DEPARTMENT OF TRANSPORTATION

National Highway Traffic Safety Administration

49 CFR Part 571

[Docket No. NHTSA–2022–0079]

RIN 2127–AM50

Advanced Impaired Driving Prevention Technology

AGENCY: National Highway Traffic Safety Administration (NHTSA), Department of Transportation.

ACTION: Advance notice of proposed rulemaking.

SUMMARY: This document initiates rulemaking that would gather the information necessary to develop performance requirements and require that new passenger motor vehicles be equipped with advanced drunk and impaired driving prevention technology through a new Federal Motor Vehicle Safety Standard (FMVSS). In this document, NHTSA presents its various activities related to preventing drunk and impaired driving and discusses the current state of advanced impaired driving technology. NHTSA also asks many questions to gather the information necessary to develop a notice of proposed rulemaking on advanced drunk and impaired driving technology.

DATES: Comments should be submitted no later than March 5, 2024.

ADDRESSES: You may submit comments to the docket number identified in the heading of this document by any of the following methods:

• *Federal eRulemaking Portal:* Go to *https://www.regulations.gov.* Follow the online instructions for submitting comments.

• *Mail: Docket Management Facility:* U.S. Department of Transportation, 1200 New Jersey Avenue SE, West Building Ground Floor, Room W12–140, Washington, DC 20590–0001.

• *Hand Delivery or Courier:* 1200 New Jersey Avenue SE, West Building Ground Floor, Room W12–140, between 9 a.m. and 5 p.m. ET, Monday through Friday, except Federal holidays.

• *Fax:* 202–493–2251.

Instructions: All submissions must include the agency name and docket number. Note that all comments received will be posted without change to *http://www.regulations.gov,* including any personal information provided. Please see the Privacy Act discussion below. NHTSA will consider all comments received before the close of business on the comment closing date indicated above. To the extent possible, the agency will also consider comments filed after the closing date.

Docket: For access to the docket to read background documents or comments received, go to *https://www.regulations.gov* at any time or to 1200 New Jersey Avenue SE, West Building Ground Floor, Room W12–140, Washington, DC 20590, between 9 a.m. and 5 p.m., Monday through Friday, except Federal Holidays. Telephone: 202–366–9826. Confidential Business Information: If you wish to submit any information under a claim of confidentiality, submit these materials to NHTSA's Office of the Chief Counsel in accordance with 49 CFR part 512. All requests for confidential treatment must be submitted directly to the Office of the Chief Counsel. NHTSA is currently treating electronic submission as an acceptable method for submitting confidential business information to the agency under part 512. If you claim that any of the information or documents provided in your response constitutes confidential business information within the meaning of 5 U.S.C. 552(b)(4), or are protected from disclosure pursuant to 18 U.S.C. 1905, you may submit your request via email to Dan Rabinovitz in the Office of the Chief Counsel at *Daniel.Rabinovitz@dot.gov.* Do not send a hardcopy of a request for confidential treatment to NHTSA's headquarters.

FOR FURTHER INFORMATION CONTACT: Ms. Chontyce Pointer, Office of Crash Avoidance Standards, Telephone: 202–366–2987, Ms. Sara R. Bennett, Telephone: 202–366–7304 or Mr. Eli Wachtel, Telephone: 202–366–3065, Office of Chief Counsel. Address: National Highway Traffic Safety Administration, 1200 New Jersey Avenue SE, Washington, DC 20590.

SUPPLEMENTARY INFORMATION:

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I. Executive Summary

Alcohol-impaired driving [1] is a major cause of crashes and fatalities on America's roadways. The National Highway Traffic Safety Administration (NHTSA) has been actively involved in addressing alcohol-impaired driving since the 1970s. Recent developments in vehicle technology present new opportunities to further reduce drunk and impaired driving crashes and fatalities or eliminate them altogether. Private and public researchers have also made significant progress on technologies that are capable of measuring and quantifying driver state and performance (*e.g.,* hands on the steering wheel, visual gaze direction, lane position). However, harnessing these technologies for drunk and impaired driving detection and prevention remains a significant challenge. NHTSA's information gathering and research efforts have found that several technologies show promise for detecting various states of impairment, which for the purposes of this document are alcohol, drowsiness, and distraction. However, technological challenges, such as distinguishing between different impairment states, avoiding false positives, and determining appropriate prevention countermeasures, remain. Due to technology immaturity and a lack of testing protocols, drugged driving is not being considered in this advance notice of proposed rulemaking.

The Infrastructure Investment and Jobs Act (Bipartisan Infrastructure Law or BIL) directs NHTSA to issue a final rule establishing a Federal Motor Vehicle Safety Standard (FMVSS) that requires new passenger vehicles to have

[1] This document discusses both drunk driving and alcohol-impaired driving. Drunk driving, as used in this document, is understood to be operating a vehicle at or above the threshold of alcohol concentration in the blood established by law. Alcohol-impaired driving describes the entire set of impairments of various driving-related skills and can occur at lower concentrations of alcohol.

''advanced drunk and impaired driving prevention technology'' by 2024.[2] The BIL also provides that an FMVSS should be issued only if it meets the requirements of the National Traffic and Motor Vehicle Safety Act. (''Safety Act''). BIL defines the relevant technology as technology that can passively[3] and accurately monitor driver performance to detect impairment or passively and accurately measure driver blood alcohol concentration (BAC) (or both in combination) and prevent or limit vehicle operation if impairment is detected. Given the current state of driver impairment detection technology, NHTSA is issuing this advance notice of proposed rulemaking (ANPRM) to inform a possible future FMVSS that can meet the requirements of the Vehicle Safety Act.

This ANPRM presents a summary of NHTSA's knowledge of alcohol's impact on driver performance and seeks comment on a variety of issues related to the state of development of driver impairment detection technologies. It also sets forth the research and technological advancements necessary to develop a FMVSS for driver impairment. This document also presents three regulatory options for how the agency might mitigate driver impairment: blood alcohol content detection, impairment-detection (driver monitoring), or a combination of the two.

II. Introduction

Driver impairment, as used in reference to motor vehicle safety, is a broad term that could encompass many different driver states that present operational safety risks.[4] There is no clear and consistent engineering or industry definition of ''impairment.'' ''Impaired'' can mean anything that diminishes a person's ability to perform driving tasks and increases the likelihood of a crash. Considering this, driver impairment would include drunk and drugged driving,[5] but it could also include drowsy driving, distracted driving,[6] driving while experiencing an incapacitating medical emergency or condition, or any other factor that would diminish driver performance and increase potential crash risk. All these driver states present operational safety risks, and each presents differing problem sizes and degrees of risk, underlying causes, states of research, data demonstrating risks from that driver state, and potential vehicle technological countermeasures that could resolve or mitigate resulting operational safety risks. Additionally, not all states of driver impairment are immediately redressable, meaning that while a vehicle safety system might help a distracted or drowsy person pay attention again, it may not help a driver be less alcohol- or drug-impaired. This difference among the driver impairment states is particularly important when considering what type of standard or countermeasure would be the most appropriate.

The negative economic and societal impacts related to impaired driving are enormous and devastating in the United States. Recent NHTSA research has identified the scope of causal factors associated with fatal and non-fatal injuries in crashes, revealing key differences among outcomes associated with reported contributory factors versus estimated causal factors.[7] NHTSA estimates here that in 2021: approximately 12,600 traffic fatalities were ''caused by alcohol impairment,'' versus approximately 13,400 fatalities ''involving alcohol;'' 12,400 fatalities were ''due to distraction''[8], but and drowsy driving led to at least 684 fatalities. Differences in values associated with reported contributory factors versus causal factors are driven by offsetting forces; underreporting is a predominant issue for estimates of fatalities and injuries caused by distraction and possibly drowsy driving, while at least some fatalities and non-fatal injuries associated with alcohol and distraction likely had other causal factors. The enormous safety potential of addressing the three states of impaired driving considered here impels NHTSA's activities relating to driver impairment.

With respect to alcohol impairment, NHTSA has been conducting behavioral research and implementing behavioral safety strategies and programs, public education, and enforcement campaigns to combat drunk driving. Despite these efforts, which have contributed to significant declines in fatalities over the past several decades, drunk driving remains a significant safety risk for the public. NHTSA is also engaged in technology-based research. This includes better understanding of the technological capabilities that measure drivers' eye movements and vehicle inputs. In addition, through the Driver Alcohol Detection System for Safety (DADSS) program, NHTSA is actively involved in cutting-edge research to help develop technology to quickly, accurately, and passively[9] detect a driver's BAC. Upon completion of this development work, this technology may prevent drivers from shifting their vehicles into gear if they attempt to operate the vehicle at a BAC above the legal limit. NHTSA believes that the passive DADSS technology, still in development, may be one way to meet the BIL mandate, and that prevention of drunk driving is the best way to reduce the number of crashes and resulting fatalities and injuries that occur due to alcohol-impaired driving.

Concerted efforts by NHTSA, States, and other partners to implement proven strategies generated significant reductions in alcohol-impaired driving fatalities since the 1970s when NHTSA records began; but progress has stalled. Between 2011 and 2020, an average of almost 10,500 people died each year in alcohol-impaired driving crashes. The agency has seen record increases in overall traffic fatalities over the last few years of the COVID–19 pandemic, likely reflecting increases in alcohol- and

[2] Infrastructure Investment and Jobs Act, Public Law 117–58, 135 Stat. 429 section 24220 (2021).

[3] For the purposes of this document, NHTSA uses the term ''passive'' to mean that the system functions without direct action from vehicle occupants. Further information about the use of the term ''passive'' is available in the ''NHTSA's Authority'' section.

[4] Part 392 of the Federal Motor Carrier Safety Regulations prohibits any driver from operating a commercial motor vehicle (CMV) while the driver's ability or alertness is so impaired, or so likely to become impaired, through fatigue, illness, or any other cause, as to make it unsafe for him/her to continue to operate the CMV. In addition, part 392 prohibits drivers from operating a CMV while (1) under the influence of, or using, specified drugs and other substances, and (2) under the influence of, or using, alcohol within specified time and concentration limits. Further, part 392 prohibits drivers from texting or using a hand-held mobile telephone while driving a CMV.

[5] Drugged driving is excluded from the scope and is discussed more in the Introduction, A. ''Background information about impaired driving states'' of this document.

[6] NHTSA has stated that distracted driving includes talking on mobile phones, texting, eating, and other non-driving activities.

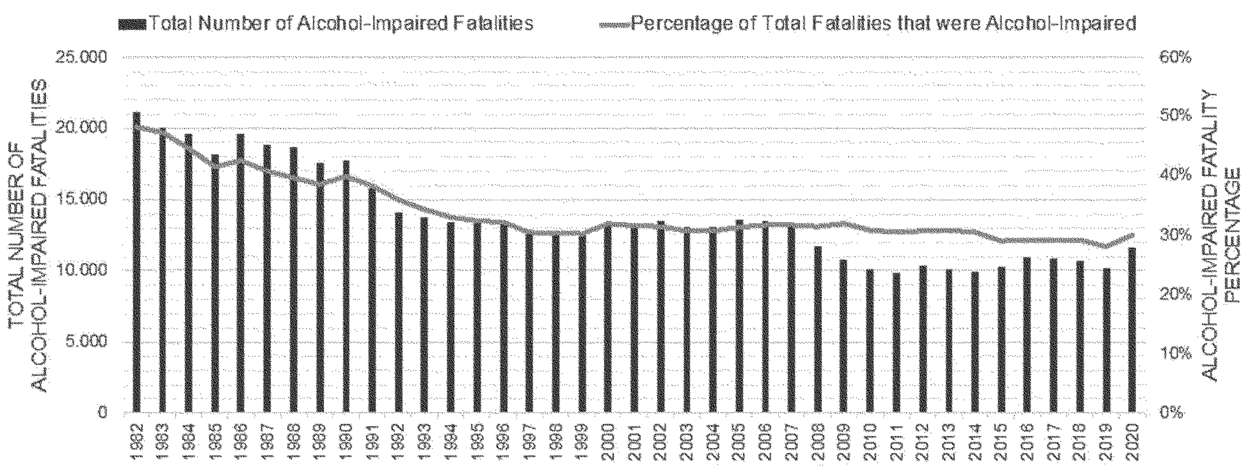
[7] Comprehensive economic costs account for the total societal harm associated with fatalities and injuries, including economic impacts and valuations of lost quality-of-life. *See* Blincoe, L., Miller, T., Wang, J.-S., Swedler, D., Coughlin, T., Lawrence, B., Guo, F., Klauer, S., & Dingus, T. (2023, February). The economic and societal impact of motor vehicle crashes, 2019 (Revised) (Report No. DOT HS 813 403). National Highway Traffic Safety Administration.

[8] Fatalities ''involving reported distraction'' refers to fatalities where a law enforcement officer reported a driver in a fatal crash as having been distracted at the time of the crash, which is associated with underreporting of all crashes, fatalities, and injuries involving and caused by distraction.

[9] The previous DADSS technology requires a directed breath toward a sensor to measure breath alcohol concentration (BrAC). The DADSS research and development effort is continuing to focus on developing technology that does not require a directed breath to detect the presence of alcohol.

drug-impaired driving.[10] While the causes of the recent fatality increases require further study and NHTSA continues to support strategies to change driver behavior, more must be done to reach our goal of zero traffic fatalities. Accordingly, in January 2022, DOT issued its National Roadway Safety Strategy (NRSS) to address the crisis of deaths on the nation's roadways.[11] The NRSS adopts the Safe Systems Approach [12] as the guiding paradigm to address roadway safety and focuses on five key objectives: safer people, safer roads, safer vehicles, safer speeds, and improved post-crash care. The Safe System Approach works by building and reinforcing multiple layers of protection both to prevent crashes from happening in the first place and to minimize the harm to those involved when crashes do occur.[13] Drunk and impaired driving is an NRSS priority.[14] The NRSS's Safe System Approach involves using all available tools, including education, outreach, enforcement, and engineering solutions, including motor vehicle technologies like alcohol, drowsiness, and visual distraction detection systems.[15] Vehicle technologies that can help prevent and mitigate risky behaviors and driver impairment are a key element of the safer vehicles element of this approach. To complement behavioral campaigns, which have reduced, but not eliminated, driving while impaired,[16] NHTSA is considering what technological countermeasures and performance requirements could be applied to motor vehicles that would achieve the NRSS safety objectives. Graph 1 provides an overview of the alcohol-impaired fatalities since the early 1980s.

Graph 1. Alcohol-Impaired Fatality Trend



Addressing each impaired driving state has its own set of unique challenges. For some, such as alcohol, technological solutions are not yet readily available that would consistently prevent a significant proportion of crashes caused by that impaired driving state. For others, such as distraction and drowsiness, there is evidence that police-reported crash data likely underestimate their role in crash causation. Amidst this uncertainty, the agency has many questions that must be answered to develop a proposal that will meet all statutory requirements and Departmental priorities.

Given the breadth of impairment states, severities, detection technologies, and interventions, it is valuable to take this opportunity to clarify the scope of this effort. In view of the larger number of fatalities associated with alcohol impairment and the well-defined legal thresholds and measurements available for alcohol impairment, as compared with other types of impairment, NHTSA is focusing this ANPRM on alcohol impairment.[17] However, based on the language in BIL, NHTSA believes that Congress did not intend to limit NHTSA's efforts under BIL to alcohol impairment. Therefore, while alcohol impairment is the focus, this ANPRM also covers two additional impairment states: drowsy driving and distracted driving. NHTSA chose these states for two reasons. First, the size of the safety problem—in particular that of distracted driving—is immense. Second, certain sensor technologies that have the potential to detect or assist in detecting alcohol impairment and are or can be incorporated into driver monitoring systems (DMS) may also have the potential to detect drowsy and distracted driving. Including these impairment states in this effort therefore presents an opportunity to deliver significant additional safety benefits to the American people. These technological considerations are discussed in greater detail in Section IV. B. "Vehicle Based Countermeasures".

Additionally, it is important to understand the many challenges with trying to identify and prevent the different types of impaired driving with a single performance standard. The agency is interested in learning more from commenters about what technologies and associated metrics might identify multiple types of

[10] Office of Behavioral Safety Research (2021, October). *Continuation of research on traffic safety during the COVID–19 public health emergency: January–June 2021.* (Report No. DOT HS 813 210). National Traffic Safety Administration.

[11] Available at *https://www.transportation.gov/NRSS.*

[12] *https://safety.fhwa.dot.gov/zerodeaths/docs/FHWA_SafeSystem_Brochure_V9_508_200717.pdf.*

[13] United States Department of Transportation (2022, October). What is a safe system. Website: *https://www.transportation.gov/NRSS/SafeSystem.*

[14] It also observes that considerable progress in behavioral research has been made to advance the knowledge and understanding of the physiological effects of both alcohol- and drug-impaired driving.

[15] *Id.* at 16.

[16] Taylor, C.L., Byrne, A., Coppinger, K., Fisher, D., Foreman, C., & Mahavier, K. (2022, June). Synthesis of studies that relate amount of enforcement to magnitude of safety outcomes (Report No. DOT HS 813 274–A). National Highway Traffic Safety Administration.

[17] Meaning that metrics, such as BAC, currently exist to measure the type of impairment.

impaired drivers.[18] Also, as discussed in later sections, one of the options the agency is considering presents challenges with accurately differentiating alcohol impairment from other types of impairment, like drowsiness, assuming differentiation is desired and necessary to select appropriate alerts, warnings, or interventions. In later sections, we discuss different types of impairment that might be identified by a particular technology.

It is also important to be clear here that driving while impaired with drugs other than alcohol (drugged driving) is not within the scope of this ANPRM even though drug impairment is also a significant problem. Many different drugs can affect drivers, and current knowledge about the effects of each on driving performance is limited. Furthermore, the technology and testing protocols for drugs other than alcohol, in the driving context, are not mature enough to indicate the degree of impairment and the risk of crash involvement that results from the use of individual drugs. Therefore, drugged driving is beyond the scope of this rulemaking effort but remains important to the Department and agency as it addresses fatal and serious crashes. The complexities inherent in the drugged driving safety problem are discussed in more detail in the following section.

A. Background Information About Impaired Driving States

Drunk Driving

Alcohol[19] impairment can lead to altered and negative behaviors, as well as physical conditions that increase the risk of unintentional injuries, particularly when driving. Alcohol is known to impair various driving-relevant abilities such as perception, visuomotor coordination, psychomotor performance, information processing and decision making, and attention management.[20] When consumed, alcohol is absorbed from the stomach and distributed by the blood stream throughout the body.[21] BAC is measured as the weight of alcohol in a certain volume of blood and expressed in grams per deciliter (g/dL).[22] The rise and fall of alcohol in the bloodstream (and thus, the BAC) depends on the interplay between various factors that determine the metabolization of alcohol within the person's body including frequency and amount of alcohol consumed, age, gender, body mass, consumption of other food, genetic factors, and time since alcohol consumption.[23]

In the United States, in general, a BAC of .08 g/dL and higher in drivers is defined as legally impaired[24] and a condition for arrest (in Utah, a BAC at or above .05 g/dL is the illegal limit). However, alcohol-impairment of various driving-related skills can occur at lower concentrations, and alcohol-impaired drivers can pose serious injury risks to themselves and others with any amount of alcohol in their bodies. As alcohol BAC levels rise in a person's system, the negative effects on the central nervous system increase.[25] Alcohol affects the body in a way that negatively impacts the skills needed for a person to drive safely because it impairs the function of the brain that relates to thinking, reasoning, and muscle coordination.[26] Table 1 provides an overview of the typical and predictable effects on driving over a range of BAC levels.

TABLE 1—EFFECTS OF ALCOHOL ON DRIVING[27] [28]

Blood alcohol concentration (g/dL)	Typical effects	Predictable effects on driving
.02	• Some loss of judgment • Relaxation • Slight body warmth • Altered mood	• Decline in visual functions (rapid tracking of a moving target). • Decline in ability to perform two tasks at the same time (divided attention).
.05	• Exaggerated behavior • May have loss of small-muscle control (*e.g.,* focusing your eyes). • Impaired judgment • Euphoric feeling • Lowered alertness • Release of inhibition	• Reduced coordination. • Reduced ability to track moving objects. • Difficulty steering. • Reduced response to emergency driving situations.
.08	• Muscle coordination becomes poor (*e.g.,* balance, speech, vision, reaction time, and hearing). • Harder to detect danger • Impaired judgment, self-control, reasoning, and memory.	• Reduced concentration. • Short-term memory loss. • Reduced and erratic speed control. • Reduced information processing capability (*e.g.,* signal detection, visual search). • Impaired perception.
.10	• Clear deterioration of reaction time and control • Slurred speech, poor coordination, and slowed thinking.	• Reduced ability to maintain lane position and brake appropriately.
.15	• Far less muscle control than normal • Vomiting may occur (unless this level is reached slowly or a person has developed a high tolerance for alcohol).	• Substantial impairment in vehicle control, attention to driving task, and in necessary visual and auditory information processing.

[18] The realization of additional safety benefits may depend on the performance requirements chosen by NHTSA, or the technological solution deployed by manufacturers.

[19] The term *alcohol* in this report refers to ethyl alcohol, or ethanol, which is the principal ingredient in alcoholic drinks and the substance measured to determine blood alcohol concentration.

[20] Moskowitz, H., & Burns, M. (1990). Effects of alcohol on driving performance. *Alcohol Health & Research World,* 14(1), 12–15.

[21] Paton, A. (2005). Alcohol in the body. *BMJ,* 330(7482), 85–87.

[22] National Highway Traffic Safety Administration. (2016). The ABCs of BAC: A guide to understanding blood alcohol concentration and alcohol impairment. Retrieved from *https://www.nhtsa.gov/document/theabcsofbac.*

[23] Zakhari, S. (2006). Overview: how is alcohol metabolized by the body? *Alcohol research & health,* 29(4), 245.

[24] 23 U.S.C. 163.

[25] *https://www.nhtsa.gov/risky-driving/drunk-driving#the-issue-alcohol-effects.*

[26] *https://www.nhtsa.gov/risky-driving/drunk-driving#:~:text=Alcohol%20is%20a%20substance%20that,the%20central%20nervous%20system%20increase.*

TABLE 1—EFFECTS OF ALCOHOL ON DRIVING [27] [28]—Continued

Blood alcohol concentration (g/dL)	Typical effects	Predictable effects on driving
	• Significant loss of balance.	

The driving skill decrements in Table 1 provide a means of approximating the impairment correlated with BAC levels. However, BAC is a measure of the amount of alcohol in the bloodstream rather than a reliable indicator of the degree of impairment.[29] [30] At least two factors contribute to the lack of a precise one-to-one correlation between BAC and impairment. First, regular drinkers may learn strategies for more cautious driving to compensate for their perceived skill decrements.[31] [32] Second, there is also empirical evidence that some regular drinkers develop a higher tolerance to alcohol, which results in less apparent declines in cognitive and motor performance after consuming low to moderate doses.[33] Therefore, BAC levels provide an imperfect measurement of probable impairment. Nearly two thirds of all alcohol-impaired fatalities involve high blood alcohol levels with a BAC level at or greater than 0.15 g/dL.[34] Yet even a small amount of alcohol can affect an individual's driving ability. In 2020, there were 2,041 people killed in alcohol-related crashes where a driver had a BAC level of .01 to .07 g/dL.

State alcohol impairment laws and alcohol detection devices focus on measuring the alcohol concentration in BAC and breath alcohol concentration (BrAC). These are the two measurements that State laws and alcohol detection devices utilize to determine whether someone is considered driving over the legal limit (*i.e.,* whether the person can be considered driving drunk, with ''drunk'' being defined as above the threshold of alcohol concentration established by law). BrAC is measured with a breath test device that measures the amount of alcohol in a driver's breath. BAC is usually measured via a blood test. Technology is under development that would allow for measurement in new ways. For example, one technology uses touch- or tissue-based detection of light absorption at pre-selected wavelengths from a beam of light reflected from within the skin tissue after an optical module is touched. In other words, BAC is calculated either by a blood test or, in the future, after someone touches a sensor and that sensor calculates the BAC level in the person's blood. NHTSA acknowledges that people may be affected by alcohol at levels below the legal limit used in most States (.08 g/dL), which is why the agency noted above that there are still crashes where alcohol is involved, but the driver's BAC was lower than the legal limit. NHTSA discusses each of these measurements and the vehicle technologies that can measure them later in this document.

Drugged Driving

Drugged driving, though important to prevent, is not included in the scope of this advance notice of proposed rulemaking. There are several complexities to understanding drugged or drug-involved driving.[35] To begin, the term drugs can refer to over-the-counter medications, prescription medications, and illicit drugs. Also, the mere presence of a drug in a person's system does not necessarily indicate impairment. Currently, most information collected on drugs within the driving context can provide information only on whether a driver is ''drug positive.'' [36] The presence of some drugs can remain in the body a considerable time after use, so presence at any point does not necessarily mean the person was or remains impaired by the drug.[37] For some drivers, certain prescribed medications, which may be included in a positive drug test result, may be necessary for safe driving.

Further, there are a wide range of drugs other than alcohol that can be used by drivers. There is limited research on crash risk and how each specific drug affects driving related skills, and the technology and testing protocols are not mature in the driving context. Today's knowledge about the effects of any drug other than alcohol on driving performance remains insufficient to draw connections between their use, driving performance, and crash risk.[38]

Recently, more research has been directed to the effects of cannabis, and specifically Tetrahydrocannabinol (THC), the active component of cannabis that can cause impairing effects on driving that might lend themselves to the development of THC-impaired driving detection techniques, like those that have been developed by NHTSA for use by law enforcement for alcohol-impaired driving.[39] [40] However, many of these effects may also be caused by alcohol, other drugs, and other impairment states like distraction, drowsiness, and incapacitation. Current knowledge about the effects of cannabis on driving is insufficient to allow specification of a simple measure of

[27] Table 1 should be used as a reference point for population-level analysis. The outlined effects may apply to certain individuals, but for the reasons discussed above, may vary from individual to individual. It should also be noted that while some effects are listed at multiple BACs (*e.g.,* difficulty steering), the effects are more likely to occur and more severe at higher BACs. Information in this table shows the BAC level at which the effect usually is first observed.

[28] Adapted from National Highway Traffic Safety Administration. (2016). The ABCs of BAC: A guide to understanding blood alcohol concentration and alcohol impairment. Retrieved from *https://www.nhtsa.gov/document/theabcsofbac.*

[29] Fillmore, M.T., & Vogel-Sprott, M.J.A.C. (1998). Behavioral impairment under alcohol: cognitive and pharmacokinetic factors. *Alcoholism: Clinical and experimental research,* 22(7), 1476–1482.

[30] Nicholson, M.E., Wang, M., Airhihenbuwa, C.O., Mahoney, B.S., Christina, R., & Maney, D.W. (1992a). Variability in behavioral impairment involved in the rising and falling BAC curve. *Journal of Studies on Alcohol,* 53(4), 349–356.

[31] Burian, S.E., Hensberry, R., & Liguori, A. (2003). Differential effects of alcohol and alcohol expectancy on risk-taking during simulated driving. *Human Psychopharmacology: Clinical and Experimental,* 18(3), 175–184.

[32] Vogel-Sprott, M. (1997). Is behavioral tolerance learned? *Alcohol health and research world,* 21(2), 161.

[33] *Id.*

[34] *https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/813120.*

[35] Berning, A., Smith, R. Drexler, M., Wochinger, K. (2022). Drug Testing and Traffic Safety: What You Need to Know. United States. Department of Transportation. (Report No. DOT HS 813 264). Washington, DC. National Highway Traffic Safety Administration.

[36] ''Drug positive'' indicates that a driver has tested positive for a drug (or drugs). However, testing positive for a drug does not indicate impairment nor any degree of potential impairment.

[37] Berning, et al., 2022.

[38] Compton, R., Vegega, M. Smither, D. (2009). Drug Impaired Driving: Understanding the Problem and Ways to Reduce It. DOT HS 811 268. Washington, DC. NHTSA.

[39] Harris, D.H., Dick, R.A., Casey, A.M., and Jarosz, C.J. (1980) The Visual Detection of Driving While Intoxicated: Field Test of Visual Cues and Detection Methods. DOT–HS–905–620. Washington, DC: NHTSA.

[40] Stuster, J.W. (1997). The Detection of DWI at BACs Below 0.10. (Report No. DOT HS 808 654). Washington, DC: U.S. Department of Transportation, NHTSA.

driving impairment outside of controlled conditions.[41]

Given these challenges, the agency is not yet considering developing performance requirements and a FMVSS for drug impaired driving.

Distracted Driving

NHTSA defines ''driver distraction'' as inattention that occurs when drivers divert their attention away from the driving task to focus on another activity.[42] In general, distractions derive from a variety of sources including electronic devices, such as navigation systems and mobile phones, as well as conventional distractions such as sights or events external to the vehicle, interactions with passengers, and eating or drinking. These distracting tasks can affect drivers in different ways, and can be categorized into the following types:

—*Visual distraction:* Tasks that require or cause the driver to look away from the roadway to visually obtain information.
—*Manual distraction:* Tasks that require or cause the driver to take a hand off the steering wheel and manipulate a device or object.
—*Cognitive distraction:* Tasks that require or cause the driver to divert their mental attention away from the driving task.

Research has shown that eyes-off-road time provides an objective measure of visual distraction, which has a demonstrated relationship with crash risk. Analyses of naturalistic data have shown that eyes-off-road times greater than 2.0 seconds have been shown to increase crash risk at a statistically significant level. Further, the risk of a crash or near-crash event increases rapidly as eyes-off-road time increases above 2.0 seconds.[43] There has been little agreement in the field regarding how to identify and measure cognitive distraction, however.[44]

Distraction can negatively affect driving performance in various ways depending on the type(s) of distraction(s), the demands of the driving task and the secondary task(s), and other factors. These effects can include decrements to reaction time, hazard detection, lateral control (*i.e.,* lane-keeping), and longitudinal control (*e.g.,* speed or following gap), as well as changes to eye movements (*e.g.,* glance patterns, eyes-off-road time), and driver workload.[45 46 47] For example, a meta-analysis aggregating the results of 18 simulator experiments and naturalistic driving studies reported that typing or reading text messages while driving significantly slowed reaction time, increased lane deviations, and increased eyes-off-road time.[48]

These degradations in driving performance due to distraction have been shown to translate into an increased risk of crash or near-crash involvement. An analysis of the second Strategic Highway Research Program (SHRP2) Naturalistic Driving Study[49] found that, when compared to alert and attentive driving, the odds of a crash were doubled when a driver was distracted, with secondary tasks that divert the driver's eyes away from the forward roadway having the largest multiplicative increase in crash risk (*e.g.,* dialing a handheld mobile phone increased crash risk by 12.2x, reading/writing increased crash risk by 9.9x, and reaching for a non-mobile device increased crash risk by 9.1x).[50] A similar study found that the use of handheld mobile phones in general, and specifically performing tasks with visual and manual elements (such as texting), were significantly associated with increased crash involvement.[51]

Outside of naturalistic driving studies, the role of distraction in crashes can be difficult to determine because pre-crash distractions often leave no evidence for law enforcement officers or crash investigators to observe, and drivers are often reluctant to admit to having been distracted prior to a crash. A NHTSA analysis of causal factors for fatal and non-fatal injuries estimates that 29 percent of fatal and non-fatal injuries are due to distraction. This estimate is over three times larger than the police-reported share of fatal crashes involving distraction (8.2% of all traffic fatalities in 2021, as reported in the Fatality Analysis Reporting System (FARS)). The difference between these values reflects the large role that underreporting of distraction plays in identifying distraction as a traffic safety risk. Distraction-affected crashes are a relatively new measure that focuses on distractions that are most likely to influence crash involvement, such as dialing a mobile phone or texting, and distraction by an outside person/event.[52] It is also worth noting that many studies on distracted driving and its consequences were conducted prior to the proliferation of smartphones, navigation apps and devices, and built-in technologies. Consequently, it is possible that distraction-related crashes will escalate as the prevalence, diversity, and use of new technologies continue to increase.

Currently, text messaging is banned for drivers in 48 States, handheld mobile phone use is prohibited in 31 States (*e.g.,* hands-free laws), and 36 States prohibit all mobile phone use by novice drivers.[53] When paired with high visibility enforcement campaigns, mobile phone and text messaging laws were shown to reduce drivers' use of handheld mobile phones in several pilot programs.[54]

Drowsy Driving

Drowsiness is ''the intermediate state between wakefulness and sleep as defined electro-physiologically by the pattern of brain waves (*e.g.,* electroencephalogram—EEG), eye

[41] Compton, R. (2017). Marijuana-Impaired Driving—A Report to Congress. DOT HS 812 440. Washington, DC. NHTSA.

[42] 78 FR 24,817 (proposed April 26, 2013). Visual-Manual NHTSA Driver Distraction Guidelines for In-Vehicle Electronic Devices.

[43] Klauer, S.G., Dingus, T.A., Neale, V.L., Sudweeks, J.D., & Ramsey, D.J. (2006). *The impact of driver inattention on near-crash/crash risk: An analysis using the 100-car naturalistic driving study data* (No. DOT HS 810 594). United States. Department of Transportation. National Highway Traffic Safety Administration.

[44] Young, R. (2012). Cognitive distraction while driving: A critical review of definitions and prevalence in crashes. *SAE International journal of passenger cars-electronic and electrical systems, 5*(2012–01–0967), 326–342.

[45] Regan, M.A., Lee, J.D., & Young, K. (2008). *Driver distraction: Theory, effects, and mitigation.* CRC press.

[46] Young, K. & Regan, M. (2007). Driver distraction: A review of the literature. In: I.J. Faulks, M. Regan, M. Stevenson, J. Brown, A. Porter & J.D. Irwin (Eds.). Distracted driving. Sydney, NSW: Australasian College of Road Safety. Pages 379–405.)

[47] Papantoniou, P., Papadimitriou, E., & Yannis, G. (2017). Review of driving performance parameters critical for distracted driving research. *Transportation research procedia, 25,* 1796–1805.

[48] Caird, J.K., Johnston, K.A., Willness, C.R., Asbridge, M., & Steel, P. (2014). A meta-analysis of the effects of texting on driving. *Accident Analysis & Prevention, 71,* 311–318.

[49] SHRP2 large scale data collection effort. Data were collected from over 3,000 drivers. For more information see: *https://www.fhwa.dot.gov/goshrp2/Solutions/All/NDS/Concept_to_Countermeasure__Research_to_Deployment_Using_the_SHRP2_Safety_Data.*

[50] Dingus, T.A., Guo, F., Lee, S., Antin, J.F., Perez, M., Buchanan-King, M., & Hankey, J. (2016). Driver crash risk factors and prevalence evaluation using naturalistic driving data. *Proceedings of the National Academy of Sciences, 113*(10), 2636–2641.

[51] Owens, J.M., Dingus, T.A., Guo, F., Fang, Y., Perez, M., & McClafferty, J. (2018). *Crash risk of cell phone use while driving: A case-crossover analysis of naturalistic driving data.* AAA Foundation for Traffic Safety. *https://aaafoundation.org/wp-content/uploads/2018/01/CellPhoneCrashRisk_FINAL.pdf.*

[52] NHTSA. (2012). *Blueprint for ending distracted driving* (Report No. DOT HS 811 629). *www.nhtsa.gov/sites/nhtsa.dot.gov/files/811629.pdf.*

[53] *https://www.ghsa.org/state-laws/issues/distracted%20driving.*

[54] Chaudhary, N.K., Casanova-Powell, T.D., Cosgrove, L., Reagan, I., & Williams, A. (2014, March). *Evaluation of NHTSA distracted driving demonstration projects in Connecticut and New York* (Report No. DOT HS 81 635). National Highway Traffic Safety Administration.

movements, and muscle activity.'' [55] Driver drowsiness has a variety of biological contributors, including sleeplessness or sleep deprivation, changes in sleep patterns, untreated sleep disorders, and use of drugs with sedative effects, including alcohol.[56] Driver drowsiness can lead to impairments in cognitive and psychomotor speed, attentional distribution, vigilance, and working memory.[57]

Within the driving context, performance measures that have shown drowsiness-related decrements include lane keeping and lane departures,[58] slower driving speed and decreased speed stability,[59] and longer reaction times.[60] Drowsiness can progress into microsleep and sleep events, in which the driver may experience cognitive and/or visual lapses of increasing duration, posing increasingly serious risks of crash involvement.[61] Situational factors such as increasing time on task and monotony of driving environment can contribute to driver drowsiness.[62]

While driver drowsiness cannot be measured directly, it can be indirectly detected and measured using both objective and subjective measures. Objective measures related to driver drowsiness include physiological signals of brain activity (*e.g.,* EEG, EKG,[63], EOG [64]), other biological markers (*e.g.,* heart rate, respiration, galvanic skin response), measures based on observations of the driver (*e.g.,* head pose, eye closure, blink rate), and vehicle control measures (*e.g.,* steering wheel angle, lane departures, speed variation). Using multiple measures in combination may increase the accuracy and reliability of drowsiness detection.[65]

Among brain activity measures, EEG is most frequently used to measure brain states, including drowsiness.[66] While factors such as individual differences, time of day, and other non-drowsiness related brain activity can be confounding factors, signal markers in EEG data can indicate the presence and degree of drowsiness.[67] While EEG and some other direct brain measures are advancing in their ease of use and portability, they are generally not feasible for in-vehicle use at the present time.

Camera-based-systems, however, are increasingly feasible and common in vehicles. Camera-based systems have the potential to measure a wide array of driver head and face characteristics that may be indicative of drowsiness, including driver head pose, driver gaze activity (*e.g.,* number and distribution of glances), the percentage of time the driver's eyes are closed (*i.e.,* PERCLOS [68]), blink speed, eye closure duration, yawns, and other facial expressions.

As noted previously, driver drowsiness tends to become progressively more pronounced over time. The progressive nature of driver drowsiness means that it is possible to estimate a driver's future drowsiness state—seconds or even more than a minute into the future—based on their current drowsiness state. Researchers have used various physiological and behavioral measures to develop models to predict drivers' subjective drowsiness,[69] predict the occurrence of microsleeps,[70] and predict drowsiness as determined by coders looking at video of drivers' faces.[71] While limited research exists to demonstrate the feasibility of drowsiness state prediction under real-world driving conditions, further developments in drowsiness prediction could allow vehicles to provide alerts and interventions to reduce the risks of drowsy driving before they become severe.

As the detection and prediction of driver drowsiness within a vehicle becomes increasingly feasible, it is possible to consider potential vehicle-based countermeasures to reduce risk. While there is limited research investigating interventions to reduce drowsy driving risks, evidence suggests that auditory,[72] visual,[73] and seat belt vibration [74] warnings can help to improve drowsy drivers' driving performance, and that there may be benefits to multi-staged warnings relative to single-stage warnings.[75]

B. Many Different Behavioral Strategies Exist, Yet Impaired Driving Persists

Alcohol-impaired driving is a behavioral issue, and in general, changing human behavior is particularly challenging.[76] NHTSA has made considerable progress in behavioral research to advance the knowledge and understanding of the physiological

[55] Johns, M.W. (2000). A sleep physiologist's view of the drowsy driver. Transportation research part F: traffic psychology and behaviour, 3(4), 241–249.

[56] *https://www.cdc.gov/sleep/features/drowsy-driving.html.*

[57] Goel, N., Rao, H., Durmer, J.S., & Dinges, D.F. (2009, September). Neurocognitive consequences of sleep deprivation. In Seminars in neurology (Vol. 29, No. 04, pp. 320–339).

[58] Fairclough SH, Graham R. Impairment of driving performance caused by sleep deprivation or alcohol: A comparative study. Human Factors. 1999; 41(1):118–128.

[59] Soares, S., Monteiro, T., Lobo, A., Couto, A., Cunha, L., & Ferreira, S. (2020). Analyzing driver drowsiness: From causes to effects. Sustainability, 12(5), 1971.

[60] Kozak, K., Curry, R., Greenberg, J., Artz, B., Blommer, M., & Cathey, L. (2005, September). Leading indicators of drowsiness in simulated driving. In Proceedings of the Human Factors and Ergonomics Society Annual Meeting (Vol. 49, No. 22, pp. 1917–1921).

[61] Blaivas, A. J., Patel, R., Hom, D., Antigua, K., & Ashtyani, H. (2007). Quantifying microsleep to help assess subjective sleepiness. Sleep medicine, 8(2), 156–159.

[62] Thiffault, P., & Bergeron, J. (2003). Monotony of road environment and driver fatigue: a simulator study. Accident Analysis & Prevention, 35(3), 381–391.

[63] Electrocardiogram (EKG or ECG).

[64] Electrooculogram (EOG).

[65] Albadawi, Y., Takruri, M., & Awad, M. (2022). A review of recent developments in driver drowsiness detection systems. Sensors, 22(5), 2069.

[66] De Gennaro, L., Ferrara, M., Curcio, G., & Cristiani, R. (2001). Antero-posterior EEG changes during the wakefulness–sleep transition. Clinical neurophysiology, 112(10), 1901–1911.

[67] Stancin, I., Cifrek, M., & Jovic, A. (2021). A review of EEG signal features and their application in driver drowsiness detection systems. Sensors, 21(11), 3786.

[68] Hanowski, R.J., Bowman, D., Alden, A., Wierwille, W.W., & Carroll, R. (2008). PERCLOS+: Development of a robust field measure of driver drowsiness. In 15th World Congress on Intelligent Transport Systems and ITS America's 2008 Annual Meeting.

[69] Murata, A., Ohta, Y., & Moriwaka, M. (2016). Multinomial logistic regression model by stepwise method for predicting subjective drowsiness using performance and behavioral measures. In Proceedings of the AHFE 2016 International Conference on Physical Ergonomics and Human Factors, July 27–31, 2016, Walt Disney World®, Florida, USA (pp. 665–674).

[70] Watson, A., & Zhou, G. (2016, June). Microsleep prediction using an EKG capable heart rate monitor. In 2016 IEEE First International Conference on Connected Health: Applications, Systems and Engineering Technologies (CHASE) (pp. 328–329). IEEE.

[71] de Naurois, C.J., Bourdin, C., Stratulat, A., Diaz, E., & Vercher, J.L. (2019). Detection and prediction of driver drowsiness using artificial neural network models. Accident Analysis & Prevention, 126, 95–104.

[72] Berka, C., Levendowski, D., Westbrook, P., Davis, G., Lumicao, M.N., Ramsey, C., . . . & Olmstead, R.E. (2005, July). Implementation of a closed-loop real-time EEG-based drowsiness detection system: Effects of feedback alarms on performance in a driving simulator. In 1st International Conference on Augmented Cognition, Las Vegas, NV (pp. 151–170).

[73] Fairclough, S.H., & van Winsum, W. (2000). The influence of impairment feedback on driver behavior: A simulator study. Transportation human factors, 2(3), 229–246.

[74] Arimitsu, S., Sasaki, K., Hosaka, H., Itoh, M., Ishida, K., & Ito, A. (2007). Seat belt vibration as a stimulating device for awakening drivers. IEEE/ASME Transactions on mechatronics, 12(5), 511–518.

[75] Gaspar, J.G., Brown, T.L., Schwarz, C.W., Lee, J.D., Kang, J., & Higgins, J.S. (2017). Evaluating driver drowsiness countermeasures. Traffic injury prevention, 18(sup1), S58–S63.

[76] In the medical field, the National Institutes of Health (NIH) established a program nearly 15 years ago to study behavior change and try to identify the most successful mechanisms that result in the most behavior change. They understood the problem and developed interventions, but they really did not understand why the intervention worked for some but not others. *See https://scienceofbehavior change.org/what-is-sobc/* for an example of a NIH project focusing on the science behind changing human behaviors.

effects of alcohol impairment on driving. Additionally, NHTSA has taken a multi-pronged approach to trying to eliminate alcohol-impaired driving. Four basic strategies are used to reduce impaired driving crashes and driving under the influence:

1. *Deterrence:* enact, publicize, enforce, and adjudicate laws prohibiting impaired driving so people choose not to drive impaired;

2. *Prevention:* reduce drinking and drug use to keep drivers from becoming impaired;

3. *Communications and outreach:* inform the public of the dangers of impaired driving and establish positive social norms that make driving while impaired unacceptable; and

4. *Alcohol and drug treatment:* reduce alcohol and drug dependency or addiction among drivers.[77]

NHTSA uses and encourages a variety of different behavioral strategies, focusing on those strategies that are demonstrably effective.[78] Some strategies, like laws, enforcement, criminal prosecution, and offender treatment and monitoring, have a deterrent effect. Other strategies focus on prevention, intervention, communications, and outreach.[79]

C. NHTSA's Authority

The National Traffic and Motor Vehicle Safety Act provides NHTSA with broad authority to address motor vehicle safety problems like driver impairment. Under the National Traffic and Motor Vehicle Safety Act (49 U.S.C. 30101 *et seq.*) (Safety Act), the Secretary of Transportation is responsible for prescribing motor vehicle safety standards that are practicable, meet the need for motor vehicle safety, and are stated in objective terms.[80] ''Motor vehicle safety'' is defined in the Safety Act as ''the performance of a motor vehicle or motor vehicle equipment in a way that protects the public against unreasonable risk of accidents occurring because of the design, construction, or performance of a motor vehicle, and against unreasonable risk of death or injury in an accident, and includes nonoperational safety of a motor vehicle.'' [81] ''Motor vehicle safety standard'' means a minimum standard for motor vehicle or motor vehicle equipment performance.[82] When prescribing such standards, the Secretary must consider all relevant, available motor vehicle safety information.[83] The Secretary must also consider whether a proposed standard is reasonable, practicable, and appropriate for the types of motor vehicles or motor vehicle equipment for which it is prescribed and the extent to which the standard will further the statutory purpose of reducing traffic crashes and associated deaths.[84] The responsibility for promulgation of FMVSS is delegated to NHTSA.[85]

To meet the Safety Act's requirement that standards be ''practicable,'' NHTSA must consider several factors, including technological and economic feasibility [86] and consumer acceptance.[87] Technological feasibility considerations counsel against standards for which ''many technical problems have been identified and no consensus exists for their resolution . . . .'' [88] However, it does not require that the technology be developed, tested, and ready for deployment at the time the standard is promulgated. Economic feasibility considerations focus on whether the cost on industry to comply with the standard would be prohibitive. Finally, NHTSA must consider consumer acceptance. In particular, the U.S. Court of Appeals for the D.C. Circuit has noted that ''motor vehicle safety standards cannot be considered practicable unless we know . . . that motorists will avail themselves of the safety system. And it would be difficult to term 'practicable' a system . . . that so annoyed motorists that they deactivated it.'' [89] NHTSA also understands that if consumers do not accept a required safety technology, the technology will not deliver the safety benefits that NHTSA anticipates.[90]

The Safety Act also contains a ''make inoperative'' provision, which prohibits certain entities from knowingly modifying or deactivating any part of a device or element of design installed in or on a motor vehicle in compliance with an applicable FMVSS.[91] Those entities include vehicle manufacturers, distributors, dealers, rental companies, and repair businesses. Notably, the make inoperative prohibition does not apply to individual vehicle owners.[92] While NHTSA encourages individual vehicle owners not to degrade the safety of their vehicles or equipment by removing, modifying, or deactivating a safety system, the Safety Act does not prohibit them from doing so. This creates a potential source of issues for solutions that lack consumer acceptance, since individual owners would not be prohibited by Federal law from removing or modifying those systems (*i.e.,* using defeat mechanisms).

Section 24220 of BIL, ''Advanced Impaired Driving Technology,'' [93] directs NHTSA to issue a final rule prescribing an FMVSS ''that requires passenger motor vehicles manufactured after the effective date of that standard to be equipped with advanced drunk and impaired driving prevention technology.'' [94] NHTSA is required to issue such a rule only if it would meet the criteria in section 30111 of the Safety Act.[95] As explained above, those criteria include, among other things, that an FMVSS be objective, practicable, and meet the need for motor vehicle safety. In analyzing these criteria, NHTSA must balance benefits and costs and consider safety as the preeminent factor in its considerations.[96]

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[77] *https://www.nhtsa.gov/book/countermeasures/alcohol-and-drug-impaired-driving/strategies-reduce-impaired-driving.*

[78] *See https://www.nhtsa.gov/book/countermeasures/alcohol-and-drug-impaired-driving/countermeasures.*

[79] *Id.*

[80] 49 U.S.C. 30111(a).

[81] 49 U.S.C. 30102(a)(9).

[82] Section 30102(a)(10).

[83] Section 30111(b)(1).

[84] Section 30111(b)(3)–(4).

[85] 49 CFR 1.95.

[86] *See, e.g., Paccar, Inc.* v. *Nat'l Highway Traffic Safety Admin.,* 573 F.2d 632, 634 n.5 ('' 'Practicable' is defined to require consideration of all relevant factors, including technological ability to achieve the goal of a particular standard as well as consideration of economic factors.'') (citations and quotations omitted).

[87] *Pac. Legal Found.* v. *Dep't of Transp.,* 593 F.2d 1338, 1345 (D.C. Cir. 1979) (noting in reference to practicable and meet the need for safety, that ''the agency cannot fulfill its statutory responsibility unless it considers popular reaction.'').

[88] *Simms* v. *Nat'l Highway Traffic Safety Admin.,* 45 F.3d 999, 1011 (6th Cir. 1995).

[89] *Pac. Legal Found.,* 593.F.2d at 1346. The court also noted that the Secretary could reasonably anticipate consumers to be more willing to accept airbags than automatic seatbelts and seatbelt interlocks because airbags impose less on the driver and research indicated a lower deactivation rate for airbags than interlock systems.

[90] *See,* 82 FR 3854, 3920. Due to the nature of the technology, consumer acceptance was a key factor discussed in the 2017 NPRM on vehicle-to-vehicle (V2V) technology. NHTSA also conducted significant research into consumer acceptance and beliefs about V2V technology.

[91] 49 U.S.C. 30122.

[92] Letter to Schaye (9/9/19) (''The ''make inoperative'' provision does not apply vehicle owners, and these owners are not precluded from modifying their vehicle by NHTSA's statutes or regulations. State and local laws, however, may impact whether an owner may use a vehicle they have modified in a particular jurisdiction.''), *available at https://www.nhtsa.gov/interpretations/571108-ama-schaye-front-color-changing-light.*

[93] Infrastructure Investment and Jobs Act, Public Law 117–58, section 24220 (2021).

[94] Section 24220(c).

[95] Section 24220(c), (e).

[96] *See, e.g., Motor Vehicle Mfrs. Assn. of United States, Inc.* v. *State Farm Mut. Automobile Ins. Co.,* 463 U.S. 29, 55 (1983) (''The agency is correct to look at the costs as well as the benefits of Standard 208 . . . When the agency reexamines its findings as to the likely increase in seat belt usage, it must

Continued

Section 24220 defines ''Advanced Drunk and Impaired Driving Technology'' as a system that

(A) can—

(i) passively monitor the performance of a driver of a motor vehicle to accurately identify whether that driver may be impaired; and

(ii) prevent or limit motor vehicle operation if an impairment is detected; or

(B) can—

(i) passively and accurately detect whether the blood alcohol concentration of a driver of a motor vehicle is equal to or greater than the blood alcohol concentration described in section 163(a) of title 23, United States Code; and

(ii) prevent or limit motor vehicle operation if a blood alcohol concentration above the legal limit is detected; or

(C) is a combination of systems described in subparagraphs (A) and (B).[97]

This means that a final rule could require vehicles be equipped with a system that detects whether the driver is impaired (an impairment-detection system); a system that detects whether the driver's BAC is above a specified threshold (a BAC-detection system); or a combination of these two systems. These options and the technology that might fulfill each option are discussed in greater detail later in this document.

Section 24220 further requires that the ''Advanced Drunk and Impaired Driving Technology'' ''passively'' monitor performance or detect BAC. For the purposes of this advance notice of proposed rulemaking, NHTSA uses the term ''passive'' to mean that the system functions without direct action from vehicle occupants.[98] As such, systems that require a ''directed breath'' towards a sensor, such as the current DADSS reference designs (discussed later in this document) or a breathalyzer that a driver must breathe into in order for the system to detect alcohol would not be considered ''passive'' because these designs require a vehicle occupant to take direct action (*i.e.,* directed breath) for the system to function.

Section 24220 does not require that a final rule give manufacturers the option of choosing between an impairment-detection and a BAC-detection system. NHTSA understands the term ''impairment,'' for the purposes of section 24220, to refer to alcohol-related impairment as well as other types of driver impairment. Of course, regardless of how the term ''impairment'' is construed for the purposes of section 24220, NHTSA also has the authority under the Safety Act to issue an FMVSS addressing any type of driver impairment if the standard would satisfy the criteria in section 30111 of the Safety Act.

The new FMVSS would be required to apply to new vehicles that carry 12 or fewer individuals, not including motorcycles or trucks not designed primarily to carry its operator or passengers.[99]

BIL also establishes a series of deadlines and requirements for NHTSA to report to Congress if those deadlines are not met. The legislation directs NHTSA to issue a final rule (if it would meet the section 30111 criteria) not later than November 15, 2024. If NHTSA does not issue a rule by this date, it must submit a report to Congress explaining (among other things) the reasons for not issuing a final rule.[100] NHTSA must submit such reports annually until it issues a final rule or ten years has expired, from the date of enactment, whichever comes first.[101]

III. Advanced Drunk and Impaired Driving Prevention Safety Problem

The overall safety problem caused by various types of states of impaired driving is substantial, and those impaired states are part of the causal chain for a large percentage of crashes in the United States. A recent NHTSA report, ''The Economic and Societal Impact of Motor Vehicle Crashes (2019),'' reviewed 2019 data and described the state of safety prior to the COVID–19 pandemic.[102] In 2019, the lost lives and costs on our society stemming from motor vehicle crashes were enormous—36,500 people were killed, 4.5 million people were injured, and the economic costs of these crashes totaled $340 billion. Of this $340 billion, nearly half ($167 billion) resulted from alcohol-involved and distracted-driving crashes alone. Furthermore, the overall safety problem has only gotten worse during the COVID–19 pandemic, as NHTSA has confirmed that the increases in fatalities, injuries, and risky driving that the country experienced in 2020 continued through the first two quarters of 2022.[103] Recent first quarter projections for traffic fatalities in 2023 [104] have reversed the trend, with NHTSA *estimating* an overall fatality decrease of about 3.3 percent as compared to the same time period in 2022. The second quarter of 2023 would represent the fifth straight quarterly decline in fatalities after seven consecutive quarters of year-to-year increases in fatalities, beginning with the third quarter of 2020. Please see Graph 2. Fatalities by Quarter [105] below. While this is encouraging overall, far too many people continue to die on our roads every year, and drunk and impaired driving crashes still result in significant numbers of those lives lost.

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also reconsider its judgment of the reasonableness of the monetary and other costs associated with the standard. In reaching its judgment, NHTSA should bear in mind that Congress intended safety to be the preeminent factor under the Motor Vehicle Safety Act.'').

[97] Section 24220(b).

[98] FMVSS Nos. 208, ''Occupant crash protection,'' and 212, ''Windshield mounting,'' use a similar definition for completely passive protection systems for occupants. 49 CFR 571.208, 571.212. DADSS has also viewed the term similarly. See Report to Congress on Progress In-Vehicle Alcohol Detection Research, October 1, 2019 through September 30, 2020.

[99] Section 24220 (b)(3), referring to 49 U.S.C. 32101(consumer information statutes).

[100] Section 24220 (e)(2). The report must also describe the deployment of advanced drunk and impaired driving prevention technology in vehicles, any information relating to the ability of vehicle manufacturers to include advanced drunk and impaired driving prevention technology in new passenger motor vehicles, and an anticipated timeline for prescribing the Federal motor vehicle safety standard.

[101] Section 24220 (e)(2)–(3). If, after ten years, NHTSA has not promulgated the FMVSS required by this subsection, the report must state the reasons why the FMVSS was not finalized, the barriers to finalizing the FMVSS, and recommendations to Congress to facilitate the FMVSS.

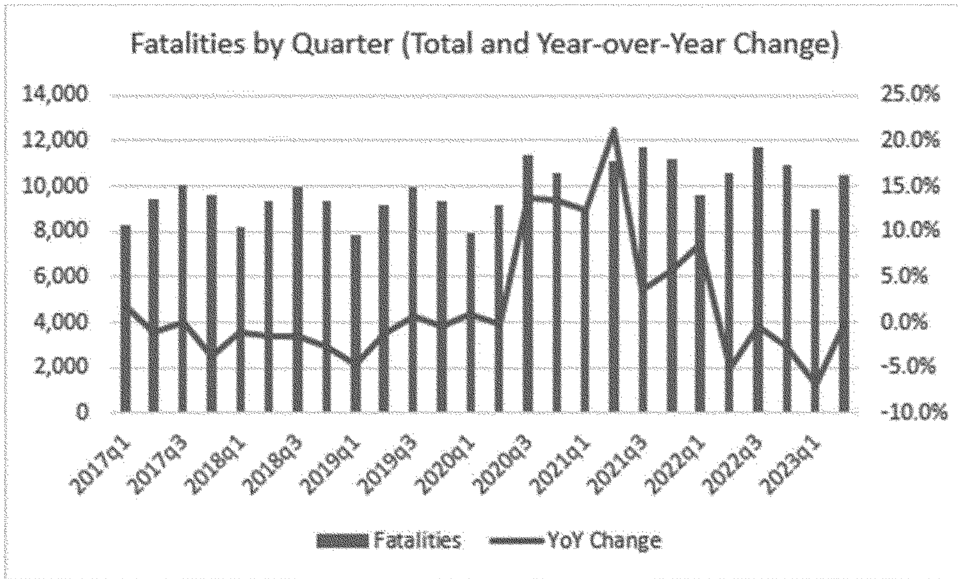
[102] Blincoe, L., Miller, T., Wang, J.S., Swedler, D., Coughlin, T., Lawrence, B., Guo, F. Klauer, S., & Dingus, T. (2023, February). The economic and societal impact of motor vehicle crashes, 2019 (Revised) (Report No. DOT HS 813 403). National Highway Traffic Safety Administration.

[103] See, for example, NHTSA Estimates: Traffic Deaths Third Quarter of 2022 | NHTSA.

[104] Crash Stats: Early Estimate of Motor Vehicle Traffic Fatalities for the First Quarter of 2023 (*dot.gov*)

[105] NHTSA (2023). *Early Estimate of Motor Vehicle Traffic Fatalities for the First Half (January–June) of 2023.* Report No. DOT HS 813 514. National Highway Traffic Safety Administration: Washington, DC. (September)

Graph 2. Fatalities by Quarter



The introduction to this advance notice of proposed rulemaking states that NHTSA is considering focusing primarily on alcohol impairment, both because of the mandate in the BIL and because alcohol impairment has the tangible strategies developed to identify it. But the agency requests comment on this focus because of the danger that other impaired states cause during the driving task and because some options described in later sections provide the opportunity to resolve multiple states of impairment with the same technological solution. In this section, NHTSA will discuss the drunk, drowsy, and distracted driving states that account for most of the fatalities and crashes related to impaired driving. NHTSA has presented the safety problem in this way because the agency is interested in proceeding with whatever practical course of action results in the most lives saved and injuries prevented in the shortest amount of time, regardless of what impaired driving state is the root cause. Additionally, NHTSA believes the public should be aware of the overall safety problem associated with driver impairment so that it may have adequate information when responding to NHTSA's questions about whether focusing on alcohol-impairment is the best path forward to achieve improved motor vehicle safety and protect the public from the complex behavioral issues that result in driver impairment.

For this analysis, we consider the three categories of impaired driving safety impacts most likely to be ameliorated by a safety countermeasure arising from this ANPRM: drunk driving, drowsy driving, and distracted driving. As mentioned in the introduction, NHTSA hopes that the agency's approach may yield additional safety benefits by considering all technologies that have the potential to mitigate or prevent impaired driving fatalities and injuries.

The safety data on drunk driving, and the confidence in those data, are much more substantial than data on other types of impaired driving, and drunk driving results in serious loss of life, injury, and economic costs to the public. This section will present estimates of annual fatalities and injuries due to drunk, drowsy, and distracted driving.

It is also worth noting that in other recent rulemakings, NHTSA decided not to use post-2019 data because the agency was not yet sure whether the disturbing uptick in crashes and fatalities was an anomaly or a trend that reflects a change in vehicle safety that would remain for more than one year or the foreseeable future. Analysis since the issuance of previous documents indicates that data from 2020 and 2021 highlight a potentially dangerous trend in the United States of an increase in motor vehicle crashes and fatalities, which is why this advance notice of proposed rulemaking differs from other documents issued in the recent past in citing post-2019 data.

A. Drunk Driving

Per FARS, in 2021 there were 13,384 traffic fatalities in which at least one driver had a BAC at or above .08 g/dL, (representing approximately 31 percent of all traffic fatalities in the United States). NHTSA's process for identifying fatalities due to drunk driving begins by acknowledging that not all alcohol-related motor vehicle fatalities and injuries are caused by alcohol consumption. In NHTSA's fatality numbers reported in FARS, use of the term ''alcohol-impaired'' does not indicate that a crash or a fatality was caused by alcohol impairment, only that an alcohol-impaired driver was involved in the crash. That is, some of the crashes may have involved causative factors other than alcohol (*e.g.,* one or multiple drivers or vehicles associated with speeding, reckless behavior, or mechanical failure).

Critically for this advance notice of proposed rulemaking, NHTSA's analysis has applied Blomberg et al.'s risk factors to estimate that alcohol is indeed a causal factor in 94 percent of crashes involving at least one driver with a BAC at or above .08 g/dL.[106] Thus, the agency estimates that, among all crashes, fatalities, and injuries involving drivers that have a BAC at or above .08 g/dL, 94 percent of them are due directly to

[106] Blincoe et al., 2023 Blomberg, R., Peck, R.C., Moskowitz, H., Burns, M., & Fiorentino, D. (2005, September). Crash risk of alcohol-involved driving: A case-control study. Dunlap and Associates; Blincoe et al., 2023.

alcohol consumption and are thus within the scope of impaired driving countermeasures that would focus on the legal limit in most States (.08 g/dL). This yields an estimate of approximately 12,581 fatalities in 2021 due to alcohol impairment. At an estimated comprehensive economic cost of approximately $12.7 million per fatality (adjusted to 2022 dollars using the GDP Implicit Price Deflator [107 108]), fatalities in alcohol impairment-related crashes were associated with societal safety costs of approximately $160 billion in 2021.

B. Distracted Driving

Historically, distracted driving crashes have been more difficult to quantify than drunk driving crashes because unlike BAC, distraction cannot yet be tested for objectively post-crash. However, Blincoe et al. developed and implemented a methodology to estimate both: (1) underreporting of cases involving distraction; and (2) the shares of crashes, fatalities, and injuries caused by distraction.[109] NHTSA applies the results of Blincoe et al. here to 2021 FARS data to estimate fatalities in 2021 due to distracted driving.

Blincoe et al. estimate that 28.9 percent of all crashes (and injuries of all severities within crashes) are due to distraction. Based on this estimate, the agency estimates that distracted driving caused 12,405 fatalities in 2021. This represents a societal safety cost of approximately $158 billion, an economic estimate of the loss of life.

Dingus et al. report that approximately seven percent of cases of distraction also involve some form of impairment. In turn, it is appropriate to assume that there is at least some degree of overlap among drunk driving and distracted driving fatalities. Thus, the combined safety problem associated with drunk driving and distracted driving is likely to be somewhat smaller than the sum of the individual estimates above (*i.e.,* distracted driving fatalities in 2021 not jointly caused by alcohol would be up to 7% lower than the estimate of 12,405 fatalities above).

C. Drowsy Driving

Drowsy driving is more difficult to quantify than drunk driving because, among other factors, there is not currently an accepted standard definition of drowsiness in a driving context, nor a threshold to define drowsiness as a causal factor in motor vehicle crashes. In turn, the level of drowsiness-related crashes and injuries is subject to faulty measurement, with underreporting more likely than overreporting. In defining the drowsy driving safety problem, NHTSA begins with estimates based on police-reported drowsiness as a contributing factor, and then considers external estimates of underreporting.

To estimate fatalities in 2021 associated with drowsy driving, the agency analyzes fatalities reported in FARS in which at least one driver was reported as asleep or drowsy: this revealed 684 fatalities, or approximately 1.6 percent of total annual fatalities.

Applying estimates of the comprehensive economic costs of injury from the last section, NHTSA estimates that reported fatalities associated with drowsy driving in 2021 represent a social cost of approximately $9 billion.

NHTSA's annual estimates of fatalities associated with drowsy driving are consistent with other NHTSA estimates (*e.g.,* annual drowsiness-related fatality estimates in NHTSA's ''Drowsy Driving 2015'').[110 111] However, the estimates are lower than other external estimates, such as Tefft, which estimates that one-sixth of traffic fatalities are associated with drowsiness,[112] and Owens et. al which estimates that approximately one-tenth of police-reportable crashes are associated with drowsiness.[113] NHTSA does not have sufficient evidence regarding underreporting. On the other hand, consistent with the discussion of drowsiness-related crashes and acknowledges that underreporting distracted driving above, it is a feasible constraint to estimating the scale of the that at least some fatalities caused by drowsy driving safety problem. are also caused by alcohol impairment or distraction (furthermore, the drowsiness itself could be caused by drinking, and the distraction itself could be caused by drowsiness). For this analysis, the agency applies its estimate as a conservative estimate of a significant safety issue (*i.e.,* NHTSA expects the true annual safety costs associated with drowsy driving to be at least as large as estimated here). The agency requests comment and data regarding underreporting of drowsy driving, and interdependencies among drunk driving, distracted driving, and drowsy driving.

IV. Overview of Current Efforts To Address Drunk and Impaired Driving

NHTSA has a robust portfolio of behavioral-prevention and vehicle-research activities focused on preventing drunk and impaired driving. NHTSA believes that the combination of these strategies (*i.e.,* behavioral strategies and vehicle-based countermeasures) is necessary to move towards a nation where alcohol-impaired individuals are unable to drive vehicles and put the lives of everyone around them at risk by doing so. As discussed in the introduction, one of the effects that leads drivers to take such unacceptable risks when intoxicated is alcohol's impact on their brain, especially in impairing judgment.

A. State and Federal Behavioral Prevention Activities

Behavioral prevention activities are public-oriented strategies intended to change the behaviors that lead to drunk and impaired driving. This is distinguished from vehicle-based countermeasures, which are discussed later in this document. To develop and implement these behavioral strategies, NHTSA collaborates with a wide array of national, regional, State, and local traffic safety partners, including those in the following sectors: public safety and criminal justice; medical, public health and emergency services; educators; parents; non-profits; traffic safety organizations; and academic institutions. More recently, NHTSA has expanded these partnerships to include substance use prevention, mental health, and overall wellness efforts as part an overall approach to address issues that lead to drunk and impaired driving.

NHTSA's behavioral prevention activities can be categorized into three main areas. First, NHTSA conducts research to identify the scope of the issue and develop effective evidence-based strategies to address the behaviors that lead to drunk and impaired driving. Second, NHTSA distributes Federal grant funds to individual States, and these funds are used for behavioral strategies.[114] Each State is required to

[107] Blincoe et al., 2023.

[108] *https://fred.stlouisfed.org/series/USAGDPDEFAISMEI.*

[109] Blincoe et al., 2023.

[110] National Center for Statistics and Analysis. (2017 October). Drowsy Driving 2015 (CrashStats Brief Statistical Summary. Report No. DOT HS 812 446). Washington, DC: National Highway Traffic Safety Administration.

[111] Knipling, R. & Wang, J. (1994). Crashes and fatalities related to driver drowsiness/fatigue. Washington, DC: National Highway Traffic Safety Administration.

[112] Tefft, B. (2010). *The Prevalence and Impact of Drowsy Driving* (Technical Report). Washington, DC: AAA Foundation for Traffic Safety.

[113] Owens, J.M., Dingus, T.A.. Guo, F., Fang, Y., Perez, M., McClafferty, J., & Tefft, B.C. (2018). *Prevalence of Drowsy Driving Crashes: Estimates from a Large-Scale Naturalistic Driving Study* (Research Brief). Washington, DC: AAA Foundation for Traffic Safety.

[114] *See, e.g.,* 23 U.S.C. 402 (fund that can be used for any purpose); 23 U.S.C. 405(d) (priority funds,

have a highway safety program, approved by the Secretary of Transportation, that is designed to reduce traffic crashes and the resulting deaths, injuries, and property damage. NHTSA provides grants to each State for their highway safety program as well as funds to address national priorities for reducing highway deaths and injuries, such as impaired driving programs. Third, NHTSA works directly with States and other stakeholders to develop, implement, and support effective programs and strategies to stop drunk and impaired driving. This includes demonstration projects, training and education for traffic safety professionals, and communications campaigns to educate the public. NHTSA also helps States use data to identify their highway safety needs and evaluate safety programs and activities, and the agency provides technical assistance and training to State program managers.

Below we briefly discuss four of the main drunk and impaired driving behavioral strategies that help us execute our three main areas mentioned above: Deterrence; Prevention; Communications and outreach; and alcohol and drug treatment programs.[115]

1. Deterrence

Deterrence includes enacting laws that prohibit drunk and impaired driving, publicizing and enforcing those laws, and identifying and punishing offenders.[116] Deterrence works by changing a driver's behavior through concern for the consequences of certain behaviors, such as being apprehended by law enforcement. Below we provide a brief overview of activities in these areas with respect to drunk and impaired driving, with a focus on State and Federal drunk driving laws and NHTSA's efforts to support and develop training and best practices for law enforcement, prosecutors, judges, and other public safety and criminal justice partners.

a. State and Federal Drunk Driving Laws

State laws, as well as Federal law governing the use of motor vehicles on Federally owned land, prohibit operation of a motor vehicle when the driver is at or exceeds the state's per se illegal limit (*i.e.,* BAC of .08 g/dL in all states, except Utah which has a .05 g/dL illegal limit).

All States have enacted drunk driving laws. Some of these laws have been incentivized by Federal law, because significant portions of the Federal funds available to the States, including State Highway funds, are conditioned on a State enacting and enforcing specific laws related to drunk driving. This includes laws prohibiting operation of a motor vehicle with a BAC of .08 percent or greater;[117] laws prohibiting individuals under the age of 21 from operating a motor vehicle with a BAC of .02 percent or greater (zero-tolerance laws);[118] laws setting a minimum drinking age of 21;[119] and laws prohibiting possession of open alcohol beverage containers and consumption of alcohol in a vehicle (open-container laws).[120] If a State does not have the required laws, it loses significant funding to which it would otherwise be entitled. Accordingly, all States have enacted such laws.[121] Many States have also gone above and beyond the Federally-incentivized laws. For instance, on December 30, 2018, Utah lowered its BAC threshold to .05 g/dL for all drivers. Examples of other laws States have enacted include driver license revocation or suspension if drivers fail or refuse to take BAC tests, and increased penalties for repeat offenders or for offenders with higher BACs.

The National Transportation Safety Board (NTSB) has recently recommended that NHTSA seek legislative authority to award incentive grants for States to establish a per se BAC limit of .05 or lower for all drivers who are not already required to adhere to lower BAC limits.[122] In response to this recommendation, NHTSA published the results of preliminary research on the effects of Utah's law.[123] This research suggests that the .05 g/dL per se law has had quantifiable positive impacts on highway safety in Utah so that lower BAC thresholds may be effective in further reducing alcohol-involved crashes. In addition to these State laws, Federal regulations prohibit drunk driving on Federal lands.[124] An individual may not operate a motor vehicle on Federal land if they are unable to safely operate the vehicle due to the influence of alcohol or other drugs, or if their BAC is .08 g/dL or greater.[125] The law also authorizes testing of three bodily fluids: blood, saliva, and urine. It includes stipulations around proper administration of accepted scientific methods and equipment used by certified personnel, noting that for blood sample testing, there are further restrictions whereby normally a search warrant is required from an authorized individual.

b. Training and Best Practices for Law Enforcement, Prosecutors, Judges, and Other Public Safety and Criminal Justice Partners

NHTSA actively supports efforts to develop training and best practices for law enforcement, prosecutors, judges, and other public safety and criminal justice partners regarding the detection, prosecution, and adjudication of drunk and impaired driving. A brief sampling of NHTSA's work in this area includes the following:

Development and application of field sobriety tests. In the mid-1970s NHTSA, with the cooperation and assistance of the law enforcement community, conducted research that resulted in a standardized battery of three field sobriety tests (the horizontal gaze nystagmus test; the walk-and-turn test; and the one-leg stand test). Police officers use these tests to help establish probable cause for a driving while intoxicated (DWI[126]) arrest.

Standards for alcohol breath-test devices. Evidential breath test devices conform to established specifications and can be used as evidence in court. NHTSA publishes standard specifications for evidential breath-test devices, and a ''Conforming Products List'' of alcohol testing and screening

specifically for impaired driving); 23 U.S.C. 154 (open container); 23 U.S.C. 164 (repeat offender).

[115] *See* Venkatraman, V., Richard, C.M., Magee, K., & Johnson, K. (2021, July). *Countermeasures that work: A highway safety countermeasures guide for State Highway Safety Offices,* 10th edition, 2020 (Report No. DOT HS 813 097). National Highway Traffic Safety Administration. (hereinafter *Countermeasures that work*). Vehicle and infrastructure strategies can also reduce the likelihood of crashes and/or injuries sustained by impaired drivers and passengers, such as improved vehicle structures and centerline rumble strips and barriers. These countermeasures are outside the scope of this discussion.

[116] Venkatraman, V., Richard, C.M., Magee, K., & Johnson, K. (2021, July). Countermeasures that work: A highway safety countermeasures guide for State Highway Safety Offices, 10th edition, 2020 (Report No. DOT HS 813 097). National Highway Traffic Safety Administration.

[117] 23 U.S.C. 163.

[118] 23 U.S.C. 161.

[119] 23 U.S.C. 158.

[120] 23 U.S.C. 154.

[121] *See https://www.ghsa.org/state-laws/issues/alcohol%20impaired%20driving* (last accessed January 5, 2023); *https://www.ncsl.org/research/transportation/drunken-driving.aspx* (last accessed January 5, 2023).

[122] *https://www.ntsb.gov/safety/safety-studies/Documents/SR1301.pdf.*

[123] Thomas, F.D., Blomberg R., Darrah, J., Graham, L., Southcott, T., Dennert, R., Taylor, E., Treffers, R., Tippetts, S., McKnight, S., & Berning, A. (2022, February). Evaluation of Utah's .05 BAC per se law. DOT HS 813 233. NHTSA.

[124] 36 CFR 4.23.

[125] If State law establishes more restrictive BAC limits, those more restrictive limits supersede the .08 g/dL limit specified in the Federal regulations.

[126] DWI and DUI are used interchangeably throughout this document.

devices.[127] Law enforcement officers use the totality of the evidence in determining whether sufficient probable cause exists to effectuate an arrest for drunk driving. This includes observation of the vehicle in motion, results of the standardized field sobriety tests, and other information to establish probable cause. An officer may use a preliminary or evidential breath test device to measure BrAC. A suspect may also be requested to provide a blood or urine sample.

Arrest and crash reporting. NHTSA provides training on arrest and crash reporting to law enforcement so that the data collected during a traffic stop or arrest, or at the scene of a crash, is uniform, clear, and concise.

Training curriculum development for law enforcement, prosecutors, judges, and other public safety and criminal justice partners. Through cooperative agreements and partnerships, NHTSA supports training for law enforcement, prosecutors, judges, and other public safety and criminal justice partners.

For example, NHTSA provides (through a cooperative agreement with the International Association of Chiefs of Police) funding for curricula development and management of programs developed to train law enforcement in detecting, investigating, and apprehending impaired drivers. NHTSA also provides the law enforcement community with resources to carry out local DWI programs, such as supplying laminated pocket guides for the standard field sobriety tests to aid officers. Through partnerships with national law enforcement organizations such as the National Criminal Justice Training Center, NHTSA maintains a wide reach when providing these resources.

NHTSA also helps ensure that organizations representing prosecutors, judges, and pretrial, parole, supervision, and probation officers have accurate and up-to-date information about the harm caused by impaired driving, the crash risk of various impairing substances, and evidence-based sanction and treatment options. For example, NHTSA has cooperative agreements with the National Traffic Law Center and the National Association of Prosecutor Coordinators to develop curricula and provide training to prosecutors working on impaired driving cases. Through these agreements, NHTSA provides prosecutors with information on relevant case law, monographs on various legal issues, an expert witness database, training courses, and peer-to-peer support from Traffic Safety Resource Prosecutors (TSRP) in each State. The TSRP Program trains current and former prosecutors to become instructors for traffic crimes prosecutors and law enforcement personnel.[128] This facilitates a coordinated, multidisciplinary approach to the prosecution of drunk and impaired driving. NHTSA also funds training through the National Judicial College on (among other things) evidence-based sentencing and supervision practices, toxicology, the use of ignition interlocks, and DWI Courts. NHTSA also funds the American Bar Association to conduct the Judicial Outreach Liaison program providing trial judges with current evidence-based practices, peer-to-peer judicial education, a liaison to the broader highway safety community.

Based on these models, NHTSA is also piloting similar education programs for pretrial, probation, parole, and supervision professionals[129] and toxicologists.

2. Prevention

Prevention strategies reduce impaired driving by reducing use of impairing substances or preventing driving by people who have been drinking or using other drugs. There are a variety of prevention countermeasures. Below we discuss the main ones.

a. Alcohol Ignition Interlocks

One impaired driving prevention strategy is requiring the installation of alcohol ignition interlocks. Ignition interlocks are devices that measure the driver's BrAC and prevent the vehicle from starting if it exceeds a pre-set level (usually .02 g/dL). Interlocks are highly effective in allowing vehicles to be started by sober drivers, but not by alcohol-impaired drivers. Alcohol ignition interlocks are typically used as a condition of probation for DWI offenders after their driver's licenses have been reinstated. Forty-four States require the devices for repeat, high-BAC, or all offenders.[130]

There is evidence that requiring interlocks for driving under the influence (DUI) offenders helps reduce recidivism. NHTSA evaluated the New Mexico Ignition Interlock program in 2010[131] and found that alcohol-sensing technology in vehicles can be successfully deployed to protect the public from alcohol-impaired drivers and that recidivism rates can be reduced if penetration of these devices is sufficient. In 2015, NHTSA reported on interlock use in 28 States.[132] This 2015 report identified important program elements for States to achieve and sustain high interlock use rates including: strong interlock requirements and incentives coupled with effective penalties for non-compliance; strong program management involving monitoring, uniformity, coordination, and education; and data and resources to support program management and to evaluate changes in program design.

A more recent study found that laws mandating alcohol ignition interlocks, especially those covering all offenders, are an effective alcohol-impaired driving countermeasure that reduces the number of alcohol-impaired drivers in fatal crashes.[133]

NHTSA has also conducted research, developed model specifications, and provided information and funding to improve State ignition interlock programs. NHTSA research on ignition interlocks dates back to early studies on the increased likelihood for DWI offenders to be involved in fatal crashes while intoxicated.[134] Based on research that license suspension alone did not keep DWI offenders from driving, NHTSA conducted research into performance-based interlocks that could prevent a drunk driver from starting the vehicle.[135] NHTSA also drafted and revised model specifications for interlock devices. These specifications have developed over time and are published in the **Federal Register** as guidelines for State interlock programs.[136] NHTSA has published an

[127] **Federal Register**/Vol. 58, No. 179/pp 48705–48710/Friday, September 17,1993/Notices (58 FR 48705) **Federal Register**/Vol. 77, No. 115/pp 35745–35750/Thursday, June 14, 2012/Notices (77 FR 35745, 77 FR 35747).

[128] *https://www.nhtsa.gov/sites/nhtsa.gov/files/documents/12323_tsrpmanual_092216_v3-tag.pdf.*

[129] *https://www.appa-net.org/idarc/training-faculty.html.*

[130] *https://www.ncsl.org/research/transportation/state-ignition-interlock-laws.aspx.*

[131] Evaluation of the New Mexico Ignition Interlock Program (2010). DOT HS 811 410.

[132] Evaluation of State Ignition Interlock Programs: Interlock Use Analyses from 28 States, 2006–2011 (2015) DOT HS 812 145.

[133] Teoh, Eric R./Fell, James C./Scherer, Michael/Wolfe, Danielle E.R., State alcohol ignition interlock laws and fatal crashes, *Traffic Injury Prevention (TIP),* October 2021.

[134] Hedlund, J., & Fell, J. (1995). Persistent drinking drivers in the U.S., 39th Annual Proceedings of the Association for the Advancement of Automotive Medicine, October 16–18, 1995, Chicago, IL (pp. 1–12). Des Plaines, IL: Association for the Advancement of Automotive Medicine.

[135] This research also considered impairment including drugs and drowsiness.

[136] 78 FR 26849 (May 8, 2013), *available at https://www.volpe.dot.gov/sites/volpe.dot.gov/files/docs/Breath%20Alcohol%20Ignition%20Interlock%20Device%20%28BAIID%29%20Model%20Specifications.pdf.*

ignition interlock toolkit,[137] a program guide on key features for ignition interlock programs,[138] and various case studies and evaluation reports.[139] NHTSA continues to fund the Association of Ignition Interlock Program Administrators.[140]

As discussed later in greater detail, since 2008 NHTSA has participated in and helped fund a cooperative research program, known as DADSS, which is developing next-generation vehicle alcohol detection technologies.

b. Designated Driver and Alternative Transportation Programs

NHTSA also supports designated driver and alternative transportation programs as another avenue for preventing impaired driving.

Designated driver programs encourage drinkers to include someone in their party who does not drink and will be able to provide a safe ride home. Some designated-driver programs provide incentives such as free soft drinks for designated drivers. Mass-media campaigns—such as the NHTSA-sponsored Ad Council campaign ''Friends Don't Let Friends Drive Drunk''—seek to raise awareness and promote the use of these programs.

Alternative transportation programs offer methods people can use to get to and from places where they drink without having to drive. This includes public transportation (such as subways and buses) as well as for-profit and nonprofit ''safe rides.'' For-profit safe rides include transportation network companies that are on-demand and may be accessed through a mobile application. Nonprofit safe-ride programs are free to patrons or charge minimal fees and often operate in specific regions or at specific times such as weekends and holidays when impaired crashes occur at higher rates. Several States fund alternative transportation as part of their impaired driving prevention efforts.

c. Alcohol Sales and Service Regulations/Programs

Another common strategy to prevent impaired driving are regulations and programs that target the point at which alcoholic beverages are sold. Responsible beverage service programs cover alcohol sales policies and practices that prevent or discourage restaurant or bar patrons from drinking excessively or from driving while impaired by alcohol. NHTSA supports server training programs to teach servers how to recognize the signs of intoxication, how to prevent intoxicated patrons from further drinking and from driving, as well as bar and restaurant management policies to reduce impaired driving.

d. Underage Impaired Driving Prevention

One particular focus of prevention strategies is preventing underage impaired driving. Teenagers drink and drive less often than adults but are more likely to crash when they do drink and drive.[141] While many of the prevention strategies discussed above apply both to adults and teenagers, NHTSA supports several prevention strategies directed specifically to those under the age of 21. NHTSA publishes fact sheets,[142] research, and funded program guides [143] on teen traffic safety and effective practices to reduce teen impaired driving. NHTSA also partners with youth advocacy organizations as well as primary and secondary education organizations to provide youth-focused impaired driving prevention education, messages, teacher resources, and educational materials for drivers of all ages. Furthermore, NHTSA partners with driver educators to teach teen and novice drivers about the dangers of impaired driving and to develop driver education standards.

3. Communications Campaigns

Public service messaging and coordinated enforcement are also important behavioral strategies. Communications campaigns inform the public of the dangers of impaired driving and promote positive social norms of not driving while impaired. NHTSA coordinates with States and other traffic safety stakeholders to educate the public about the impairing effects of alcohol and drugs and the dangers they pose to drivers of all ages. NHTSA produces a communications calendar annually with details about specific campaign and enforcement periods, holidays, and other notable events during which time there may be increased dissemination of campaign messages and coordinated law enforcement efforts at the State and local level. Campaign materials are made accessible to the public and stakeholders online at Traffic Safety Marketing (TSM).[144] These communications efforts can be divided into two categories: high-visibility enforcement and social norming campaigns.

a. High-Visibility Enforcement Campaigns

High-visibility enforcement campaigns coordinate highly visible and proactive law enforcement activities with public service messages highlighting the dangers of impaired driving and the enhanced enforcement efforts. NHTSA runs two national high-visibility impaired driving campaigns each year—one in August, leading up to and including Labor Day weekend, and one in December, during the winter holiday period. High-visibility enforcement campaigns include national media segments that air on TV and radio as well as digital media in English and Spanish. Both campaigns include national paid media buys incorporating both an alcohol-impaired driving message (Drive Sober or Get Pulled Over) and a drug-impaired driving message (If You Feel Different, You Drive Different. Drive High, Get a DUI). These campaign assets are available at no cost for States, regions, and other stakeholders to download and use during applicable campaign periods. During each campaign timeframe, NHTSA encourages law enforcement and other State agencies to use the provided assets on social media. State leaders can also engage with the local news media to expand awareness of the campaigns and associated messages. Each campaign period comes with information on how to conduct Media Buys, and its reports on the number of impressions made.

b. Social-Norming Campaigns

Communications efforts are not limited to high-visibility enforcement campaigns but also continue throughout the year. For instance, NHTSA has public service announcement campaigns that rely on donated time

[137] *https://www.nhtsa.gov/sites/nhtsa.gov/files/documents/ignitioninterlocks_811883_112619.pdf.* This is a toolkit for policymakers, highway safety professionals and advocates that brings together resources that explain and support the use of alcohol ignition interlocks, identifies issues faced by ignition interlock programs and includes information on the use of interlocks in each State and the District of Columbia. It is designed to advance the understanding of ignition interlock technology, improving its application as an effective strategy to save lives and prevent impaired driving injuries.

[138] *https://www.nhtsa.gov/sites/nhtsa.gov/files/811262.pdf.*

[139] *See, e.g., https://rosap.ntl.bts.gov/view/dot/1909.*

[140] *https://aiipaonline.org/.*

[141] Bingham CR, Shope JT, Parow JE, Raghunathan TE. Crash types: markers of increased risk of alcohol-involved crashes among teen drivers. J Stud Alcohol Drugs. 2009 Jul;70(4):528–35. doi: 10.15288/jsad.2009.70.528. PMID: 19515292; PMCID: PMC2696293.

[142] *https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/813313.*

[143] *See e.g., https://www.ghsa.org/resources/Peer-to-Peer19.*

[144] *https://www.trafficsafetymarketing.gov/.*

and space from various media outlets throughout the nation. The main message for alcohol-impaired driving is ''Buzzed Driving is Drunk Driving,'' and the main message for drug-impaired driving is ''If you Feel Different, You Drive Different.'' NHTSA works with the Ad Council to produce campaign resources (TV, radio, digital, print, and outdoor advertising) and distributes them to organizations that donate time and space to support campaign messaging.

4. Alcohol and Drug Treatment, Monitoring, and Control

Treatment for substance use is another major strategy to address the behaviors leading to drunk and impaired driving. It is widely recognized that many DWI first offenders and most repeat offenders meet criteria for an alcohol use disorder and are likely to continue to drink and drive unless the underlying substance use disorder is addressed. DWI arrests provide an opportunity to identify offenders with alcohol use problems, and as part of a plea bargain or diversion program, refer them to treatment in addition to imposing sanctions.

NHTSA endorses the use of the Substance Abuse and Mental Health Services Administration's Screening, Brief Intervention and Referral to Treatment (SBIRT) approach. This is a comprehensive, integrated, public health approach to the delivery of early intervention and treatment services for persons with substance use disorders, as well as those who are at risk of developing these disorders.[145] To help States use an SBIRT approach NHTSA funded the American Probation and Parole Association to develop the Impaired Driving Assessment. This tool provides a framework for screening impaired drivers, estimating their risk for future impaired driving, and assessing responsivity to intervention efforts, among other things.

NHTSA also encourages States and jurisdictions to establish DWI courts. DWI courts are specialized, comprehensive programs providing treatment, supervision, and accountability for repeat DWI offenders. These courts follow the well-established drug court model and are usually aimed at drivers with prior DWI offenses or those with BACs of .15 g/dL or higher. In 2019, NHTSA entered into a cooperative agreement with the National Center for DWI Courts to develop the 10 Guiding Principles for DWI Courts document, provide education and training for both new and existing DWI Courts, fund technology for the expansion of reach to underserved populations, and fund services (*e.g.,* treatment) to high-risk/high-need offenders.[146] There is evidence that DWI courts have greater success in changing driver behavior compared to traditional court processes and sanctions. A 2011 evaluation by NHTSA of three Georgia DUI Courts found substantial reductions in recidivism for repeat DUI offenders.[147]

B. Vehicle-Based Countermeasures

While the previous section discussed the various behavioral efforts that NHTSA has engaged in, NHTSA is conducting complementary research on vehicle safety technologies that have the potential to prevent or mitigate drunk and impaired driving. The behavioral campaigns and the vehicle-based countermeasures are part of NHTSA's dynamic strategy to achieve zero fatalities related to driver impairment.

1. Summary of Research on Vehicle-Based Countermeasures

This section summarizes five major research efforts focused on vehicle safety technologies: (1) Driver Alcohol Detection System for Safety, (2) Driver Monitoring of Inattention and Impairment Using Vehicle Equipment, (3) NHTSA's Request for Information, (4) Technology Scans, and (5) Additional ongoing research.

a. Driver Alcohol Detection System for Safety

NHTSA has been conducting research to understand ways to detect driver impairment. A major research program is DADSS. NHTSA began the DADSS Program in 2008 through a Cooperative Agreement between the Agency and the Automotive Coalition for Traffic Safety (ACTS) to develop non-invasive technology to prevent alcohol-impaired driving by measuring blood or breath alcohol accurately, precisely, and rapidly. Exploratory research in early phases of the program established the feasibility of two sensor approaches for in-vehicle use: breath- and touch-based. Since then, there have been significant advances in sensor hardware and software development, as the program works toward meeting high-performance standards required for passive, accurate, and reliable alcohol measurement.

There are two technology approaches under development for DADSS, and both use infrared spectroscopy to measure a driver's alcohol concentration. The DADSS touch sensor measures the BAC in the capillary blood in the dermis layer of the skin on the palmar side of a driver's hand. A touch pad with an optical module could be integrated into an ignition switch or steering wheel. When the driver touches the steering wheel or ignition switch, a near infrared light shines into the driver's skin. The portion of the near infrared light that is reflected back is collected by the touch pad. This light transmits information about the skin's chemical properties, including the concentration of alcohol present. The DADSS breath sensor uses detectors that simultaneously measure the concentrations of alcohol and carbon dioxide (CO_2) in a driver's exhaled breath.[148] The diluted breath is drawn into a measurement cavity where optical detectors measure the amount of infrared light absorbed by the alcohol and CO_2. Using these measurements, the driver's BrAC is calculated.

It is worth emphasizing that the current DADSS breath sensor requires directed puff of breath toward the sensor and would therefore not be considered passive under BIL. The end design that the DADSS program is working toward is a breath sensor that will capture naturally exhaled breath to make the calculation and may be considered passive as required by the BIL. The goal is not to require the driver to actively blow or puff air or take other action to provide the requisite sample for the system to analyze. The DADSS touch sensor is being designed to be embedded in something that the driver must touch to operate the vehicle, for example, push-to-start button, the steering wheel, or the gear shift selector. Therefore, NHTSA tentatively determines that such a touch sensor could be considered passive.

As part of the cooperative agreement with NHTSA, ACTS is planning to develop DADSS Reference Designs for the sensors that include schematics, specifications, minimum hardware requirements, and other documentation for the DADSS sensors so the technology can be licensed, and sensors manufactured. ACTS plans for open licensing of the sensors, which means the technology will be made available on the same terms to any automaker or supplier interested in installing the technology into their vehicles or products. The first DADSS Reference Design—a directed-breath, zero-tolerance (BrAC >.02 g/dL) accessory

[145] *https://www.samhsa.gov/sbirt.*

[146] *https://rosap.ntl.bts.gov/view/dot/2055.*

[147] *https://rosap.ntl.bts.gov/view/dot/2055.*

[148] The concentration of CO_2 in the breath provides an indication of the degree of dilution of the alcohol concentration indicating the distance from the sensor the breath was exhaled to determine if the sample is from the driver.

system for limited deployment in fleet vehicles—was released for open licensing in December 2021. A second DADSS zero-tolerance touch system reference design intended for fleet vehicles is expected in 2024, according to ACTS. ACTS expects touch and breath sensor reference designs for private vehicles, capable of higher BAC measurements, in 2025.[149] NHTSA is aware that these delivery dates may be affected by several factors including further research and development and continued supply-chain issues resulting from the COVID–19 pandemic. These dates do not include the time necessary for any manufacturer to consider and implement design changes necessary to integrate these systems into vehicles.

b. Driver Monitoring of Inattention and Impairment Using Vehicle Equipment

Another research initiative that NHTSA has conducted is a program with the University of Iowa National Advanced Driving Simulator called Driver Monitoring of Inattention and Impairment Using Vehicle Equipment (DrIIVE).[150] The research program explored driver impairment through two separate tracks of research: (1) detection, and (2) mitigation. The main goal of the DrIIVE detection track was to develop and evaluate a system of vehicle-based algorithms to identify alcohol, drowsiness, and distraction impairment. Three impairment-detection algorithms, covering impairment from alcohol intoxication, drowsiness, and distraction, successfully detected matching impairment type (*e.g.,* drowsiness algorithm identified drowsy drivers from a dataset of drowsy and non-drowsy drivers) but had mixed results when applied to cross-impairment datasets (*e.g.,* drowsiness algorithm identifying drowsiness from a dataset of drowsy and distracted drivers).

The alcohol intoxication algorithm adapted well to the distracted and drowsy datasets, assuming that there was no alcohol intoxication present in those datasets (participants in the non-alcohol condition were neither dosed with alcohol, nor was BAC measured). The distraction algorithm also worked moderately well when applied to a cross-impairment dataset, although it worked better with head pose incorporated as a driver-based sensor signal (*e.g.,* head pose, body posture), as discussed further below.

It is important to note that the DrIIVE projects have focused on vehicle-based sensor data; however, they have also incorporated driver-based sensor signals. Additionally, the researchers investigated the benefits of taking individual differences between drivers into account in the training and operation of an algorithm. Driver-based sensors provided an added benefit to the performance and generalization of the distraction-detection algorithm, while individualizing the algorithms for individuals provided an added benefit to a drowsiness algorithm and an alcohol-intoxication algorithm. NHTSA recognizes that there are substantive challenges in individualizing algorithms across the entire driving population.

Overall, the algorithms showed good success rates at correctly identifying driver impairment (and the correct source). However, the results of these studies also showed an interesting finding in which, in rare instances, drowsy drivers were categorized as alcohol impaired (despite not being dosed with alcohol). NHTSA has plans to initiate follow on research to refine the algorithm with the aim of determining if alcohol impairment detection can be achieved with a higher degree of accuracy. NHTSA recognizes the importance of accuracy of alcohol-impaired driver detection so that non-impaired drivers are not inconvenienced.

The DrIIVE mitigation research demonstrated the potential short-term effectiveness of both haptic and auditory staged alerts (*i.e.,* the ability to improve driving performance for a period of time after the drowsiness alert is provided). Results show that drowsy drivers who received mitigation alerts maintained better vehicle control and had fewer drowsy lane departures than drowsy drivers without this mitigation. Additionally, drowsy drivers with mitigation showed less variability in speed maintenance. Furthermore, the research suggested that staged alerts may be more effective than discrete alerts for very drowsy drivers. Finally, alert modality did not affect driving performance, nor did the alerts significantly lower self-reported drowsiness. NHTSA has ongoing warning mitigation research for intoxication.

c. NHTSA's November 12, 2020 Request for Information

NHTSA also sought input from the public on impaired driving technologies through its November 12, 2020, NHTSA Request for Information (RFI).[151] The notice requested information to inform NHTSA about the capabilities, limitations, and maturity of available technologies or those under advanced stages of development that target impaired driving. Specifically, it requested details about technologies that can detect degrees of driver impairment through a range of approaches including: (1) technologies that can monitor driver action, activity, behavior, or responses, such as vehicle movements during lane keeping, erratic control, or sudden maneuvers; (2) technologies that can directly monitor driver impairment (*e.g.,* breath, touch-based detection through skin); (3) technologies that can monitor a driver's physical characteristics, such as eye tracking or other measures of impairment; and (4) technologies or sensors that aim to achieve direct measurement of a driver's physiological indicators that are already linked to forms of impaired driving (*e.g.,* BAC level for alcohol-impaired driving). NHTSA received 12 responses to the request for information. The following provides a high-level summary of those responses.

The Alliance for Automotive Innovation (Auto Innovators) noted that Driver State Monitoring and Driver Behavior Systems are promising technologies that, with continued development, have the potential to significantly reduce distracted and drowsy driving. The Auto Innovators also stated that they are ''. . . unaware of existing research demonstrating the robust effectiveness of these systems in detecting alcohol impairment. . . .'' The Auto Innovators further stated that ''Driver State Monitoring/Driver Behavior Systems' ability to identify high-functioning individuals impaired by alcohol is unknown, but likely poor. Additional research is needed to understand the opportunities and limitations of these systems relative to individual alcohol impairment. Pre-operation systems, including DADSS, are not so limited because they are designed to quantify a driver's BAC.''

Three automotive suppliers[152] of camera-based DMSs and occupant monitoring systems responded to the November 12, 2020, Request for

[149] *https://dadss.org/news/updates/when-might-the-dadss-technology-be-in-u-s-cars-and-trucks.*

[150] Brown, T.L., & Schwarz, C.W., Jasper, J.G., Lee, J.D., Marshall, D., Ahmad, O. (in press) ''Driver Monitoring of Inattention and Impairment Using Vehicle Equipment (DrIIVE) Phase 2.'' National Highway Traffic Safety Administration.

[151] 85 FR 71987, *available at https://www.regulations.gov/docket/NHTSA-2020-0102.*

[152] While not a passive device, a fourth supplier, Evanostics, provided information on a table-top oral fluid testing device that it suggests can test for alcohol and 10 classes of drugs in 15 minutes. A second supplier, Impirica, provided information on a mobile (tablet and phone) based cognitive screening that is designed to evaluate real time driving impairment.

Information. Veoneer, a worldwide supplier of automotive technology, reported that it launched its first camera-based DMS to the market in 2020. Its technology uses a true eye gaze system that determines the directional attributes of where the eyes are focused. Seeing Machines Limited, a DMS supplier, described their technology as providing evidence for the ability to reliably detect both drowsiness and visual distraction. Sony Depthsensing Solutions, an in-cabin occupant monitoring systems provider, described their ability to recognize driver features such as eye open/close and body position. The information they gain through sensors is used ''to extract higher level features such as drowsiness, microsleep, sleep, distraction (long and short) detection, emotion estimation or sudden sickness detection.'' Veoneer and Seeing Machines both noted that detecting driver alcohol impairment is more challenging and requires more technology development and research. Sony Depthsensing Solutions did not comment on the ability to detect other forms of impairment (*e.g.,* alcohol). Eyegaze Inc., an eye tracking technology supplier, suggested their product, with additional work, could provide a solution to monitor driver attention when housed in an automobile.

Safety advocates generally provided support for vehicle safety technologies. The National Safety Council, a safety advocate group, stated their support for in-vehicle passive alcohol detection technology options and DMSs. The Advocates for Highway and Auto Safety, a roadway safety advocacy group, noted their support for vehicle safety technologies, including voicing support for crash avoidance technologies, expedited DADSS research and offender ignition interlocks, among other things. Mothers Against Drunk Driving (MADD) submitted two separate comment submissions to the docket, which included 241 examples of technology related to detection of alcohol in blood or breath, other indicators of alcohol intoxication, drug impairment, drowsiness, and driver distraction/inattention. Finally, a submission by the American National Standards Institute, Inc, provided research references on eye tracking as an indicator of impairment.

d. Technology Scans

In addition to the aforementioned RFI, NHTSA contracted with two different groups to independently review the state of publicly available information related to impairment detection. The first is an update to the ''Review of Technology to Prevent Alcohol- and Drug-Impaired Crashes (TOPIC)'' report.[153] This report updates the 2007 evaluation of vehicular technology alternatives to detect driver BAC and alcohol-impaired driving. It includes additional findings related to the detection of impaired driving due to drugs other than alcohol, drowsiness, and distraction. This report reviews relevant literature and technologies and incorporates input from stakeholders and the public (*i.e.,* information received from the RFI). The report finds that tissue spectroscopy technologies are more accurate in estimating BAC than other technologies available at this time. Although driver attention monitoring technologies are presently able to detect drowsy driving and distracted driving, none specifically able to detect alcohol- or drug-impaired driving were found to be commercially available.

The second technology scan is ''Assessment of Driver Monitoring Systems for Alcohol Impairment Detection and Level 2 Automation.'' The report presents a review of DMS for alcohol impairment detection. A total of 331 systems were reviewed, more than 280 of which met inclusion criteria and are included in the report. The study found that few technologies are commercially available for alcohol impairment detection; some were not designed for in-vehicle use, and others were identified based on patent applications rather than evidence of functional systems. The review focused on features that were explicitly mentioned or indicated on the manufacturers' websites, patents, device manuals, publications, or reports. The review, which was completed in October 2022, noted that camera-based DMS have been in vehicles since 2018 for monitoring driver inattention to the forward roadway for SAE Level 2 driving automation systems,[154] as well as other vehicle-based sensors such as lane position monitoring and steering wheel torque monitoring to measure driver engagement and performance.

The DMS were reviewed with a focus on the applicability of each system to driver alcohol impairment detection. The systems were classified as physiology-based, tissue spectroscopy-based, camera-based, vehicle kinematics-based, hybrid (*i.e.,* two or more of the classification types), and patent-stage systems. A key focus was to review systems that are being developed with the potential to detect alcohol-based driving impairment, as well as systems that can precisely estimate BAC.

Of the systems reviewed, no commercially available product was found to estimate the amount of alcohol or identify alcohol-based impairment in the driver during the driving task. Behavioral indicators investigated included eye glances, facial features, posture, and vehicle kinematic metrics. However, systems with these capabilities are currently at various stages of the research and development process.

Based on industry stakeholder interviews and expert review of technology documentation, the researchers found that approaches that are furthest along in the development process are those which measure the presence and amount of alcohol in a person's body using BrAC and tissue spectroscopy. Camera-based and most physiology-based DMS are still in stages of preliminary research and design for alcohol-based impairment detection in passenger vehicles. The efficacy of vehicle kinematic measures in identifying alcohol-based impairment is currently unknown. Finally, hybrid systems are promising in being able to discern between driver states due to the number of different measures used in making state determinations.

e. NHTSA's Driver Monitoring Research Plans

In addition to state-of-the-art assessments on DMSs, NHTSA has conducted research on driver state monitoring used in conjunction with SAE Level 2 driving automation.[155] While using Level 2 driving automation, drivers are expected to both monitor the environment and supervise vehicle automation which is simultaneously providing lateral and longitudinal support to the driver. Some systems do not require the driver to have their hands on the wheel, while others include advanced features like automated lane changes and point-to-point navigation. The research included a literature review, stakeholder interviews, and system assessments. Many, but not all, Level 2 driving automation systems monitor visual and physical driver indicators, using camera-based sensing systems. Useful

[153] Pollard, J.K., Nadler, E.D., & Melnik, G.A. (In Press). Review of Technology to Prevent Alcohol- and Drug-Impaired Crashes (TOPIC): Update. National Highway Traffic Safety Administration.

[154] SAE International, Standard J3016, ''Taxonomy and Definitions for Terms Related to On-Road Motor Vehicle Automated Driving Systems,'' April 2021.

[155] Prendez, D.M., Brown, J.L., Venkatraman, V., Textor, C., Parong, J., & Robinson, E. (in press). Assessment of Driver Monitoring Systems for Alcohol Impairment Detection and Level 2 Automation. National Highway Traffic Safety Administration.

measures of general driver visual attention include measures of eye/pupil movement (*e.g.,* fixation duration), measures of glance location (*e.g.,* eyes on/off road), and measures of glance spread and range (*e.g.,* scan path).

While NHTSA's research on DMS for Level 2 driving automation systems has implications for DMS applied to detection of alcohol impairment with regard to technological feasibility, there are important differences between these two applications. The safety issues, indicators and measures of driver risk, consumer acceptance, and potential interventions may be different for Level 2 driving automation than they are for alcohol impairment. For example, drivers who are impaired by alcohol may appear to be visually attentive as measured by eye gaze toward the forward roadway, so alternative measures will be important to achieve reliable detection of impairment. Additionally, while alerts may prompt inattentive drivers to return their attention to the road, alerts alone cannot remedy driver impairment from alcohol. Additionally, the use of Level 1 and higher driving automation itself may pose challenges for the detection of alcohol impairment. This is because some of the driving performance measures that may be indicative of alcohol impairment (*e.g.,* instability of lane position and speed) cannot be used when the vehicle itself is controlling that portion of the dynamic driving task. NHTSA is currently conducting research examining distraction that does not specifically focus on drunk driving or metrics but might be helpful to consider if the agency pursues an approach that requires camera-based driver monitoring to detect drunk driving.

2. Passive Detection Methods and Available Technologies

The ''advanced drunk and impaired driving prevention technology'' under BIL prescribes three methods of passive detection—(1) passively monitor the performance of a driver of a motor vehicle to accurately identify whether that driver may be impaired; (2) passively and accurately detect whether the blood alcohol concentration of a driver of a motor vehicle is equal to or greater than the blood alcohol concentration described in section 163(a) of title 23, United States Code; [156] or (3) a combination of the first and second options.

NHTSA interprets the first option as passively monitoring the driver's performance (*e.g.,* eyes on the forward roadway; taking appropriate steering, braking, or accelerating action) to gain an accurate determination of whether the driver may be impaired. Since ''driver impairment'' could include more than just alcohol-impairment, the collective states of driver impairment would constitute the largest real-world safety problem. NHTSA interprets the second option to require passive and accurate detection of BAC over a prescribed limit (which is currently .08 g/dL). This would exclusively target a subset of driver impairment conditions (*i.e.,* alcohol-impaired drivers) focused on BAC detection. Alcohol-impaired drivers constitute the largest fatal driver impairment type. The third option is a combination of both the first and second. The following subsections discuss each of these options.

a. *Passively Monitor the Performance of a Driver To Accurately Identify Whether That Driver May Be Impaired*

For the purposes of this section, the following driver impairments were considered: drowsiness, distraction, and drunk, in the order of increasing fatality counts in the United States. While drugged driving is another known driver impairment, the ability to explicitly detect drug-impaired drivers is currently limited. Some of the effects of drugged driving, however, may be similar to the effects of alcohol-impaired or distracted driving, and therefore it is possible that vehicle technologies designed to detect other forms of impairment may also have the ability to detect some drug-induced impairments as well. As stated in the introduction, NHTSA is considering prioritizing alcohol impairment due to the significant safety problem caused by drivers intoxicated by alcohol and requests comment on whether that scope is most appropriate and whether its focus should be expanded to other types of impairment, including those discussed in this section.

Driver performance generally consists of being attentive to the driving task, and taking appropriate vehicle control actions (*i.e.,* steering, accelerating, and braking). Modern vehicles are equipped with many crash avoidance and driver assistance sensors that may provide opportunity to contribute to the detection of driver impairment. The following provides examples of those sensing technologies.

Camera-Based Driver Monitoring Sensors: Camera-based DMSs are becoming more prevalent in vehicles with Level 2 driving automation features (*i.e.,* adaptive cruise control and lane centering).[157] NHTSA reviewed several available and prototype camera-based driving monitoring systems that publicly state the ability to monitor aspects of driver state, including driver's eye gaze, eyelid/eye closure, pupil size, head/neck position, posture, hand/foot position, and facial emotion during the driving task.[158] The review found that most systems are currently available and intended for use in detecting driver drowsiness, inattention, and sudden sickness/non-responsive drivers and few are for specifically detecting alcohol-impairment. Although measures such as eye closure over time, pupil diameter, saccades (an eye movement between fixations), and fixations are parameters under study for detecting alcohol impairment, the review found that there was a lack of clinical and psychophysiological research to aid in specifically detecting driver alcohol impairment. The review found only three systems that claimed alcohol-based impairment detection as the objective, but the systems with these capabilities are not available on the market.

It is notable, however, that other past NHTSA research suggested that the driver states of drowsiness and alcohol-impairment can present similarly to a driver monitoring system.[159] So there may be an opportunity ''to detect'' some alcohol-impaired drivers that present as drowsy. However, as discussed further below, the countermeasure for ''prevention'' applied to a sober drowsy driver, as opposed to an alcohol-impaired driver, may not be the same. For example, NHTSA contemplates and seeks comment on whether a sober drowsy driver may respond favorably to a warning and may even take a break from driving to recover, whereas an alcohol-impaired driver may not respond to a warning at all, or worse,

[156] 23 U.S.C. 163(a) states ''The Secretary shall make a grant, in accordance with this section, to any State that has enacted and is enforcing a law that provides that any person with a blood alcohol concentration of 0.08 percent or greater . . .''.

[157] The Path to Safe Hands-Free Driving | GM Stories; Ford BlueCruise | Consumer Reports Top-Rated Active Driving Assistance System | *Ford.com;* Nissan ProPILOT Assist Technology | Nissan USA; Teammate Advanced Drive Backgrounder—Lexus USA Newsroom.

[158] Prendez, D.M., Brown, J.L., Venkatraman, V., Textor, C., Parong, J., & Robinson, E. (in press). Assessment of Driver Monitoring Systems for Alcohol Impairment Detection and Level 2 Automation. National Highway Traffic Safety Administration.

[159] Brown, T.L., & Schwarz, C.W, Jasper, J.G., Lee, J.D., Marshall, D., Ahmad, O. (in press) ''Driver Monitoring of Inattention and Impairment Using Vehicle Equipment (DrIIVE) Phase 2.'' National Highway Traffic Safety Administration.

respond in a negative way (*e.g.,* becoming a more risky driver).

Hands-On-Wheel Sensors: Drivers with their hands off the steering wheel for an extended period of time can be an indicator of driver inattention. Vehicles equipped with Level 2 features often have capacitive or steering torque sensors to confirm that the driver has at least one hand on the steering wheel. Capacitive sensing detects the change in capacitance of the steering wheel that results from the driver's hands being removed from the wheel. Steering wheel torque sensing detects small steering inputs made by the driver. These sensors are commonly used in algorithms to encourage drivers to remain attentive during driving.[160] It should be noted, however, that some Level 2 feature designs permit hands-off-wheel while supervising the vehicle automation. Current production vehicles with Level 2 features that permit drivers to remove their hands from the wheel have camera-based DMS that alert drivers if they look away from the forward roadway for more than a few seconds.

Lane Departure and Steering Sensors: Poor precision as indicated by unintended lane excursions may indicate unsuitable driver states, including alcohol-based impairment.[161] Alcohol reduces driving precision, and lane positioning is a key skill that is affected, even at low doses. Deviation of lane position from the lane center increases with increasing doses of alcohol.[162] The Standard Deviation of Lane Position (SDLP) is considered a sensitive (but not specific) measure of alcohol impairment.[163] Relatedly, measures of steering inputs can be used to detect alcohol impairment.[164] Specifically, drivers who are impaired due to alcohol may exhibit more erratic driving patterns with tendencies to deviate from their lane position.[165]

The following crash avoidance sensor technologies equipped on modern vehicles could aid in detecting lane departure: forward-looking external cameras; steering wheel torque sensors; and blind spot detection sensors.

When driven manually, forward-looking external cameras commonly used in lane departure warning systems have the potential to identify a vehicle drifting out of its travel lane, typically when lane markings are present and observable (*i.e.,* not snow-covered or worn). This could include drifting off the roadway or drifting into oncoming traffic. Tracking a vehicle's lane departure warning activations over time could present as an indicator of a driver directing the vehicle to weave in and out of its travel lane (weaving and weaving across lanes are cues used by officers in detection of impaired driving).[166] NHTSA's research suggests that many vehicle manufacturers use lane position monitoring for detecting unintentional lane drift from several driver impairments—drowsiness and inattention.[167] Some vehicle manufacturers were found to use lane position monitoring in available features, such as oncoming lane mitigation and run-off road mitigation.[168]

Some vehicles are equipped with steering wheel torque sensors that monitor a driver's steering inputs. Such sensors could detect and monitor erratic steering corrections over time during the course of a trip. NHTSA's research suggests that some vehicle manufacturers use steering input monitoring for detecting inattention, drowsiness, or sudden sickness/non-responsive driver for vehicles equipped with Level 2 systems (used in an active emergency stop assist application).[169]

Many modern vehicles also come with blind spot warning sensors on the sides of the vehicle that can identify a vehicle in an adjacent lane.[170] If an impaired driver attempts to steer into an adjacent lane of travel when another vehicle is in its blind spot, a vehicle equipped with this technology can warn the driver, or in some vehicles, even intervene via active blind spot intervention technology.

Speed/Braking Sensors: Speed maintenance is generally affected by high BAC levels. NHTSA's research has found that driver alcohol doses greater than BAC .05 g/dL can significantly impair an individual's ability to maintain appropriate speed, particularly in complex environments.[171] While some studies report increased speeds by alcohol-impaired drivers, others report speed decreases.[172] The reduced ability to maintain consistent speed is referred to as the Standard Deviation of Speed Deviation (SDPD), which is commonly used to measure relative performance of impaired drivers compared to control groups. While findings concerning speed directionality (*i.e.,* increase or decrease) are mixed, studies have consistently shown that speed deviation from posted speed limits tends to increase in alcohol-impaired driver groups.[173]

That said, some forward-looking external cameras can detect and interpret posted speed limit signs, which could provide an indicator of speeding when compared to the actual speed the vehicle is traveling. Some vehicles have telematics and maps that provide posted speed limit information. Vehicles also have brake sensors that could be monitored over time to sense repeated incidences of hard braking during a trip.

Time-Based Sensors: Two other vehicle sensors that could be used in an overall driver impairment algorithm include duration of trip, and time of day. Monitoring the trip duration is used in some vehicle algorithms to warn about drowsy driving.[174] After a certain

[160] Driver Monitoring | Alliance For Automotive Innovation (*autosinnovate.org*).

[161] *https://www.nhtsa.gov/sites/nhtsa.gov/files/808677.pdf.*

[162] Harrison, E.L., & Fillmore, M.T. (2005). Are bad drivers more impaired by alcohol? Sober driving precision predicts impairment from alcohol in a simulated driving task. Accident Analysis & Prevention, 37(5):882–9. doi: 10.1016/j.aap.2005.04.005; Lee JD, Fiorentino D, Reyes ML, Brown TL, Ahmad O, Fell J, Ward N, Dufour R. (2010). Assessing the Feasibility of Vehicle-Based Sensors to Detect Alcohol Impairment. National Highway Traffic Safety Administration. Report No. DOT HS 811–358; Calhoun, V.D. & Pearlson, G.D. (2012). A selective review of simulated driving studies: Combining naturalistic and hybrid paradigms, analysis approaches, and future directions. *NeuroImage, 59*(1), 22–35; Irwin C, Iudakhina E, Desbrow B, McCartney D. (2017). Effects of acute alcohol consumption on measures of simulated driving: A systematic review and meta-analysis. *Accident Analysis & Prevention, (102),*248–266. doi: 10.1016/j.aap.2017.03.001. Epub 2017 Mar 24. PMID: 28343124.

[163] Irwin C, Iudakhina E, Desbrow B, McCartney D. (2017). Effects of acute alcohol consumption on measures of simulated driving: A systematic review and meta-analysis. *Accident Analysis & Prevention, (102)*248–266. doi: 10.1016/j.aap.2017.03.001. Epub 2017 Mar 24. PMID: 28343124.

[164] Das D., Zhou S., Lee J. D. (2012). Differentiating alcohol-induced driving behavior using steering wheel signals. *IEEE Trans. Intel. Transp. Syst.* 13 1355–1368. 10.1109/TITS.2012.2188891.

[165] Kersloot, Tanita & Flint, Andrew & Parkes, Andrew. (2003). Steering Entropy as a Measure of Impairment.

[166] *https://www.nhtsa.gov/sites/nhtsa.gov/files/808677.pdf*

[167] Prendez, D.M., Brown, J.L., Venkatraman, V., Textor, C., Parong, J., & Robinson, E. (in press). Assessment of Driver Monitoring Systems for Alcohol Impairment Detection and Level 2 Automation. National Highway Traffic Safety Administration.

[168] Prendez, D.M., Brown, J.L., Venkatraman, V., Textor, C., Parong, J., & Robinson, E. (in press). Assessment of Driver Monitoring Systems for Alcohol Impairment Detection and Level 2 Automation. National Highway Traffic Safety Administration.

[169] Prendez, D.M., Brown, J.L., Venkatraman, V., Textor, C., Parong, J., & Robinson, E. (in press). Assessment of Driver Monitoring Systems for Alcohol Impairment Detection and Level 2 Automation. National Highway Traffic Safety Administration.

[170] *https://www.nhtsa.gov/equipment/driver-assistance-technologies.*

[171] Veldstra et al., 2012; Mets et al., 2011.

[172] Rezaee-Zavareh et al., 2017; Lee et al., 2010; West et al., 1993; Irwin et al., 2017; Lenne et al., 2010.

[173] Arnedt et al., 2001; Yadav & Velaga, 2020; Irwin et al., 2017.

[174] Driver Attention Warning | Hyundai.

length of time, a vehicle may provide an icon (*e.g.,* a coffee cup-like symbol) on the instrument panel to suggest a driver take a break from the driving task. Monitoring the trip duration may also help in identifying repeated lane departures over time. Monitoring the time of day could be added to other detection methods to help confirm detection of drowsiness or alcohol-impairment states at late night times. Most alcohol-impaired driving fatalities in the United States occur between 6 p.m. and 3 a.m.[175]

Physiological Sensors: There are also a variety of physiological-based systems under research that use biometric measures from the driver to infer driver state. These could include heart rate, sweat, and blood pressure, among others. NHTSA's research found that many were in the research and development stage, including those for breath alcohol detection (which will be discussed in the next section).[176] A practical limitation of their use may be the fact that detecting driver impairment may be reliant upon background knowledge of a specific driver's baseline physiological characteristics (to sense elevated levels) and can be attributable to multiple physiological states (*e.g.,* stress).

In summary, NHTSA's research suggests that many driver impairment detection strategies use different combinations of measures, but the available documentation of multi-detection approaches is rare, and when present, details of the underlying algorithms are sparse.[177] It is reasonable to assume that the combination of more sensors and driver metrics will improve the confidence in driver state inference. Little data is available, however, to inform NHTSA on which combination of sensors and indicators of driver state, if any, would achieve greater accuracy and reliability of impairment detection.

Vehicle manufacturers have announced concept vehicles or production plans for active/passive technologies to mitigate alcohol-impaired driving for many years. For example, a media article [178] cited alcohol-impaired driver research by General Motors dating back to the 1970s on a critical tracking test (CTT) ''experimental deterrent'' that used the result from a 10-second test the driver took each time he or she got behind the wheel to determine whether the car would start. Tests were reported to use driver steering wheel movement and a gauge on the instrument panel where the driver would have to keep the needle on the gauge in the acceptable range through a series of progressive needle movements. Another concept involved cognitive tests where a series of five numbers appeared above five numbered white buttons on the instrument panel (or on a keypad). To pass the test, the driver must replicate the number sequence by using buttons and complete it in a designated timeframe.

More recently, a 2016 patent held by General Motors, ''Method and System for Mitigating the Effects of an Impaired Driver,'' aims to detect inattention and alcohol-based impairment through use of camera-based detection measures (*i.e.,* eye gaze, eyelid/eye closure, and facial/emotional measures), as well as lane monitoring and steering input.[179]

Similarly, in 2007, Toyota announced its intent to create a fail-safe system for cars that detects drunk drivers and automatically shuts the vehicle down if sensors pick up signs of excessive alcohol consumption. According to a media report,[180] cars fitted with the detection system will not start if sweat sensors in the driving wheel detect high levels of alcohol. The system could also detect abnormal steering, or if a special camera shows that the driver's pupils are not in focus, the car would be slowed to a halt. Toyota had reportedly hoped to fit cars with the system by the end of 2009. NHTSA does not know the current status of this Toyota technology and seeks comment on its effectiveness and availability.

During the same timeframe, Nissan also reportedly developed a concept car with technology to detect alcohol in the breath and sweat of the driver.[181] Nissan's concept car had an alcohol sensor in the transmission shift knob, and in the driver's and passenger's seats. Both reportedly worked together to detect traces of alcohol in the cabin past a certain threshold. If the driver's seat or shift knob had detected any alcohol while still parked, the transmission locked and made the car immobile. A second feature was a facial monitoring system built to monitor signs of drowsiness or distraction by monitoring the driver blinking rate. Once detected, a voice message alert was issued, and the seat belt was tightened to gain the attention of the driver. A third concept that was further developed after the 2007 timeframe was a road monitoring system. Nissan put technology in vehicles that monitored lanes and alerted drivers when the vehicle drifted out of the current lane, which Nissan reportedly believed mitigated safety risks associated with distracted driving.

Hyundai Mobis, a global Tier 1 [182] supplier, has been researching a technology called DDREM—Departed Driver Rescue and Exit Maneuver. Initially announced at the Consumer Electronics Show in 2018,[183] DDREM uses an infrared camera to capture driver facial and eye movements to determine if the driver keeps eyes forward, changes blinking patterns, or exhibits other signs of drowsiness. The technology also looks for key identifiers used in advanced driver assistance systems (*e.g.,* if the driver is moving in and out of a lane, crossing lanes, zig zagging, or making erratic movements).

On March 20, 2019, Volvo Cars announced plans to deploy in-car cameras and intervention against intoxication and distraction.[184] Its press release stated, ''Volvo Cars believes intoxication and distraction should be addressed by installing in-car cameras and other sensors that monitor the driver and allow the car to intervene if a clearly intoxicated or distracted driver does not respond to warning signals and is risking an accident involving serious injury or death.'' The press release provided examples of behaviors to be detected: a complete lack of steering input for extended periods of time, drivers who are detected to have their eyes closed or off the road for extended

[175] Traffic Safety Facts 2020: A Compilation of Motor Vehicle Crash Data (*dot.gov*) Table 31.

[176] Prendez, D.M., Brown, J.L., Venkatraman, V., Textor, C., Parong, J., & Robinson, E. (in press). Assessment of Driver Monitoring Systems for Alcohol Impairment Detection and Level 2 Automation. National Highway Traffic Safety Administration.

[177] Prendez, D.M., Brown, J.L., Venkatraman, V., Textor, C., Parong, J., & Robinson, E. (in press). Assessment of Driver Monitoring Systems for Alcohol Impairment Detection and Level 2 Automation. National Highway Traffic Safety Administration.

[178] A GM onboard experimental alcohol and drug impairment detection device of the 1970s | Hemmings

[179] Prendez, D.M., Brown, J.L., Venkatraman, V., Textor, C., Parong, J., & Robinson, E. (in press). Assessment of Driver Monitoring Systems for Alcohol Impairment Detection and Level 2 Automation. National Highway Traffic Safety Administration.

[180] Toyota creating alcohol detection system (*nbcnews.com*).

[181] Nissan Is Ahead of Its Time in Developing Anti-Drunk Driving Technology Over a Decade Before Potential Federal Mandate | *GetJerry.com.*

[182] Tier 1 suppliers are companies that are direct suppliers to Original Equipment Manufacturers (OEM).

[183] *https://www.businesswire.com/news/home/20180103005023/en/2018-CES-Hyundai-Mobis-Announces-Lifesaving-Autonomous-Vehicle-Technology-to-Potentially-Eliminate-Drowsy-Driving-Fatalities,* last accessed July 7, 2023.

[184] *https://www.media.volvocars.com/global/en-gb/media/pressreleases/250015/volvo-cars-to-deploy-in-car-cameras-and-intervention-against-intoxic.*

periods of time, as well as extreme weaving across lanes or excessively slow reaction times. It further stated introduction of the cameras on all Volvo models will start on the next generation of Volvo's scalable SPA2 vehicle platform in the early 2020s.

Most recently, Volvo introduced the model year 2024 Volvo EX 90 that has a ''Driver Understanding System,'' which uses two interior sensors and a capacitive steering wheel along with the vehicle's exterior sensors to understand if a driver is distracted or drowsy and when the vehicle may need to step in and support.[185]

Given the advancements in driver impairment detection (*i.e.,* due to use in combination with SAE Level 2 driving automation technology), it is expected that other approaches will improve over time as strategies for mitigating inattention, incapacitation, drowsiness, and alcohol-impairment detection evolve—both from a technology perspective and a consumer acceptance stance. For example, Consumer Reports published an article suggesting that early versions of these driver impairment technologies are already appearing on cars in other countries.[186] NHTSA seeks comment on the current state of technology and its effectiveness in passively detecting driver impairment.

Questions on Technologies That Passively Monitor the Performance of a Driver To Accurately Detect Whether That Driver May Be Impaired

1.1. NHTSA requests feedback on the two technology scan findings. Are there technologies, or technology capabilities or limitations not captured in these reports? If so, what are they?

1.2. NHTSA is concerned that behaviors consistent with drunk driving, like repeated potential lane departure and erratic speeding/braking, would be masked by an engaged SAE Level 2 driving automation systems. Would there be enough information from other sensors (*e.g.,* camera-based DMS, hands-on-wheel detection) to detect driver impairment and driver impairment type when SAE Level 1 or 2 driving automation systems are active?[187]

1.3. NHTSA is concerned about the limitations of vehicle sensor-based impairment detection systems to operate fully when certain sensors are impeded. External circumstances may include common roadway conditions such as darkness, heavy weather, roads with poor markings, or unpaved roads. Circumstances within the vehicle may include driver accessories, such as infrared light-blocking sunglasses, masks, or hats that may obscure the view of the driver to a DMS camera. If one or more sensors are impeded by such conditions, is there enough information from other sensors to detect driver impairment? Does this vary by impairment type? What are the operational limitations of such systems?

1.4. NHTSA is seeking input on how a test procedure for driver impairment detection systems could be developed and executed in a FMVSS. For example, does the test need to be conducted in a moving vehicle to capture lane drift or weaving? If so, what are potential testing approaches or procedures? Are humans required for camera-based DMS assessment? Are there particular accessories (*e.g.,* sunglass types, facial coverings) that would be required for testing? Is it feasible to conduct testing in darkness? What type of accuracy could be attained? How might this vary based on intended impairment type detection?

1.5. What kind of performance requirement should NHTSA consider to mitigate defeat strategies (*e.g.,* taping over the camera-based DMS or removing/replacing rear-view mirrors that contain driver monitoring equipment)?

1.6. What metrics and thresholds (*e.g.,* eye gaze, lane departure violations, speed, blind spot warning triggers, lane position variability, speed variability), or combination thereof, are most effective at measuring driver impairment? These would include time-based parameters from the start of the ignition cycle and those used for continuous monitoring. How feasible is it to implement these metrics in passenger vehicles? Should these vary by impairment type? Might these measures conflict across impairment types? Should NHTSA require impairment detection systems be able to collect specific metrics? Why or why not?

1.7. NHTSA seeks comment on whether it should be necessary for an impairment detection system to determine what kind of impairment a driver has (*e.g.,* drowsy, distracted, drunk) if the driver triggers certain metrics that indicate the driver is impaired by at least one of those impairments? For example, incapacitation, drowsiness, and distraction could be captured by camera-based monitoring systems, but they may also detect some alcohol-impaired drivers.

1.8. Are there characteristics that would separate sober impairments from alcohol-induced impairments (*e.g.,* horizontal gaze nystagmus or myokymia)? If so, what are they? Are there other non-alcohol induced conditions in which some of these characteristics might appear? If so, please provide examples.

1.9. NHTSA seeks comment about whether certain conditions listed in the previous question (*e.g.,* myokymia) might result in false positives[188] in certain situations (*e.g.,* stress) or with certain populations (*e.g.,* older drivers).

1.10. What precision and accuracy should driver monitoring technology be required to meet for the purposes of detecting alcohol impairment? Under what conditions should these technologies be demonstrated to work? Are there driver characteristics, environmental conditions, or other factors that might limit the usefulness or applicability of certain technologies under certain conditions? Should there be a maximum time allowed for a system to develop a determination of impairment, after the indicators of impairment are detected?

1.11. Under what conditions should a vehicle allow a driver to turn off driver impairment monitoring, if at all? If

[185] 2024 Volvo EX90 Full Electric 7 Seater SUV | Volvo Car USA (*volvocars.com*) According to its website, the vehicle's ''Pilot Assistance'' feature ''can help keep an eye on the traffic and lane markings and support you by adapting your speed and distances given the current driving conditions. It can provide speed control in steep curves and steering support while changing lanes. If the car detects any sign of the driver being unresponsive, it can brake the vehicle to a standstill within the lane.''

[186] *https://www.consumerreports.org/car-safety/driver-monitoring-can-pull-car-over-if-driver-incapacitated-a1204997865/* ''Some Volkswagen Arteon sedans sold in Europe and equipped with the Emergency Assist 2.0 feature will turn on their flashers and pull over to the side of the road if a driver becomes unresponsive. According to the automaker, if the car senses that a driver is not using the accelerator, brake, or steering wheel, it will first try to awaken a driver by sounding alarms and tapping the brakes to ''jolt'' the driver into awareness. If the driver still doesn't respond, it will automatically steer itself to the lane furthest from traffic on a multilane road and bring the vehicle to a stop. In Japan, Mazda has said it will debut its Co-Pilot system on new vehicles this year. Tamara Mlynarczyk, a Mazda spokesperson, tells CR that the system is ''continuously monitoring'' the driver's performance. ''In a potential emergency situation where the driver loses consciousness, the system is prepared to intervene and assist the driver or pull the car over to a safer location,'' she says. On a multilane road, it may be able to pull the vehicle to the road's shoulder.''

[187] 2020 Data: Alcohol-Impaired Driving (*dot.gov*).

[188] A false positive could occur when the system indicates a person is at the detection level for impairment, when they are not impaired.

allowed, should a system be reset to "on" upon the next ignition cycle?

1.12. NHTSA is interested in data, studies, or information pertaining to the effectiveness of various sensors or algorithms in correctly detecting driver impairment (collectively, and individual impairments). NHTSA is seeking comment on which metrics, thresholds, sensors, and algorithms employed by existing DMS technology that could be used in an alcohol impairment detection system could be sufficiently robust to meet the requirement that an FMVSS be objective.

1.13. Are there other innovative technologies, such as impaired-voice recognition,[189] that could be used to detect driver impairment at start-up? If so, how might these function passively without inconveniencing unimpaired drivers? How mature and accurate are these technologies?

1.14. What level of sensitivity and specificity is necessary to ensure the DMS technology does not unduly burden unimpaired drivers or prevent unimpaired drivers from driving? Are there any DMS available on the market capable of detecting alcohol impairment with the level of sensitivity and specificity necessary to ensure this?

1.15. How can developers of DMS technology ensure that people with disabilities are not disproportionately impacted? Specifically, how can the technology accurately account for facial/body differences, chronic health conditions, and adaptive driving technologies?

1.16. How repeatable and reliable must these systems be? Is there societal acceptance of some potential false positives that could inconvenience sober drivers knowing that it would capture drunk drivers? If so, what countermeasure might best facilitate this? In considering a possible performance standard, what false positive rate would place too great a burden on unimpaired drivers?

1.17. What can be done to mitigate physical destruction or misuse concerns? If mitigations exist, how might these mitigations impact the effectiveness of DMS monitoring driver impairment?

1.18. NHTSA seeks to ensure fairness and equity in its programs and regulations. As NHTSA considers technologies that can passively detect impairment, some of which monitor facial features through camera-based systems or voice recognition, how can NHTSA, in the context of an FMVSS, best ensure these systems meet the needs of vehicle users of all genders, races and ethnicities, and those with disabilities?

b. Passively and Accurately Detect Whether the Blood Alcohol Concentration of a Driver of a Motor Vehicle Is Equal to or Greater Than the Blood Alcohol Concentration Described in Section 163(a) of Title 23, United States Code

The second option presented in BIL is one that requires the passive and accurate detection of a driver of a motor vehicle whose BAC is equal to or greater than the BAC described in Section 163 (a) of title 23, United States Code.

Section 163(a) of title 23 of the United States Code currently reads as follows:

(a) General Authority.—

The Secretary shall make a grant, in accordance with this section, to any State that has enacted and is enforcing a law that provides that any person with a blood alcohol concentration of 0.08 percent or greater while operating a motor vehicle in the State shall be deemed to have committed a per se offense of driving while intoxicated (or an equivalent per se offense).

Therefore, for this BIL option, a technology would need to passively and accurately detect whether the BAC of a driver of a motor vehicle is equal to or greater than .08 g/dL. Typically, BAC is measured as the weight of alcohol in a certain volume of blood (expressed in g/dL). Accurate measurement of BAC typically requires a driver's blood being drawn by a phlebotomist and sent to a lab where a medical laboratory scientist prepares samples and performs tests using machines known as analyzers.

To measure BAC passively and accurately in a motor vehicle setting would therefore require alternative detection methods. The DADSS breath-based sensor, discussed above, can measure driver breath samples at the start of the trip or during the drive to measure driver BrAC. The DADSS touch-based sensor has the potential to be located on the ignition push-button or on the steering wheel. Similarly, it will be designed to take measurements at the start of the trip, or during the drive, in the case of the steering wheel application.

Previous research through the DADSS program has established that the alcohol measurements from breath and touch sensors can be consistent, reproducible, and correlate well with traditional blood and breath alcohol measurements.[190] As noted, the prototypes under development for a passive, accurate breath-based sensor[191] are planned for design completion in 2024 and a passive, accurate touch-based sensor[192] for 2025, with additional time needed to integrate systems in vehicle models and conduct verification and validation. Preliminary estimates suggest that manufacturers will need at least 18–24 months to integrate the technology into vehicles.[193]

Therefore, a current limitation of this option is the fact that NHTSA is not aware of a passive and accurate .08 g/dL BAC detection technology available for production vehicles today, and hence the timeframe for fleet implementation may be an issue.

Questions on Technologies Aimed at Passively and Accurately Detecting Whether the BAC of a Driver of a Motor Vehicle Is Equal to or Greater Than .08 g/dL

2.1. In a follow-up to NHTSA's technology scans, NHTSA seeks any new information on technologies that can passively and accurately detect whether the BAC of a motor vehicle driver is equal to or greater than .08 g/dL.

2.2. Although the legal thresholds for DUI/DWI laws focus on BAC/BrAC, BAC/BrAC are typically not used in isolation by law enforcement to determine impairment. BrAC/BAC may provide additional evidence of impairment after an officer has observed driving behavior, the appearance of the driver (*e.g.,* face flushed, speech slurred, odor of alcoholic beverages on breath), the behavior of the driver, and any statements the driver has made about alcohol or drug use. Additionally, an officer may have administered the Standard Field Sobriety Test. Considering this, should regulatory options use BAC/BrAC in isolation to determine whether drivers are above the legal limit? If so, why?

[189] *https://neurosciencenews.com/ai-alcohol-voice-22191/.*

[190] Lukas S.E., Ryan E., McNeil J., Shepherd J., Bingham L., Davis K., Ozdemir K., Dalal N., Pirooz K., Willis M., Zaouk A. 2019. Driver alcohol detection system for safety (DADSS)—human testing of two passive methods of detecting alcohol in tissue and breath compared to venous blood. Paper Number 19–0268. Proceedings of the 26th International Technical Conference on the Enhanced Safety of Vehicles.

[191] The breath sensor is being designed to capture a driver's naturally exhaled breath upon first entering the vehicle.

[192] The touch sensor is being designed to be imbedded in something that the driver is required to touch to operate the vehicle such as the push-to-start button or the steering wheel rim.

[193] When might the DADSS technology be in U.S. cars and trucks?—DADSS—Driver Alcohol Detection System. (last accessed 3/20/2023), available at *https://dadss.org/news/updates/when-might-the-dadss-technology-be-in-u-s-cars-and-trucks/.*

2.3. Are commenters concerned about using the legal limit (.08 g/dL) when there are indications that some individuals exhibit intoxication that would impact driving at lower or higher levels, depending on a number of factors discussed in the introduction? Why or why not? Might drivers with a BAC greater than 0 g/dL but less than .08 g/dL interpret the fact that their vehicle allows them to drive as an indication that it is safe for them to drive after drinking? If so, are there ways to mitigate this possible unintended consequence?

2.4. Given the quantifiable positive impacts on highway safety that Utah has experienced since lowering its BAC thresholds to .05 g/dL, should NHTSA consider setting a threshold lower than .08 g/dL?

2.5. Is a BrAC detection that correlates to a BAC of .08 g/dL or above sufficiently accurate?

2.6. Would a standard that allows or requires systems that approximate BAC using BrAC (at any concentration) meet the Safety Act's requirement that standards be objective? Would the technology detect BAC?

2.7. NHTSA is seeking input on how a .08 g/dL BAC detection test procedure could be developed and executed in a FMVSS. For example, are dosed humans required or would a test device to simulate human dosing be required? What type of accuracy could be attained? Would static test procedures accurately simulate dynamic performance? In a BrAC evaluation, how would variance in vehicle cabin volume be accounted for?

2.8. What precision/accuracy should BAC detection technology be required to meet? Should any precision/accuracy requirement be fixed at a final rule stage, or should it become progressively more stringent over time with a phase-in?

2.9. For a BAC-based sensor, NHTSA seeks comment on when during a vehicle's start-up sequence an impairment detection measurement should occur. For example, should an initial measurement of BAC/BrAC be required upon vehicle start-up, or before the vehicle is put into drive, and why? What is a reasonable amount of time for that reading to occur?

2.10. NHTSA recognizes that ongoing detection would be necessary to identify if a driver reaches an impairment threshold only after commencing a trip, particularly if drinking during a drive. NHTSA seeks comment on whether BAC/BrAC measurements should be required on an ongoing basis once driving has commenced, and, if so, with what frequency, and why. Further, would a differentiation of the concentration threshold between initial and ongoing detection be recommended and why?

2.11. NHTSA requests comments on operational difficulties in using touch-based sensing (*e.g.,* consumer acceptance in colder climates when gloves may interfere) or in using breath-based sensing (*e.g.,* mouthwash, vaping, alcohol-drenched clothing, or other false positive indicators).

2.12. What can be done to mitigate physical destruction and misuse? Examples may include having a sober passenger press the touch sensor or breathe toward the breath sensor. If mitigations exist, how might these mitigations impact the effectiveness of alcohol detection systems?

2.13. Are there cybersecurity threats related to impairment detection systems? If so, what are they? Are there potential vulnerabilities that might allow outside actors to interfere with vehicles' impairment detection systems or gain unauthorized access to system data? How can cybersecurity threats be mitigated? Are there impairment detection methods or technologies that are less vulnerable than others?

2.14. What temporal considerations should NHTSA include in any performance standards it develops (*i.e.,* should NHTSA specify the amount of time a system needs to make a first detection upon startup before it will enable driving)? What amount of time is reasonable?

c. A Combination Detection Approach: Passively Monitor the Performance of a Driver of a Motor Vehicle To Accurately Identify Whether That Driver May Be Impaired and Passively and Accurately Detect Whether the BAC of a Driver of a Motor Vehicle Is Equal to or Greater Than .08 g/dL

This regulatory option combines the prior two. The combination of driver impairment detection (*e.g.,* using camera-based driver monitoring and other vehicle sensors) and .08 g/dL BAC detection may provide more opportunity to capture alcohol-impaired drivers at the start of the trip as well as those that have elevated BAC during the drive. It further may have the potential to help mitigate false positive detections by providing multiple detection methods.

In a NHTSA research study,[194] all the reviewed hybrid systems used camera-based DMS measures in addition to vehicle kinematic or physiological measures. The study further suggested that augmentation of camera-based measures with other measures is expected to be a trend in driver state monitoring systems, particularly those that measure alcohol impairment. Specifically, NHTSA's research study found sensors from two vehicle manufacturers, Toyota and Nissan, that used variables that have been found sensitive to alcohol impairment, including eye and eye closure measures, sweat, and BrAC. However, neither is on the market.

Therefore, a current limitation of this option is the fact that NHTSA is not aware of a passive and accurate .08 g/dL BAC detection technology available for production vehicles, as discussed in the previous section, and hence the timeframe for implementation may be a limiting factor.

Questions on Technologies Aimed at a Combination of Driver Impairment and BAC Detection

3.1. In light of the technology development needs to both passively and accurately detect .08 g/dL BAC and passively monitor the performance of a driver of a motor vehicle to accurately identify whether that driver may be impaired, are there interim strategies NHTSA should pursue?

3.2. If an alcohol impairment detection system utilizes both BAC detection and DMS components, which DMS metrics best complement a BAC system to ensure accuracy, precision, and reliability?

3.3. One possible benefit of a hybrid approach is that a camera system could help prevent intentional defeat of BAC/BrAC sensors. For example, when a driver presses a touch sensor to measure BAC, a camera using machine vision could verify that it is the driver and not a passenger who touches the sensor. Could the camera provide additional benefits against defeating the system?

3.4. NHTSA is considering a phased approach to addressing alcohol impairment. The agency is concerned about false positives. Effectively, this approach could have a first phase that aims to address alcohol-impaired drivers with a BAC of .15 g/dL or higher, where an alcohol sensor could have better accuracy in detecting alcohol-impairment, in combination with a camera-based DMS and/or other vehicle technologies. By improving the BAC detection accuracy, it may gain more consumer acceptance by lowering the false positive rate (*i.e.,* the chance that someone with a BAC below .08 g/dL is incorrectly identified as alcohol-

[194] Prendez, D.M., Brown, J.L., Venkatraman, V., Textor, C., Parong, J., & Robinson, E. (in press). Assessment of Driver Monitoring Systems for Alcohol Impairment Detection and Level 2 Automation. National Highway Traffic Safety Administration.

impaired by a vehicle system). This would also target the drivers with the highest levels of impairment. With time and accuracy improvement, a second phase could be pursued to achieve the .08 g/dL BAC accuracy needed to comply with BIL. NHTSA therefore seeks comment on the viability of this regulatory approach. Is a BAC of .15 g/dL the right limit to phase in?

3.4. An option could also be a system with primary and secondary indicators within a driver impairment algorithm. For example, a system could incorporate a zero or low (.02 g/dL) tolerance BAC detection technology to initially sense whether alcohol is present in the vehicle. This would serve to ''wake up'' a driver impairment algorithm. Since this could be hand sanitizer or alcohol on a person's clothing, a second confirmation of driver impairment from a driver monitoring system would be needed. Driver performance measures, such as eye gaze, lane weaving, etc. would be the primary indicators of impairment and utilize evidence of alcohol as a supplementary indicator for alcohol impairment. Given this approach, would such a system allow a vehicle to better distinguish between alcohol impairment and other forms of impairment that have similar indicators (*i.e.,* the percentage of eyelid closure can be an indicator of both drowsy and drunk driving)? NHTSA notes that it has not identified any passive, production-ready, alcohol-impaired driver detection technology capable of accurate detection at .02 g/dL and seeks comment on the status of such technology.

3. Proposed Vehicle Interventions Once Driver Impairment or BAC Is Detected

Once drunk driving or driver impairment is detected by a vehicle, the question becomes—what does the vehicle do with that information? BIL states that advanced drunk and impaired driving technologies include the ability to ''prevent or limit'' motor vehicle operation. There are a variety of strategies to prevent or limit operations that have been under research or have been implemented in production vehicles, such as the ignition interlocks discussed above.[195] Others range from not allowing the vehicle to move out of park (transmission interlocks), to warnings (used perhaps as a supplement to an intervention approach), to slowing or stopping the vehicle (in lane, or on the shoulder or right-most lane). There are also many considerations involved in selecting appropriate interventions, given the timing of impairment detection (*i.e.,* prior to the start of driving or during driving). Additionally, interventions appropriate for drunk driving may be different than those employed for other forms of driver impairment. For example, drunk drivers may respond more slowly to warnings than a sober but drowsy driver. Additionally, repeatedly warning a driver beyond the level or frequency that generates a positive reaction could lead to consumer annoyance and defeat efforts. NHTSA seeks to balance these concerns.

a. Prohibiting Driving at Start of the Trip

Ideally, once a defined level of alcohol has been accurately sensed from an impaired driver by vehicle technology, that individual would be prohibited from driving the vehicle. For example, this prohibition could be accomplished through an ignition or transmission shift interlock for an internal combustion engine vehicle. The vehicle could be put in accessory mode, and not able to move. Prohibiting an impaired driver from driving the vehicle at the start of a trip targets the largest number of alcohol-impaired fatalities.

The .08 g/dL BAC touch-sensor and/or breath-sensor detection technologies, which can ideally take immediate BAC measurements, are better suited for prohibiting driving at the start of the trip versus others that require a temporal measure of driver performance. While the technology readiness of the DADSS technologies to provide accurate .08 g/dL BAC detection is still undergoing research and development at this time, there are still many challenges associated with this prevention method that should be considered if it were to become a viable regulatory option.

Assuming an accurate detection technology is fully developed (including a standardized method for testing), NHTSA would have to consider the overall effectiveness of the intervention strategy and the overall cost (economic, societal, etc.). Some considerations would, among other things, include: consumer acceptance; defeat strategies; unintended consequences of immobilizing a vehicle; need for an emergency override; and time between disablement and re-enablement. NHTSA is seeking feedback on the following questions.

Questions on Prohibiting Driving at the Start of the Trip

4.1. How would an alcohol-impaired person react to their vehicle not starting, and how can/should this be considered? Would some individuals decide to walk to their destination in the road, increasing their risk of being hit by another vehicle? Would they get a sober person to start their vehicle and then take over the driving task themselves? Are there countermeasures to discourage this practice by shutting down the vehicle for a period of time after two failed attempts? NHTSA seeks comment on potential research designs to develop better information in this area.

4.2. What are the pros/cons of an ignition interlock as opposed to a transmission interlock prevention method for internal combustion engine vehicles? Is one superior to the other? Should both be acceptable compliance options if considered for an FMVSS? How would this differ for electric vehicles and what issues specific to electric vehicles should NHTSA consider?

4.3. NHTSA seeks comment on any adverse consequences of an impaired driver being unable to drive his/her vehicle. For example, this could result in an alcohol-impaired person being stranded late at night for hours and susceptible to being a victim of crime or environmental conditions (*e.g.,* weather). Or an alcohol-impaired camper may need to use his/her vehicle to escape from a rapidly approaching wildfire or environmental conditions (weather). How often would such incidences expect to occur (assuming full fleet implementation)? Are there logical strategies for mitigating the negative effects? What if the vehicle owner wishes to drive their vehicle on private land (*i.e.,* not on public roads)?

4.4. Given the previous examples, should there be an override feature for emergencies? Should the maximum speed of the vehicle be limited during override? How could an override feature be preserved for extreme situations and not used routinely when alcohol-impaired?

4.5. If a system detects alcohol impairment prior to the start of a trip and an interlock is activated, should retest(s) be allowed, at what elapsed time interval(s), and why? NHTSA especially seeks comment on test/data analysis methods for determining an optimal retest interval strategy. Finally, should data be recorded on the vehicle if retesting is permitted?

b. Vehicle Warnings Once Impairment Detected (On-Road)

In addition to driver impairment being detected and prevented at the start of a trip, driver impairment can be monitored over time during the drive. Detecting that a driver is alcohol-impaired mid-trip is obviously a less

[195] NHTSA notes that nothing in this document is intended to replace ignition interlocks used as a sanction for impaired driving offenses.

desirable scenario (than detecting that a driver is impaired via an ignition/transmission interlock) since an alcohol-impaired driver may have the unfortunate opportunity to get in a crash before the driver impairment is detected. However, this type of strategy may mitigate a larger group of driver-impairment fatalities, not just alcohol, and vehicle warnings could be relatively low cost.

That said, there are many challenges associated with this intervention that should be addressed for it to become a viable regulatory option. Assuming an accurate detection technology was fully developed (including a standardized method for testing), NHTSA would have to consider the overall effectiveness of warnings as an intervention strategy against the various driver impairments, and the overall cost (*e.g.,* economic, societal). Some of the considerations would, among other things, include: consumer acceptance, defeat strategies, unintended consequences of warnings, need for an incapacitation sensor, etc. NHTSA is seeking feedback on the following questions.

Questions on Vehicle Warnings Once Impairment Is Detected

5.1. NHTSA is aware of many vehicle manufacturers using visual/auditory warnings (*e.g.,* a coffee cup icon) and encouraging drivers to take a break from the driving task. There are also visual/auditory/haptic warnings to identify distracted driving or hands off the steering wheel while Level 2 driving automation systems are engaged. NHTSA is interested in any studies to support the effectiveness of these warnings, including designing against defeat strategies. NHTSA also seeks comment and studies on whether similar warnings may be effective for alcohol-impaired or incapacitated drivers or would additional interventions be needed. The system attributes that enhance a system's effectiveness are of particular interest to NHTSA. Are there any unintended consequences from these warnings? If so, what are they?

5.2. NHTSA's research suggested that indicators of alcohol impairment are often also potential indicators of other conditions, such as drowsiness. Hence, the preventative measures of each condition may need to be addressed differently. For example, distracted drivers can quickly return their attention to the driving task, and drowsy drivers can recover with adequate rest as an intervention, but drunk drivers may need a much longer recovery time as alcohol metabolizes.[196] NHTSA therefore requests research and information on what warning strategy would effectively encourage both drivers that are alcohol-impaired and drivers that have a different impairment to improve their performance in the driving task (*e.g.,* by resting, getting a caffeinated beverage)? Or is there research to support that a warning would only be effective for a distracted driver or a drowsy driver, but may aggravate an alcohol-impaired driver? Are there other adverse consequences from using warnings to address multiple types of impairment? If so, what are they?

5.3. NHTSA seeks comment on how manufacturers balance multiple alerts in response to different impairment detections. Given the many forms of impairment, if systems are developed that can distinguish effectively between alcohol impairment and other forms, is it practicable to employ a variety of different responses? Will multiple warnings (auditory, visual, or haptic) or other interventions for different forms of impairment only serve to confuse drunk drivers and lessen effectiveness for responses to drunk driving?

5.4. NHTSA seeks comment on how warnings, especially multiple warnings, may impact drivers with an auditory or sensory processing disability. Would multiple warnings distract some drivers?

5.5. NHTSA seeks comment on how systems react if the drowsy driver (or other inattentive or impaired driver) does not respond to warnings? What types of warning escalation strategies (timing, perceived urgency, and frequency) are used in industry and are they consistent among manufacturers?

c. Vehicle Interventions Once Impairment Is Detected (On-Road)

The most challenging countermeasure for preventing drunk and impaired driving fatalities is implementing vehicle interventions while the vehicle is in motion. There are a variety of strategies that have been under research, in development, or in production. Some are discussed below:

Limp Home Mode—once impairment (or incapacitation) is detected, the vehicle speed is reduced to a lower speed for a given amount of time. Adaptive cruise control with a long following gap setting could be turned on to prevent a forward crash with other vehicles. Systems may provide the driver a warning that the driver needs to leave the highway.

Stop in Lane—depending upon the vehicle manufacturer, the vehicle reduces speed and ultimately stops in the lane after a given time period of unresponsiveness of the driver (typically when the Level 2 driving automation system is engaged), putting on emergency flashers and unlocking the doors for easier entry into the vehicle. This presents a new hazard to motorists approaching the stopped vehicle, and a different kind of hazard for occupants of the stopped vehicle (*i.e.,* the original hazard was the drunk driver, but now the hazard is potentially being hit by other motorists). Some SAE Level 2 driving automation systems make use of this feature if the driver becomes unresponsive and some also can call for assistance.

Pull over to the Slow Lane (Right Lane) or Shoulder—some vehicle manufacturers have introduced more advanced concept or production vehicles that can pull over to the side of the road or into the ''slow lane'' once driver impairment (or incapacitation) is detected when Level 2 systems are engaged.[197] This requires the vehicle to be equipped with lane-changing capability, where a vehicle needs to be able to understand whether there are vehicles or other road users in (or approaching) its blind spot in order to make a lane change. Modern vehicles increasingly have the technology to detect lane lines and blind spots, and to automate lane changes, under certain circumstances.

For example, in 2019, media reports suggested a Volvo system would detect drunkenness, drowsiness, or distraction,[198] and interventions could include limiting the speed of the vehicle or slowing it down and safely parking the car.[199] The agency believes this Volvo system will not be available on production vehicles in the U.S. until 2024.[200] The agency will evaluate technologies as they become available.

Questions on Vehicle Interventions Once Detected (On-Road)

6.1. What types of vehicle interventions are in use today for SAE Level 2 driving automation systems when the system detects the driver is incapacitated? What prevents their use

[196] Hancock, P.A. (2017). Driven to distraction and back again. In Driver Distraction and Inattention (pp. 9–26). CRC Press.

[197] *https://www.forbes.com/wheels/advice/automatic-emergency-stop-assistance/.*

[198] *https://www.motortrend.com/news/volvo-drunk-driving-distracted-cameras-sensors-safety/.*

[199] *https://www.theverge.com/2019/3/20/18274235/volvo-driver-monitoring-camera-drunk-distracted-driving.*

[200] *https://www.volvocars.com/us/cars/ex90-electric/.*

in being coupled with driver impairment or BAC detection technology? What is the feasibility of using these interventions without engaging Level 2 driving automation?

6.2. Stopping in the middle of the road could introduce new motor vehicle safety problems, including potential collisions with stopped vehicles and impaired drivers walking in the roadway. What strategies can be used to prevent these risks? How are risks different if the vehicle stops on the shoulder of the road? What preventative measures could be implemented for vehicles approaching the stopped vehicle? What are the risks to occupants involved in those scenarios?

6.3. What is the minimum sensor and hardware technology that would be needed to pull over to a slower lane or a shoulder and the cost?

Questions on Other Approaches To Reduce Impaired Driving

7.1. As vehicle technologies continue to develop with potential to reduce impaired driving, what steps or approaches should NHTSA consider now, including potential partnerships with States or other entities?

7.2. Which best practices have States found most effective in reducing impaired driving? Have States found approaches such as sharing information about drunk driving convictions to be helpful in reducing impaired driving?

V. Summary of Other Efforts Related to Impaired Driving

NHTSA is aware of several other ongoing efforts by external entities to establish performance requirements for systems to detect alcohol impairment or otherwise influence the development of such performance requirements.

SAE International has developed SAE J3214, a ''Breath-Based Alcohol Detection System'' standard. This standard focuses on directed breath zero-tolerance systems, which are systems that look for any level of alcohol via the driver's BrAC and require that a driver direct a breath toward a device for measurement. The standard was published on June 27, 2021.[201]

The various New Car Assessment Programs (NCAPs) from around the world are also considering protocols for detection of driver state and system warning or intervention.[202] Euro NCAP focuses on DMS and while its assessment protocol mentions impaired driving, the actual assessment focuses only on distraction, fatigue (*i.e.,* drowsiness), and unresponsive drivers.[203] Euro NCAP currently describes no specific assessment for alcohol impairment. Euro NCAP Vision 2030 states that expanding the program's scope of driver impairment by adding specific detection of driving under the influence is a priority for the mid-term: ''. . . [A] key real-world priority for the midterm therefore is to expand the scope of driver impairment adding specific detection of driving under the influence and sudden sickness with advanced vision and/or biometric sensors and introducing more advanced requirements for risk mitigation functions.'' [204] Mid-term is not defined in the text of the document, but a graphic indicates that 2032 is Euro NCAP's targeted timeline. Even so, NHTSA is monitoring Euro NCAP's efforts to see if they might be leveraged in this rulemaking activity. NHTSA's understanding is that Australasian NCAP is considering protocols like Euro NCAP. Additionally, NHTSA has sought comment on the inclusion of DMS and alcohol detection systems in U.S. NCAP.[205] NHTSA is in the process of considering all comments received and drafting a final decision that will establish a roadmap that includes plans to upgrade U.S. NCAP in phases over the next several years. Other organizations, like Consumer Reports [206] and the Insurance Institute for Highway Safety (IIHS),[207] include DMS in their programs. Finally, NHTSA is aware of and following the work of the Impairment Technical Working Group that is intended to assist with the implementation of advanced impaired driving technology.[208] The group is co-chaired by members of the Johns Hopkins Center for Injury Research and Policy at the John Hopkins Bloomberg School of Public Health and MADD. The Impairment Technical Working Group formed with the goal of ''identifying efficient and effective approaches for implementing driver impairment prevention technology in new cars.'' The Impairment Technical Working Group is one of many groups or organizations interested in influencing this rulemaking proceeding. On April 18, 2023, the Impairment Technical Working Group issued a short ''Views Statement'' that included three recommendations for implementing advanced impaired driving technology.[209] These three recommendations are largely duplicative of the mandate in BIL but deviate slightly in that they explicitly request that multiple impairment types be included through this rulemaking (*i.e.,* not limited to alcohol impairment). Also, the group's three recommendations, when read together, describe the group's preference for the third (*i.e.,* hybrid) option in BIL.

VI. Privacy and Security

In considering next steps, NHTSA is aware of the need for comprehensive analysis of the privacy considerations that are relevant to developing performance requirements for systems that would identify and prevent individuals who are intoxicated from driving. Per the E-Government Act of 2002 and internal DOT policies and procedures, NHTSA intends to conduct a privacy threshold analysis (PTA) to determine whether the agency should publish a draft Privacy Impact Assessment (PIA) concurrent with its issuance of a regulatory proposal that would establish performance requirements for advanced impaired driving technology. Although NHTSA welcomes privacy-related comments in response to this advance notice of proposed rulemaking, the agency expects that any future regulatory proposal and any accompanying draft PIA would provide the public with more detailed analysis necessary to evaluate potential privacy risks and proposed mitigation controls associated with advanced impaired driving technology.

NHTSA also intends to consider closely any potential security implications that are relevant to developing performance requirements

[201] *https://www.sae.org/standards/content/j3214_202101/.*

[202] NHTSA's New Car Assessment Program (NCAP) provides comparative information on the safety performance of new vehicles to assist customers with vehicle purchasing decisions and to encourage safety improvements. In addition to star ratings for crash protection and rollover resistance, the NCAP program recommends particular advanced driver assistance systems (ADAS) technologies and identifies the vehicles in the marketplace that offer the systems that pass NCAP performance test criteria for those systems.

[203] *https://cdn.euroncap.com/media/70315/euro-ncap-assessment-protocol-sa-safe-driving-v101.pdf.*

[204] *https://cdn.euroncap.com/media/74468/euro-ncap-roadmap-vision-2030.pdf.*

[205] 87 FR 13452 (March 9, 2022), *available at https://www.federalregister.gov/documents/2022/03/09/2022-04894/new-car-assessment-program.*

[206] Driver Monitoring Systems Can Help You Be Safer on the Road—Consumer Reports.

[207] IIHS creates safeguard ratings for partial automation.

[208] U.S. Senator Ben Ray Luján (2022) Luján, Advocates Announce Technical Working Group to Implement Advanced Impaired Driving Prevention Technology. June 14, 2022. *https://www.lujan.senate.gov/newsroom/press-releases/%EF%BF%BClujan-advocates-announce-technical-working-group-to-implement-advanced-impaired-driving-prevention-technology/.*

[209] *https://advocacy.consumerreports.org/research/technical-working-group-on-advanced-impaired-driving-prevention-technology-views-statement-on-implementing-driver-impairment-prevention-technology/.*

for systems that would identify and prevent individuals who are intoxicated from driving. NHTSA requests comments on privacy and security issues that the agency should consider while developing its proposal. NHTSA acknowledges that many of the answers to these questions would be design-specific, and thus, expects that commenters might provide generalized input now with more specific input at the proposal stage.

Questions About Privacy and Security Considerations

8.1. NHTSA understands that personal privacy considerations are critical to the design of any system that monitors driver behavior or condition. Such considerations are also one component of consumer acceptance of systems described in this advance notice of proposed rulemaking. NHTSA seeks comment on privacy considerations related to use and potential storage of data by alcohol and impairment detection systems and how best to preserve driver and passenger personal privacy. Are there strategies or requirements (*e.g.,* prohibitions on camera-based DMS from recording certain types of imagery) to protect privacy?

8.2. Given the potential for different privacy impacts associated with different types of systems and information used in those systems, how should NHTSA weigh the different potential privacy impacts? For example, how should accuracy be weighed against privacy? Do certain metrics result in less privacy impact than others while providing the same or more accuracy? If so, how?

8.3. What performance-based security controls should NHTSA consider including in its potential performance requirements for advanced impaired driving technology? Are there any industry or voluntary standards specific to these technologies that NHTSA should consider? If not, which standards do commenters believe would be most appropriate for these systems to comply with and why?

8.4. Are there any additional security vulnerabilities that these systems would present that do not already exist in modern vehicles (*e.g.,* passenger vehicles that are equipped with various technologies such as automatic emergency braking, lane keeping support, and others)? If so, what needs to be done to mitigate those potential vulnerabilities?

8.5. What suggestions do commenters have regarding how the agency should go about educating the public about security and privacy aspects of advanced impairment and drunk driving detection technology?

VII. Consumer Acceptance

As discussed in the authority section of this document, consumer acceptance is one component of practicability that NHTSA must consider when developing a FMVSS. NHTSA is aware that a combination of misinformation related to advanced drunk and impaired driving technologies, and misbelief that there exists a right to drive while drunk[210] have resulted in some individuals believing that this rulemaking is pursuing a course of action that might unduly infringe upon their rights. NHTSA has received correspondence that leads the agency to believe that some individuals believe that they not only have a right to drive,[211] but a right to drive while intoxicated by alcohol.[212] As NHTSA has said before, driving is a privilege, not a right.[213] These examples highlight potential consumer acceptance challenges, but not all such instances would be considered legitimate or sufficient to undermine the practicability prong of the Safety Act.

Additionally, NHTSA is encouraged by the results of a recent study conducted by researchers with Johns Hopkins Bloomberg School of Public Health and published in the Journal of the American Medical Association Network Open.[214] This study provides survey results from a relatively small-scale study with the objective of measuring public support for driver monitoring and lockout technologies. The survey contained two parts, one part querying whether participants supported or opposed ''the recent action by Congress to require drunk driving prevention in all new vehicles.'' The second part ask participants to indicate their level of agreement regarding six different warning or lockout technologies. A five-point scale was used for responses to both parts of the survey (strongly agree to strongly disagree). The primary findings of the study were that support for the congressional mandate on vehicle impairment detection technology was high, with 63.4 percent of respondents supporting the law (survey part 1.) For survey part 2, the author reported that 64.9 percent of respondents either agreed or strongly agreed with the statement, ''All new cars should have an automatic sensor to prevent the car from being driven by someone who is over the legal alcohol limit.'' Results for neutral and negative responses were only reported in graphical form, not exact measurements (*i.e.,* reported percentages and confidence intervals).

Safety is the predominant consideration when evaluating potential vehicle performance requirements designed to combat drunk driving effectively. However, the public may not realize estimated associated benefits if vehicle performance requirements and the technologies that meet them are not designed to differentiate with precision drivers who are impaired from those who are not, minimize interventions to those necessary to achieve results, and conform with principles of human factors engineering and design.

Question About Consumer Acceptance

9.1. NHTSA requests comment on legitimate consumer acceptance issues related to advanced drunk and impaired driving technologies and suggestions for how the agency might be able to craft future proposed performance requirements to remedy any consumer acceptance issues.

VIII. General Questions for the Public

In the preceding preamble, NHTSA seeks comment on a variety of complex issues related to establishing a new FMVSS to require that passenger motor vehicles be equipped with advanced drunk and impaired driving prevention technology. These questions are numbered and included throughout the preamble text in the appropriate sections. But not all questions fit neatly under the preceding titles. As such,

[210] *https://www.rollingstone.com/culture/culture-news/tiktok-drunk-driving-booze-cruise-gang-alcohol-1234588210/.* NHTSA would believe this trend was entirely edgy satire if it had not received correspondence that indicates that some genuinely believe they have a right to drive drunk. ''Few would react the same to someone announcing they occasionally text while driving as they would to admitting to the occasional booze cruise while statistically there isn't much difference in added danger.'' NHTSA agrees that both texting while driving and driving while intoxicated are dangerous activities that put the safety of the public at risk.

[211] NHTSA has said before that driving is a privilege, not a fundamental right. See *https://www.nhtsa.gov/open-letter-driving-public#:~:text=Driving%20is%20a%20privilege%2C%20and,to%20protect%20all%20of%20us.* Obeying the rules of the road is a prerequisite for the privilege of driving. See *https://www.nhtsa.gov/teen-driving/parents-hold-keys-safe-teen-driving.*

[212] Assertions that drunk driving is acceptable, or even a right, are not new. This 1984 opinion piece in the New York Times provides an example of someone who thought he was entitled to drive drunk, seemingly because he hadn't killed or injured anyone yet. See *https://jalopnik.com/check-out-this-pro-drunk-driving-op-ed-the-nyt-publishe-1847408294; https://www.nytimes.com/1984/06/03/nyregion/long-island-opinion-drinking-and-driving-can-mix.html.* Please visit the docket for a letter NHTSA received that appears to assert that some individuals should be permitted to drive drunk.

[213] *Id.*

[214] *https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2803962?utm_source=For_The_Media&utm_medium=referral&utm_campaign=ftm_links&utm_term=042023.*

NHTSA also seeks comment on the remaining questions listed below.

10.1. NHTSA seeks comment on any reliability or durability considerations for alcohol impairment detection technology that may impact functionality over its useful life.

10.2. NHTSA requests any information regarding the final installed costs, including maintenance costs, of impairment detection systems.

10.3. Should NHTSA propose a standardized telltale [215] or indicator [216] (or set of telltales) indicating that impairment has been detected (and/or that vehicle systems have been limited in response)? Are there standardized industry telltales or indicators already developed for this sort of system that NHTSA should consider?

10.4. NHTSA broadly seeks comment on how to best ensure that manufacturers have the flexibility to develop more effective impairment detection technology while preserving a minimum level of accuracy and reliability.

10.5. Should NHTSA consider establishing a requirement that allows a vehicle's BAC detection threshold to be adjusted downward based on the BAC thresholds of local jurisdictions or fleet owners? Note, this technology would not be intended or designed to replace a State's enforcement of its own statutes.

10.6. Earlier in this document, NHTSA noted that progress in reducing drunk driving resulting from many behavioral safety campaigns has plateaued. Should NHTSA devote more of its behavioral safety resources towards those programs and efforts that address underlying contributors to alcohol use disorder, including drunk driving, like mental health conditions? Are there effective behavioral safety campaigns or tactics NHTSA is not using?

[215] Telltale means an optical signal that, when illuminated, indicates the actuation of a device, a correct or improper functioning or condition, or a failure to function.

[216] Indicator means a device that shows the magnitude of the physical characteristics that the instrument is designed to sense.

IX. Rulemaking Analyses

A. Executive Order 12866, Executive Order 13563, Executive Order 14094, and DOT Regulatory Policies and Procedures

The agency has considered the impact of this ANPRM under Executive Orders (E.O.) 12866, 13563, 14094 and the Department of Transportation's regulatory policies and procedures. This action has been determined to be significant under E.O. 12866 (Regulatory Planning and Review), supplemented and reaffirmed by E.O. 13563 and amended by E.O. 14094, and DOT Order 2100.6A, ''Rulemaking and Guidance Procedures.'' It has been reviewed by the Office of Management and Budget under E.O. 12866. E.O. 12866 and 13563 require agencies to regulate in the ''most cost-effective manner,'' to make a ''reasoned determination that the benefits of the intended regulation justify its costs,'' and to develop regulations that ''impose the least burden on society.'' Additionally, E.O. 12866 and 13563 require agencies to provide a meaningful opportunity for public participation, and E.O. 14094 affirms that regulatory actions should ''promote equitable and meaningful participation by a range of interested or affected parties, including underserved communities.'' We have asked commenters to answer a variety of questions to elicit practical information about the approach that best meets these principles and the Safety Act and any relevant data or information that might help support a future proposal.

B. Privacy Act

Anyone can search the electronic form of all documents received into any of NHTSA's dockets by the name of the individual submitting the document (or signing it, if submitted on behalf of an association, business, labor union, etc.). As described in the system of records notice DOT/ALL 14 (Federal Docket Management System), which can be reviewed at *https://www.transportation.gov/individuals/privacy/privacy-act-systemrecords-notices,* the comments are searchable by the name of the submitter.

C. Regulation Identifier Number (RIN)

The Department of Transportation assigns a regulation identifier number (RIN) to each regulatory action listed in the Unified Agenda of Federal Regulations. The Regulatory Information Service Center publishes the Unified Agenda in April and October of each year. You may use the RIN contained in the heading at the beginning of this document to find this action in the Unified Agenda.

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Ann Carlson,

Acting Administrator.

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