiscal years 2006 to 2011. States with a primary safety belt law received this funding, which could be used for any other highway safety effort, including motorcycle safety. NHTSA's grant system does not track how states spend Impaired Driving Program funding but, according to NHTSA officials, the amounts used for motorcycle safety are likely even smaller. Under MAP-21, states may also continue to use certain non-motorcycle grant funds for motorcycle safety.

The limitations on spending Motorcyclist Safety Grant funds affect states' ability to pursue a range of strategies or try new approaches to motorcycle safety. GAO has reported on the potential benefits of allowing states more flexibility in using NHTSA's safety incentive grant programs. Specifically, we reported that the structure of highway safety grants since SAFETEA-LU did not always allow states sufficient flexibility to direct funding toward safety priorities as identified in highway safety plans.⁹³ We also reported that flexibility could become a key issue in the future as emerging issues become more critical.⁹⁴

Furthermore, as previously noted, major studies on motorcycle safety issues as well as NHTSA have identified the need for states to approach motorcycle safety with a comprehensive range of strategies. In particular, the highest-priority recommendations of the National Agenda for Motorcycle Safety recently identified by NHTSA recommend a range of strategies states should pursue to improve motorcycle safety. These recommendations include

- using effective strategies to increase use of DOT-compliant helmets,
- improving motorcyclist training and licensing,
- educating police about motorcycle safety issues in order to strengthen enforcement,
- increasing the safety awareness of motorcyclists (including discouraging them from mixing alcohol and other drugs with motorcycling and encouraging them to increase conspicuity), and
- promoting voluntary helmet use.

Guidelines for states on addressing motorcycle safety prepared by NHTSA and the Transportation Research Board also recommend various strategies to address motorcycle safety.⁹⁵ Additionally, both the National

⁹³ GAO, *Traffic Safety: Grants Generally Address Key Safety Issues, Despite State Eligibility and Management Difficulties*, [GAO-08-398](#) (Washington, D.C.: March 2008).

⁹⁴ GAO, *Traffic Safety Programs: Progress, States' Challenges, and Issues for Reauthorization*, [GAO-08-990T](#) (Washington, D.C.: July 16, 2008).

⁹⁵ National Highway Traffic Safety Administration, *Uniform Guidelines for State Highway Safety Programs: Highway Safety Program Guideline No. 3- Motorcycle Safety* (2006); and National Highway Traffic Safety Administration, *Countermeasures That Work, 2011*; Transportation Research Board/National Cooperative Highway Research Program, *NCHRP Report 500: Volume 22: A Guide for Addressing Collisions Involving Motorcycles* (2008).

Transportation Safety Board and CDC have highlighted increasing the use of DOT-compliant helmets as a high priority for saving lives on the nation's highways.⁹⁶

The restrictions in how states can use their motorcyclist safety grants may impede states' ability to fund some motorcycle safety activities they believe are needed. In fiscal year 2013 budget estimates, NHTSA proposed amending the Motorcyclist Safety Grant Program to provide states additional flexibility. Specifically, NHTSA proposed amending the program so that states could use these funds to promote the use of DOT-compliant motorcycle helmets, increase efforts to reduce impaired riding, and reduce the number of improperly licensed motorcyclists. According to a NHTSA official, expanding the possible uses for the grants would allow states to develop and implement additional countermeasures specific to the motorcycle safety-related problems in their states. Officials we interviewed in 14 of the 16 states said that the grant program is too restrictive. State officials cited a variety of activities that they would enhance or undertake in order to improve motorcycle safety in their state if they could use the grant funding for those purposes. These include activities related to enforcement as well as alcohol impairment, training law enforcement officers, increasing safety awareness through outreach to motorcyclists,⁹⁷ enforcing the use of compliant helmets, and promoting voluntary helmet use. One state with a universal helmet law explained that the state needs more funding to train police officers about motorcycle safety issues, especially how to work with motorcyclists to increase safety awareness or how to recognize non-compliant helmets. According to a highway safety association official, each state's motorcycle safety efforts would benefit greatly from convening a summit of stakeholders to develop a state strategic plan for motorcycle safety, but funding for such an activity is generally not available.

⁹⁶National Transportation Safety Board, *NTSB Most Wanted List: Critical Changes Needed to Save Lives* (2011); U. S Department of Health and Human Services, Centers for Disease Control, National Center for Injury Prevention and Control, *Motorcycle Safety, How to Save Lives and Save Money*, (Atlanta, GA). CDC's report emphasizes universal helmet laws as the only approach proven to be effective in reducing motorcycle fatalities.

⁹⁷The types of motorcyclist outreach efforts envisioned by state officials included those emphasizing the importance of riding unimpaired and of wearing safety gear and conspicuous clothing, accomplished through various mechanisms such as conferences, bumper stickers, or public service announcements.

NHTSA Has Conducted Some Studies on Motorcycle Safety Strategies, but Gaps Exist

NHTSA has conducted motorcycle safety research on various topics and has used the results to provide states and others with information on factors that contribute to motorcycle crashes and fatalities, the effectiveness of existing strategies, and new strategies that may have potential to improve motorcycle safety. Funding allocated to motorcycle safety research from fiscal years 2007 to 2012 totaled \$7.3 million, of which \$2.5 million was for research conducted in fiscal year 2012.⁹⁸ Conducting research is part of NHTSA's overall mission. According to NHTSA officials, states do not have sufficient resources to evaluate the strategies they are using and expecting them to do so is not realistic.

Some of NHTSA's research addresses the factors that contribute to motorcycle crashes and fatalities. In fiscal years 2008 through 2011, NHTSA's research on factors included studies on the effects of alcohol on motorcycle-riding skills and on motorcycle rider braking control behavior, among other topics. One study currently under way—the Instrumented On-Road Study of Motorcycle Riders—will use instrumentation mounted on motorcycles to record information about motorcyclists' riding behaviors, such as acceleration, position in lane, and braking. According to NHTSA officials, participants will also provide information about their attitudes, personality, and risk-taking behaviors before the instrumentation is installed. According to NHTSA officials, this study could result in a broad range of findings that could provide additional information on factors that could contribute to motorcycle crashes and fatalities and possibly identify improvements needed in strategies, such as training, rider conspicuity, road infrastructure, or the design of motorcycles. NHTSA also plans to use this information to determine relationships between riders' attitudes and crash involvement as well as other riding behaviors. NHTSA expects to complete this study in the fall of 2015.

Other NHTSA research focuses on strategies that states currently use or on new strategies being considered. In fiscal years 2008 through 2011, NHTSA's research on strategies included a study on youth motorcycle-related brain injury by helmet law type, an expert panel on evaluating motorcycle training and a demonstration program to educate motorcyclists about the dangers associated with operating a motorcycle

⁹⁸These funds came out of NHTSA's behavioral safety research budget, which totaled \$9.9 million in fiscal year 2012.

while under the influence of alcohol.⁹⁹ NHTSA's research on strategies in fiscal year 2012 could help to address some of the current limitations in knowledge, discussed previously, about the effectiveness of motorcycle safety strategies that states have used or could use. This research emphasized identifying ways to improve law enforcement efforts, training, licensing, and promotion of helmet use (see table 3). According to NHTSA officials, this research should produce new information about the effectiveness of high visibility enforcement, which NHTSA has identified as a promising strategy. It should also produce new information on an innovative method to increase licensing among motorcyclists that includes outreach to law enforcement and the motorcyclist community. Additionally, NHTSA's research should provide information that may lead to improvements in training for motorcyclists. Finally, NHTSA recently initiated a research project to determine whether there are states without universal helmet-use laws that have higher helmet-use rates than other states without such laws and to identify factors and programs that may be related to higher helmet use in these states. Such information could help identify ways to promote voluntary use of helmets in the 31 states that do not have universal helmet laws.

⁹⁹NHTSA also funded several studies on the effects of daytime running lights (on both motorcycles and motor vehicles) on motorcycle conspicuity. These focused on vehicle-based strategies rather than strategies that could be implemented by states.

Table 3: NHTSA Research and Development on Strategies to Improve Motorcycle Safety, Fiscal Year 2012

Title	Actual or planned completion	Type of strategy studied
Motorcycle High Visibility Enforcement Demonstrations (Partnership with Georgia State Patrol)	Spring 2013	Law enforcement related to alcohol impairment, licensing, and use of DOT-compliant helmets
Study to Improve Crash Avoidance Skills ^a	Winter 2013	Training
Effect of Sight Distance Training on Motorcycle Skills	Winter 2013	Training
Examination of Washington State’s Vehicle Impoundment Law for Motorcycle Endorsements	Winter 2013	Law enforcement related to licensing
Examine the Puerto Rico .02 BAC for Motorcycle Riders	Winter 2013 ^b	Law enforcement related to alcohol impairment
Examination of the Feasibility of Alcohol Interlocks for Motorcycles	Fall 2013	Law enforcement related to alcohol impairment
Demonstration to Increase the Number of Properly Endorsed Motorcyclists (Partnership with Commonwealth of Massachusetts)	Fall 2013	Licensing
High Visibility Impaired Riding Crackdown Demonstration in Four States	Fall 2013	Law enforcement related to alcohol impairment
Study on Influential Factors for Helmet Usage in States Without Universal Helmet Laws	Uncertain ^c	Promotion of voluntary helmet use
The Effect of Entry-Level Motorcycle Rider Training on Motorcycle Crashes	Spring 2015	Training

Source: GAO analysis of NHTSA information.

^aThis study is evaluating the impacts of motorcyclist training over time to assess its effectiveness.

^bAccording to NHTSA officials, this study has been completed, but insufficient data were available to draw meaningful conclusions from the analysis. Consequently, NHTSA does not plan to issue a report.

^cAccording to NHTSA officials, the estimated completion date for this project is uncertain at this time because of the nature of the project and could range from Spring 2013 through Fall 2015.

This research could increase knowledge about which motorcycle safety strategies would be effective or promising for states to use. However, NHTSA has not researched two strategies it has identified as a high priority or promising. In particular, NHTSA has not researched how to encourage motorcyclists to increase their conspicuity to motorists. The agency has identified this strategy as a high priority, based on its recent assessment of the recommendations of the *National Agenda for Motorcycle Safety*. Furthermore, among the high priority *National Agenda for Motorcycle Safety* recommendations identified by NHTSA is a recommendation for the federal government to develop and evaluate a

graduated-licensing model for motorcyclists. Although NHTSA and the American Association of Motor Vehicle Administrators have developed such a model,¹⁰⁰ an evaluation of the model has not been performed. As noted previously, NHTSA considers graduated licensing a promising strategy for improving motorcycle safety.

NHTSA officials pointed out that the agency's highway safety research budget is limited, and the agency must prioritize its investments in research. According to NHTSA officials, they have prioritized their research efforts based on problems identified through crash data and the factors on which the agency can have the most impact. The officials explained that they have not studied how to increase motorcyclists' safety awareness, including encouraging riders to increase their conspicuity, because experience in other highway safety areas has shown the effectiveness of public education alone, without enforcement, to be low.¹⁰¹ Nevertheless, in the report on its prioritization of the National Agenda for Motorcycle Safety recommendations, the agency reported that efforts to increase motorcyclist conspicuity could have an impact if they were well-researched and supported by rider groups.¹⁰² NHTSA officials also explained that they have not evaluated a model graduated-licensing system for motorcyclists because no states are currently using the approach the officials have proposed. They noted that they are considering the possibility of conducting a demonstration project to evaluate such a model-licensing system, but would need to identify a state that would be willing to participate.

As previously noted, some states have expressed concerns about gaps in knowledge regarding the effectiveness of motorcycle safety strategies and have noted that these gaps make it difficult to decide how to target

¹⁰⁰See National Highway Traffic Safety Administration, *A Guideline Document for Motor Vehicle Administrators On Motorcycle Operator Licensing*, 2009.

¹⁰¹Officials also explained that NHTSA has not researched motorist awareness strategies for similar reasons.

¹⁰²National Highway Traffic Safety Administration, *Prioritize Recommendations of the National Agenda for Motorcycle Safety, Final Report* (2010). NHTSA determined the potential impact of motorist awareness campaigns in addressing the problem of multi-vehicle motorcycle crashes to be lower than that of increasing motorcyclist conspicuity, noting that such campaigns share many characteristics of traffic safety communications campaigns that have been found to be ineffective. In particular, they promote a passive message ("be aware") rather than focus on changing behaviors.

constrained resources. While helmet laws have been proved effective in reducing motorcyclist fatalities and NHTSA's current research could help to broaden the range of strategies that are shown to be effective, further research on high priority strategies or promising strategies that have been proved successful in other highway safety areas could help states make more informed choices as they make decisions about what motorcycle safety strategies to pursue.

NHTSA does not have a current comprehensive plan for motorcycle safety to guide its research efforts in this area. In 2007, DOT issued a plan to reduce motorcyclist fatalities that identified research NHTSA had under way as well as research that it planned to conduct in the future. According to NHTSA officials, the 2007 plan is still relevant as they are working on items identified in that plan. They do, however, intend to begin developing a new plan for motorcycle safety in spring 2013. According to NHTSA officials, this plan will cover a range of NHTSA initiatives, including research on motorcycle safety strategies, but NHTSA officials have not yet decided what types of research to include. Given NHTSA's limited resources for research, developing and publishing a new plan provides an opportunity for NHTSA to identify research priorities for motorcycle safety, based on gaps in knowledge about the effectiveness of motorcycle safety strategies and the types of strategies that have been identified as high priorities. NHTSA officials agreed that the new plan provided this opportunity.

Conclusions

Motorcycle crashes can result not only in serious injuries or death but also can impose significant costs that are borne by the victims and their families as well as by society, including the government, employers, private insurers, and healthcare providers. While universal helmet laws are the only strategy proved to be effective in reducing motorcyclist fatalities, such laws can be controversial and it is uncertain whether the number of states with such laws, currently 19, will increase or decrease in the future. It is important that states approach motorcycle safety in a comprehensive manner, in order to address the various factors that contribute to crashes as well as fatalities. By providing states with greater flexibility in how they can use their Motorcyclist Safety Grants, Congress could increase states' ability to pursue the combination of strategies states believe is needed to prevent crashes and reduce fatalities. Furthermore, the gaps in knowledge about the effectiveness of various types of strategies other than universal helmet laws impede states' ability to make informed decisions about what combination of strategies to pursue with their limited resources. NHTSA has researched a variety of

motorcycle safety strategies. Given its limited funding for research, however, NHTSA could better fulfill its role as a leader in identifying strategies states can use to address motorcycle safety by reexamining its research priorities in light of the factors that contribute to crashes and fatalities and gaps in knowledge regarding motorcycle safety strategies. In particular, by focusing on researching high priority and promising strategies that it has identified, NHTSA could better assist states in targeting their resources and prioritizing their efforts to improve motorcycle safety.

Matter for Congressional Consideration

In order to provide states with greater flexibility to pursue a range of strategies to address the various factors contributing to motorcycle crashes and fatalities, Congress should consider allowing states to use the Motorcyclist Safety Grants for purposes beyond motorcyclist training and raising motorist awareness of motorcycles.

Recommendations

To provide the states with information that could better enable them to effectively address the factors that contribute to motorcycle crashes and fatalities, NHTSA should

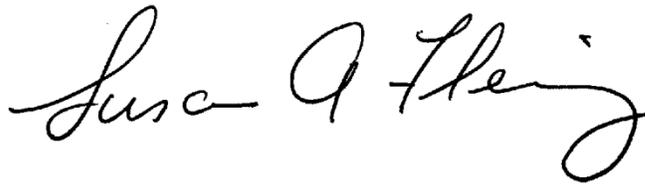
- as part of its expected comprehensive plan for motorcycle safety, identify research priorities that address these factors as well as gaps in knowledge about the effectiveness of state strategies, particularly those that it has identified as a high priority or promising.
- in addition to setting these research priorities, conduct research on the following strategies that it has identified as a high priority or promising:
 - encouraging motorcyclists to increase their conspicuity, and
 - implementing a graduated-licensing model for motorcyclists.

Agency Comments

We provided a draft of this report to DOT for review and comment. DOT officials agreed to consider our recommendations and provided technical comments, which we incorporated as appropriate. DOT also noted that, while additional research focus by NHTSA on motorcycle safety strategies may be useful in the future, state universal helmet laws are the one strategy that has been proved to be effective in saving lives, as stated in our report.

We are sending copies of this report to interested congressional committees and the Secretary of Transportation. In addition, this report will be available at no charge on GAO's Web site at <http://www.gao.gov>.

If you or your staff have any questions about this report, please contact me at (202) 512-2834 or flemings@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made major contributions to this report are listed in appendix II.

A handwritten signature in black ink that reads "Susan Fleming". The signature is written in a cursive style with a large, looping 'S' and 'F'.

Susan Fleming
Director, Physical Infrastructure Issues

Appendix I: Scope and Methodology

This report addresses: 1) what is known about the costs of motorcycle crashes; 2) the factors that contribute to motorcycle crashes, and to fatalities when crashes occur, and strategies states are pursuing to address these factors; and 3) the extent to which NHTSA assists states in pursuing strategies that address these factors.

To determine what is known about the costs of motorcycle crashes we reviewed research related to the costs of these crashes, including the amount and types of costs they impose and who pays them. We included studies authored or provided to us by federal and state agencies and independent research organizations that we interviewed and other relevant studies on this topic published in the last 10 years. In some cases, we also included studies published more than 10 years ago when there was limited or no research about that topic in the last 10 years. Because existing estimates were either for vehicles as a whole or only covered specific types of motorcycle crash costs, we developed an estimate of the total direct measureable costs specifically for motorcycle crashes in 2010. To arrive at this estimate, we used data developed in a 2002 National Highway Traffic Safety Administration (NHTSA) study, which provided estimates of direct measurable costs of all motor vehicle crashes in 2000 for each of nine cost categories across various levels of crash severity.¹ These categories include medical costs, costs associated with emergency services, loss in market productivity and household productivity, insurance administration, legal, travel delay, property damage, and workplace costs. We reviewed NHTSA's methodology for calculating costs and decided to use NHTSA's cost estimates for our purposes because they provide the most detailed estimates of crash costs using the most comprehensive data and are used by the Centers for Disease Control and Prevention (CDC) and others to develop and report on crash costs.

Specifically, to develop our 2010 motorcycle safety cost estimate, we first updated NHTSA's 2000 cost estimates for all motor vehicles to 2010 values by adjusting for inflation using the Bureau of Labor and Statistics'

¹L. Blincoe et al, *The Economic Impact of Motor Vehicle Crashes, 2000* (Washington, D.C.: National Highway Traffic Safety Administration, 2002).

consumer price index.² Subsequently, to estimate the costs attributable solely to motorcycle crashes, we applied these updated motor vehicle crash cost estimates to NHTSA's 2010 data on motorcycle crashes. We obtained the number of fatal motorcycle crashes from NHTSA's Fatality Analysis Reporting System (FARS) dataset and obtained the number of property-damage-only crashes and other non-fatal crashes from NHTSA's General Estimates System data.³ To estimate the number of non-fatal crashes by injury severity, we constructed an injury profile of these non-fatal crashes based on findings from NHTSA's 2009 report on helmet use and head and facial injuries;⁴ the constructed injury profile from that report contains the proportion of non-fatal crashes in various injury severity categories for non-fatal crashes, based on the maximum abbreviated injury scale.⁵ This allowed us to estimate the number of non-fatal crashes by level of injury severity in 2010. The number of fatal motorcycle crashes, property-damage crashes and non-fatal crashes by injury severity were multiplied by their specific average per-person costs (in 2010 dollars), and aggregated to yield the total direct measureable cost of motorcycle crashes. To check for consistency, we compared various components of costs that are also covered in other existing estimates identified in our literature review as these estimates might apply to some specific costs such as medical costs. We also adjusted for the time periods under consideration because these existing estimates might be based on data from time periods different from ours.

²This estimate inflates the medical costs estimated in the 2002 study by the general consumer price index rather than the one for medical costs. According to researchers in NHTSA and the Pacific Institute for Research and Evaluation who have conducted analyses of crash costs, even though the medical costs in general have risen faster than the consumer price index, due to both improvements in injury management and data collection, the medical costs for crashes have likely not risen as fast as the economy-wide rise in medical costs. Therefore, for our primary analysis, we use the general consumer price index to adjust the 2000 costs estimates to 2010 levels. However, one researcher told us that the same dollar figure used in 2000 may be the best representation of medical costs for these crashes today—that is, *without any adjustment for inflation*.

³NHTSA's General Estimates System is part of its National Automotive Sampling System database. The data comes from a nationally representative sample of police-reported motor vehicle crashes of all types, from minor to fatal.

⁴NHTSA (2009), *Motorcycle Helmet Use and Head and Facial Injuries: Crash Outcomes in CODES-Linked Data*. The report evaluated combined data from 18 states on 89,086 motorcycle crashes and 104,472 motorcyclists between 2003 and 2005.

⁵The maximum abbreviated injury score represents the maximum injury severity level experienced by the victim and ranges from 0, for no injury, to 5, for critical injury.

Our cost analysis uses the following assumptions and has the following limitations:

- We assumed that the injury profile of motorcyclists did not change for non-fatal crashes from the 2003–05 period to 2010.
- We assumed the average severity of a particular injury category based on the maximum abbreviated injury scale score is the same for both motorcyclists and other motor vehicle crash victims. However, motorcycle crash victims often suffer very different injuries from other motor vehicle crash victims. As a result, the consequence and treatment costs could vary significantly even if the resulting injuries had the same score⁶
- The abbreviated injury scale scores used in the NHTSA report are not always accurate predictors of long-term injury outcomes. Some injuries with low scores, such as lower extremity injuries, can actually result in serious and expensive long-term outcomes.
 - The analysis also implicitly assumes that the distribution of costs across the category types stayed constant from 2002 to 2010. We thus assume all cost components grew at the same rate as the general consumer price index.
 - The analysis does not include costs of unreported crashes and environmental costs, because those data were not available.
 - The analysis does not include other difficult to quantify costs such as longer term costs of treatment and intangible costs associated with emotional pain and suffering.

To identify the factors that contribute to motorcycle crashes and fatalities and strategies that states are pursuing to address these factors, we interviewed NHTSA, the Federal Highway Administration (FHWA), CDC, the National Transportation Safety Board (NTSB), and key stakeholder organizations involved in motorcycle safety, including the Motorcycle Safety Foundation, the Insurance Institute for Highway Safety (IIHS), the American Association of State Highway and Transportation Officials, the American Association of Motor Vehicle Administrators, Governors Highway Safety Association, the National Association of State Motorcycle

⁶ For example, a motorcycle crash victim may suffer a brain injury, and a motor vehicle crash victim may suffer a back injury. While both victims' injuries might have the same injury severity score and the same assumed severity, in reality, the medical costs of treating a brain injury could be higher than treating a back injury of similar severity. As a result, our estimates of the total costs of motorcycle crashes would underestimate the true direct measurable costs.

Safety Administrators, and the American Motorcyclist Association. Furthermore, we conducted interviews with and reviewed documentation from the state agencies that have lead responsibility for motorcycle safety, generally the Highway Safety Office, in the following 16 states: Arizona, California, Colorado, Florida, Idaho, Iowa, Maryland, Mississippi, Missouri, New Hampshire, New Jersey, New York, Texas, Utah, Washington and Wisconsin. We selected states representing a range of fatality rates, varying types of motorcycle safety laws and policies, varying levels of ridership, and that are geographically diverse. For five of these states—Florida, Iowa, Maryland, Texas, and Wisconsin—we interviewed additional agencies and organizations responsible for motorcycle safety, including the applicable NHTSA region, state agencies responsible for motorcycle licensing and training; state and local law enforcement agencies; and motorcycle advocacy groups.⁷

In addition, we conducted a literature review to obtain information on the factors that contribute to motorcycle crashes and fatalities as well as to determine the extent of knowledge about the effectiveness of motorcycle safety strategies used by states. We identified studies for our review through a search of numerous bibliographic data bases (including searched EMBASE, SocialSciSearch, SciSearch, MEDLINE, ProQuest, Transportation Research International Documentation, BIOSIS, and National Technical Information Service); interviews with NHTSA, the FHWA, CDC, NTSB, the Motorcycle Safety Foundation, and IIHS; and bibliographic references in NHTSA's *Countermeasures that Work* report, as well as other documents reviewed. From this search, we screened the identified studies for relevance to our report and selected studies that met the following criteria: (1) conducted in the U.S., (2) peer-reviewed as well as by or for federal or state agencies, (3) included an original analysis of data, and (4) published in the last 10 years. In order to assess the effectiveness of motorcycle helmet laws, we also considered studies published more than 10 years ago because many changes in helmet laws occurred and were evaluated more than 10 years ago. In some cases, for other strategies we also included studies published more than 10 years ago when there was limited or no research about that strategy in the last 10 years. In such cases, we considered the extent to which factors may have changed over time that could affect the relevance of their findings.

⁷We did not include states' motorcycle safety efforts related to road infrastructure or emergency response in our review. Also, we were unable to schedule an interview with an advocacy group in Maryland and law enforcement officials in Texas and Florida.

In addition, for motorcycle helmet laws, we limited studies to those including the entire U.S. population (and met the criteria listed above). This was done in part to limit the scope to larger studies that provided more power to detect effects of helmet laws while controlling for other important factors.

Furthermore, for studies of the factors associated with motorcycle crashes and fatalities, we restricted our review to studies that addressed either crashes or fatalities. For studies of the effectiveness of strategies, we restricted our formal review to studies that met the following criteria: (1) examined the effectiveness of motorcycle safety strategies covered in our review⁸ (2) addressed either motorcycle crashes or motorcyclist fatalities as an outcome: and (3) used an experimental (e.g., randomization of individuals or communities to receive the program) or quasi-experimental design (e.g., statistically controlling for individual, community, or state exposure to the program policy) to evaluate the effects of the strategy. Out of the 117 studies we screened, we identified 20 studies that met these screening criteria, including 18 studies of motorcycle safety strategies. Each of these studies was evaluated for relevance and reviewed by social science specialists to ensure that any findings presented reflected the methodological approaches and limitations of each study.

Finally, to identify characteristics of crashes we reviewed NHTSA reports covering calendar years 1991 through 2010 based on their analyses of data from their FARS database. To identify characteristics that were not available in NHTSA's published reports (primarily from 2010 FARS data), we analyzed data on vehicle fatalities from FARS and data on vehicle registrations from the FHWA. We reviewed existing documentation about the data and interviewed officials knowledgeable about the data and their limitations in order to assess the extent which the data are accurate and complete. In addition, we conducted data comparisons, logic tests, and tests for missing data and errors. We estimated missing blood alcohol concentration (BAC) test results using NHTSA's method of multiple

⁸We covered the following strategies in our review: licensing, training, enforcement of alcohol impairment and speeding laws, efforts to increase motorcyclist safety awareness, efforts to increase motorist awareness of motorcyclists, helmet laws, enforcement of use of DOT-compliant helmets, and promotion of helmet use. These strategies are generally aimed at changing the behavior of motorcyclists and motorists. We did not include strategies related to road infrastructure, emergency response, or vehicle safety.

imputation.⁹ We found FARS data, vehicle registration data, and NHTSA's published reports to be sufficiently reliable for our purposes.

To determine the extent to which NHTSA assists states in pursuing strategies that address the factors that contribute to motorcycle crashes and fatalities, we reviewed the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users¹⁰ and the Moving Ahead for Progress in the 21st Century Act¹¹ and relevant portions of the United States Code to determine NHTSA's responsibilities and authority related to motorcycle safety. We also reviewed reports, studies, and other documentation and interviewed officials in NHTSA headquarters and regional offices to determine what NHTSA has done to assist states to identify and promote motorcycle safety strategies for use by states. We also analyzed data on Motorcyclist Safety Grant funds awarded to states¹² and interviewed state officials from states in our selection to determine how and the extent to which they have used the Motorcycle Safety and other grant programs to address motorcycle safety and challenges they have faced in using the grants. We also reviewed information on NHTSA's research and development related to motorcycle safety for the last 5 years to identify the extent to which they addressed factors that contribute to crashes and fatalities and strategies to address those factors. In addition, we interviewed the stakeholder groups cited above and state officials in the 16 states we selected to obtain their views on NHTSA's efforts. Finally, we reviewed key reports on motorcycle safety, such as reports by the Transportation Research Board, and the Motorcycle Safety Foundation, and pertinent GAO reports, as well as NTSB recommendations, in evaluating NHTSA's efforts. We limited our work to NHTSA's efforts to identify and promote motorcycle safety strategies for states to use and did not cover other NHTSA motorcycle

⁹ When the alcohol test results are unknown, BAC values have been assigned to drivers and non-occupants involved in fatal crashes, using NHTSA's method of multiple imputation that was revised in 2002 (NHTSA Technical Report DOT HS 809 403, *Transitioning to Multiple Imputation: A New Method to Estimate Missing Blood Alcohol Concentration (BAC) Values in FARS.*)

¹⁰Pub. L. No. 109-59, 119 Stat. 1144 (2005).

¹¹Pub. L. No. 112-141, 126 Stat 405 (2012).

¹²SAFETEA-LU established a Motorcyclist Safety grant program, also known as the Section 2010 grant program. MAP-21 eliminated individual safety grant programs, including Section 2010, but established a National Priority Safety Program, which among other things includes provisions for motorcycle safety grants.

safety efforts, such as data collection, research on vehicle safety, or helmet standards.

We conducted this performance audit from October 2011 to November 2012 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient and appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Appendix II: GAO Contact and Staff Acknowledgments

GAO Contact

Susan Fleming, (202) 512-2834 or flemings@gao.gov

Staff Acknowledgments

In addition to the contact named above, Judy Williams-Tapia (Assistant Director), Namita Bhatia-Sabharwal, Leia Dickerson, Sharon Dyer, Lorraine Ettaro, Lynn Filla-Clark, Bert Japikse, Terence Lam, Janet Lee, Stephanie Purcell, and Amy Rosewarne made important contributions to this report.

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