

Among the alcohol-impaired driving interventions examined in a recent report from the National Academies of Sciences, Engineering, and Medicine are designated driving programs, which incentivize patrons to designate a driver who will not drink alcohol.



PHOTO: TECH SGT. CHRIS STAGNER, U.S. AIR FORCE

NASEM STUDY

Eliminating Alcohol-Impaired Driving Fatalities

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Alcohol-impaired driving is the deadliest and costliest danger on the nation's roads, with approximately one-third of all traffic deaths in the United States caused by drinking and driving. One person dies in an alcohol-impaired driving crash every 49 minutes—that is 29 people each day. In 2016, 10,497 deaths were caused by alcohol-impaired driving—the largest single cause of traffic fatalities (see Figure 1, page 4). In comparison, distracted driving accounted for 3,450 fatalities in 2016. Almost 40% of alcohol-impaired driving fatalities are victims other than the drinking driver. The economic cost is staggering: \$121.5 billion in 2010, including medical costs, earnings and productivity losses, legal costs, and vehicle damage (see box, page 4).

Although the causes of this problem are complex, the resulting deaths are preventable. A report released by the National Academies of Sciences, Engineering, and Medicine early this year identifies many

evidence-based and promising policies, programs, and systems changes to accelerate national progress in reducing deaths from alcohol-impaired driving.

Getting to Zero

As a public health and safety problem, alcohol-impaired driving transcends the transportation, law enforcement, and clinical care systems. Despite its persistent nature, however, the problem is not intractable. Many evidence-based and promising strategies to address alcohol-impaired driving are available; however, a coordinated, multilevel approach across multiple sectors is required to accelerate change.

To address alcohol-impaired driving fatalities, the National Highway Traffic Safety Administration (NHTSA) commissioned the Health and Medicine Division of the National Academies to identify evidence-based and promising interventions to reduce fatalities caused by alcohol-impaired driving in the

Key Facts About Alcohol-Impaired Driving

- ◆ Each day 29 people in the United States die in an alcohol-impaired driving crash; this is equal to one death every 49 minutes.
- ◆ Since 1982, an average of one-third of all traffic fatalities were alcohol-impaired driving fatalities; more than 10,400 people were killed in 2016.
- ◆ Nearly 40% of alcohol-impaired driving fatalities are victims other than the drinking driver.
- ◆ In 2016, 214 children 14 years of age or younger were killed in alcohol-impaired driving crashes.
- ◆ Rural areas are disproportionately affected by alcohol-impaired driving crashes and fatalities.
- ◆ In 2010, the total economic cost of alcohol-impaired driving crashes was \$121.5 billion—including medical costs, earnings losses, productivity losses, legal costs, and vehicle damage.



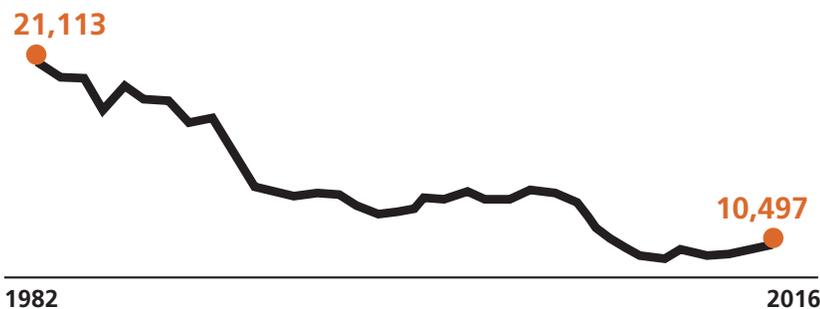
Standard drink sizes for alcohol include (left to right) 12 fluid oz regular beer, 8–9 fluid oz malt liquor, 5 fluid oz table wine, and 1.5 fluid oz distilled spirits.

United States. Focusing on strategies to provide maximum benefit at the population level, the study committee (see box, page 10) released its final report, *Getting to Zero Alcohol-Impaired Driving Fatalities: A Comprehensive Approach to a Persistent Problem*, in January 2018.¹

For the most part, this article will focus on the report's chapter on driving while impaired (DWI) interventions; that is, interventions that reduce the likelihood that an individual will drive once already

¹ To view the report and other materials, see www.nationalacademies.org/stopDWIdeaths.

FIGURE 1 Alcohol-impaired driving fatalities in the United States, 1982–2016.



impaired by alcohol. Other chapters in the report cover such topics as the current alcohol environment, interventions to reduce drinking to impairment, postcrash and arrest interventions, data surveillance needs and opportunities, and efforts to initiate and sustain action to reduce alcohol-impaired driving fatalities. The report's appendixes include four commissioned papers that offer additional context and perspective on alcohol-impaired driving and fill gaps in related literature.

Overview of Approach and Methods

Traditional preventive countermeasures for motor vehicle crashes are categorized as follows, with each category representing opportunities for interventions: before the crash, during the crash itself, and after the crash.

The study committee primarily covered interventions directly related to the prevention of alcohol-impaired driving injuries and fatalities. These include precrash interventions—alcohol policies that affect price, the availability of alcohol, and alcohol consumption—as well as interventions that affect whether or not an impaired person will drive, such as alternative transportation and ridesharing options. The committee embraced Vision Zero, a philosophy in which no alcohol-impaired driving deaths are acceptable and in which each alcohol-impaired driving crash represents a failure of the system, from excessive alcohol service to poor road design to lack of effective policies and enforcement.

The literature on the effectiveness and applicability of interventions provides important information for assessing which interventions are most effective and cost-effective, as well as which are suitable for either a general or more specific population. Comparisons of interventions often are incomplete because studies vary in appropriateness of design and setting and outcomes measured as well as in consideration of unintended consequences and interactions with other interventions. With this in mind, the study committee examined the available literature.

Eliminating Alcohol-Impaired Driving Crash Fatalities

BAC Laws

In the United States, drivers 21 years of age and older are prohibited from driving with a blood-alcohol concentration (BAC) that exceeds 0.08%—the limit prescribed in state per se laws for alcohol-impaired drivers (I).² Based on the number of grams of alcohol (ethanol) per 100 mL of blood, BAC commonly

² A per se law means that the act in question is illegal in and of itself.

is used for medical or legal purposes to quantify an individual's level of alcohol impairment.

For drivers under age 21, BAC limits generally are lower, ranging from zero to 0.02% depending on the state. Laws limiting the BAC of drivers are a key intervention to reduce alcohol-impaired driving and resulting crashes, injuries, and fatalities. In December 2018, Utah will be the first state to lower its BAC per se law to 0.05%.

According to high-quality laboratory and real-world crash studies, alcohol impairment begins at BAC levels well below 0.08% (see Table 1, page 6). For example, experimental motor vehicle and motorcycle simulator studies consistently have shown impairment at a BAC level of 0.05%. Despite state laws currently mandating a limit of 0.08% BAC in the United States, evidence shows that a substantial proportion of alcohol-related crashes and fatalities occur when drivers have BAC levels below 0.08%.

Studies around the world consistently show that drivers with BAC levels between 0.05% and 0.079% are more at risk of being involved in a fatal crash than drivers with a BAC of zero. In 2015, approximately 1,800 alcohol-related driving fatalities involved a driver with a BAC of less than 0.08%. As of 2015, 34 countries comprising 2.1 billion people have laws limiting a driver's BAC to 0.05% or less. Many high-income countries—including Australia, France, Germany, and Italy—have adopted such BAC limits, considered a best practice by the World Health Organization. Based on the available studies, these countries have implemented and enforced this policy without placing undue burdens on the court system.

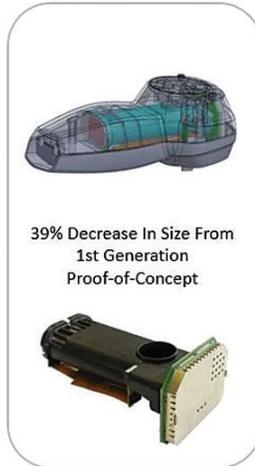
The majority of international evidence suggests that lowering the BAC limit for drivers to 0.05% reduces alcohol-related crashes and driving fatalities—an effect greatest among highest-risk groups. Based on recent literature reviews and estimates by the committee and others, national adoption of 0.05% BAC per se laws could save more than 1,500 lives annually (2). The committee recommended that state governments enact such per se laws, noting that this change would be most effective if implemented along with high-visibility enforcement activities, such as frequent, widely publicized sobriety checkpoints.

Enforcement and Arrest

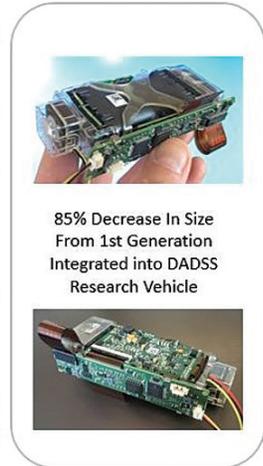
One intervention with a strong, consistent evidence base is the use of sobriety checkpoints. This high-visibility enforcement strategy involves checking drivers for signs of impairment, often through breath testing. Law enforcement officers can conduct breath testing at sobriety checkpoints either selectively or randomly. In selective breath testing, which is used in



Proof-of-Principle



39% Decrease In Size From 1st Generation Proof-of-Concept

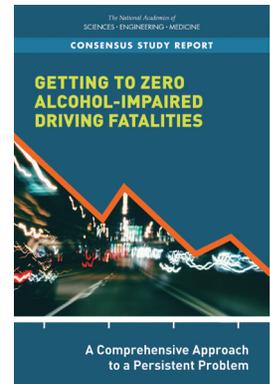


85% Decrease In Size From 1st Generation Integrated into DADSS Research Vehicle

the United States, officers stop vehicles and conduct a breath test on the driver only when they observe and suspect impairment; in random breath testing—used in many European countries and Australia but illegal in the United States—officers test all drivers they stop (3).

The Community Preventive Services Task Force (CPSTF) found strong evidence for the effectiveness of publicized sobriety checkpoint programs, based a systematic review of studies published between 2000 and 2012 (3). Reduced fatalities were attributed to publicized sobriety checkpoint programs implemented in cities, counties, states, and nationwide, as well as in areas that are rural or urban or both—indicating the effectiveness of these programs across a wide range of settings.

(Left to right:) First, second, and third generations of DADSS devices.



The consensus study report *Getting to Zero Alcohol-Impaired Driving Fatalities* is available at <https://www.nap.edu/catalog/24951/getting-to-zero-alcohol-impaired-driving-fatalities-a-comprehensive-approach>.



Pre-crash interventions—like local laws that limit days or hours of sales—are critical to reducing alcohol-related crashes.

PHOTO: OMIVAE, WIKIMEDIA

When publicized and conducted frequently, sobriety checkpoints are highly visible strategies that can decrease alcohol-related crashes by up to 20%.



Photo: Amanda 1st Class Tammi Ransoue, U.S. Air Force

Other reviews by CPSTF found that sobriety checkpoints with selective breath testing decreased alcohol-related crashes by 20% and checkpoints with random breath testing reduced these crashes by 18% (4). NHTSA's *Countermeasures That Work: A Highway Safety Countermeasure Guide for State Highway Safety Offices* rates the effectiveness of sobriety checkpoints as high and notes that implementation time can be short if law enforcement officers are trained appropriately (5).

Checkpoints sometimes have unintended negative consequences, however. Evidence suggests that these consequences include racial profiling and

targeting of undocumented immigrants. To minimize the likelihood of racial profiling, Bergen et al. encourage systematic selection and standardization methodologies to select vehicles and drivers for breath testing, so that driver selection is not left to the discretion of law enforcement officers (3).

Despite the potential unintended consequences of sobriety checkpoints, the study committee recommended that, based on its review of a strong body of evidence, states and localities conduct frequent sobriety checkpoints in conjunction with widespread publicity to promote awareness of these enforcement initiatives.

Technology and Vehicle Factors

Ignition Interlock Devices

The study committee also focused on current and emerging technological interventions that have reduced, or shown promise of reducing, alcohol-impaired driving and alcohol-related crashes. One such technological intervention is the use of ignition interlock devices; that is, breath-alcohol analyzers connected to a vehicle's ignition. These devices require a breath sample to start the engine and inhibit driving if the sample contains more than a preset alcohol concentration—usually 0.02%. Ignition interlock use has increased, with more than 318,000 devices in use in 2014, but the devices remain underused relative to the number of eligible alcohol-impaired driving offenders. Research suggests the current ratio of installed interlocks per DWI arrests is one to five.

Most states have all-offender ignition interlock laws—laws requiring all convicted impaired-driving offenders to install an interlock device—but these vary in the length of time for which offenders must keep the device installed. For example, some states require an interlock device only for repeat offenders or those with a high BAC. Ohio and Oklahoma require offenders to obtain a marked license indicating they can only drive a vehicle with an interlock.



Photo: VCU Flickr

Ignition interlock devices require an alcohol breath analysis to start a car's engine, preventing a user from driving with a BAC concentration over a preset limit.

TABLE 1 Alcohol's Effects on Driving Ability

BAC	Typical Effects on Driving
0.02%	<ul style="list-style-type: none"> • Decline in visual function • Decline in ability to perform two tasks at the same time (divided attention)
0.05%	<ul style="list-style-type: none"> • Reduced coordination • Reduced ability to track moving objects • Difficulty steering • Reduced response to emergency driving situations

NOTE: BAC = blood-alcohol concentration.

Other states have no requirements for interlocks; these states may instead offer such incentives as a limited driving permit or jail time avoidance if an offender installs an ignition interlock.

Ignition interlock fees generally are affordable and are borne by the offender. Offenders usually pay \$100 to \$250 to install the device, and then approximately \$65 to \$90 per month. Ignition interlocks can be made more affordable for low-income offenders via indigent funds, helping to address low installation rates. Research also suggests that all-offender interlock devices are cost-effective, especially for first-time offenders.

Substantial scientific evidence from the United States and other countries such as Canada and Sweden indicates that ignition interlock devices are effective in reducing alcohol-impaired driving, as well as in reducing recidivism and crashes. The positive effects of ignition interlock devices generally dissipate after their removal; therefore, an interlock program may benefit from being paired with alcohol use disorder treatment.

Based on the evidence, the study committee recommended that all states enact all-offender ignition interlock laws to reduce alcohol-impaired driving fatalities. The committee also recommended that these laws require an ignition interlock for all offenders with a BAC above the limit set by state law and that, to increase effectiveness, states should consider increased monitoring periods based on the offender's BAC or past recidivism.

Safety Restraints

Another vehicle-based intervention is safety restraints, since alcohol-impaired drivers are less likely to use seat belts than nonimpaired drivers. Several different factors can affect seat belt use: primary versus secondary seat belt laws, time of day, urban versus rural driving, and the strength of a car's seat belt reminder system.

Primary seat belt laws are those that allow law enforcement officials to stop vehicles if drivers or passengers are not wearing seat belts, and secondary seat belt laws are those that only allow law enforcement officials to ticket drivers for noncompliance with seat belt laws if the vehicles are first pulled over for another offense (6). A 4-year study conducted by Lange and Voas found that after California changed its state seat belt laws from secondary to primary, the rate of compliance increased from 53.4% to 92.1% among drivers with BAC levels of 0.10% or less (7). In addition, enhanced belt reminder systems have been found to increase the rate of seat belt use by about 3% (8–9). The study committee concluded that, given the low rates of seat belt use and high

PHOTO: STATE FARM



Laws that penalize not wearing a seat belt could reduce crash injuries and fatalities for alcohol-impaired drivers, who are less likely to buckle up.

rates of crashes in rural areas, universal adoption of primary seat belt laws for all occupants combined with enhanced enforcement could reduce alcohol-related crash injuries and fatalities.

Passive Technologies

Passive technologies that can detect levels of alcohol in the driver's body also show promise. The study committee examined the Driver Alcohol Detection System for Safety (DADSS), a public–private partnership between NHTSA and the Automotive Coalition for Traffic Safety that is developing non-invasive, vehicle-integrated technology to prevent a vehicle from moving when the driver's BAC exceeds the legal limit—for example, a touch-based DADSS device that uses spectrometry to measure alcohol concentration in the driver's skin tissue (10–11). The technology would be integrated into the push button of new vehicles to measure a driver's BAC when they use their fingertip to start the vehicle (10). A breath-based DADSS device, using spectrometry to measure alcohol concentration in a driver's exhaled breath, also is being explored (11–12).

The study committee recommended that, when DADSS is accurate and available for public use, auto insurers should offer policy discounts to stimulate its adoption. Once the cost of the device is on par with other automobile safety features and the technology is demonstrated to be accurate and effective, NHTSA should make DADSS mandatory in all new vehicles, the committee further advised.

Autonomous Vehicles

The committee also explored the potential of autonomous vehicles. Although research and development in autonomous vehicles shows potential, the committee noted, the solutions offered by these vehicles for addressing alcohol-impaired driving fatalities are not yet feasible. It is important to continue efforts to reduce alcohol-impaired driving using technological resources, the study committee noted. There may come a time when vehicle occupants no longer have to be mindful of their alcohol consumption when it comes to driving, but that time is far off.

Physical Environment and Transportation

Designated Driver Programs

The designated driver concept originated in Scandinavia and was popularized in the United States in the late 1980s and early 1990s (7). The two most common approaches to promoting designated driver use are population-based campaigns and programs that incentivize patrons at drinking establishments to act as designated drivers. Incentives can include non-alcoholic beverages and free or discounted admission to a venue (13).

Although the costs of designated driver programs are low and their implementation time is short, few

studies have evaluated the effects of the programs on traffic injuries. This is partly because of variations in the definition of the term and the selection of a designated driver. According to CPSTF, because of the small magnitude of observed changes and the limitations of measured outcomes, studies on designated driver programs did not provide sufficient evidence to determine whether these programs were effective. The study committee also found that the available evidence is insufficient to determine whether designated driver programs are effective in reducing alcohol-impaired driving crashes.

Alternative Forms of Transportation

Ridesharing Another intervention is for alcohol-impaired drivers to seek alternative means of transportation via smartphone-enabled transportation network ridesharing (e.g., Uber and Lyft). Emerging empirical evidence examines the association between the uptake of network ridesharing and alcohol-impaired driving crashes, alcohol-related driving fatalities, and potential unintended consequences.

Current literature is limited to evaluations of data available after the publicly reported start date of Uber's launch in any given local market (of transportation network companies to date, Uber has the largest market share). As of September 2017, six

According to the study committee, national adoption of 0.05% BAC per se laws could save approximately 1,500 lives each year.



Photo: Mark Taylor, Flickr



Student use of Phoenix's light rail system has been linked to significantly lower odds of impaired driving in one study.

independent analyses have been published, three in peer-reviewed literature and three in online economics working papers. Although the methodologies and findings are somewhat heterogeneous, the main findings generally demonstrate either that ride-sharing has a net positive benefit in addressing alcohol-impaired driving or that it makes no difference.

Some evidence shows that the effect of smartphone-enabled transportation network ridesharing on reducing alcohol-involved crashes may be strongest in areas with poor public transportation usage.

Safe Ride Programs and Public Transportation Other forms of alternative transportation include safe ride programs and public transportation. Safe ride programs can be conducted with vehicles such as taxis, private cars, limousines, and trolleys, and they usually supplement public transportation options. *Countermeasures That Work* concluded that the effectiveness of safe ride programs has not yet been determined and that different study methods produce different results (5).

It is difficult to obtain appropriate data and assess causality, so evidence is sparse regarding public transportation and impaired driving. A few studies focusing on specific urban areas attempted to correlate ridership with impaired driving, however: a study of light rail in Phoenix, Arizona, found that frequent light rail use by college students was associated with

significantly decreased odds of impaired driving (14).

Additionally, a 2011 study evaluated changes in Washington, D.C., Metro schedules from 1999 to 2003 that resulted in the system staying open until 3 a.m. on Fridays and Saturdays (15). When Metro operated until 3 a.m., ridership increased 7% per hour and DWIs declined by 7% per hour of additional service. Alcohol-related arrests increased 8% in areas close to a Metro station.

Although the limited research into alternative transportation options is mixed, the study committee

When the Washington Metropolitan Area Transit Authority expanded weekend hours until 3 a.m., ridership increased and DWI citations decreased by equal amounts.



Committee on Accelerating Progress to Reduce Alcohol-Impaired Driving Fatalities

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observed that the area that shows great promise. For that reason, the committee recommended that municipalities support policies and programs that increase the availability, convenience, affordability, and safety of transportation alternatives for drinkers who might otherwise drive. This includes permitting transportation network company ridesharing; enhancing public transportation options, especially during nighttime and weekend hours; and boosting or incentivizing transportation alternatives in rural areas.

Conclusion

Taken together, the recommendations outlined in this article and the additional recommendations in the report have the potential to reinvigorate commitment and accelerate progress to eliminate deaths from alcohol-impaired driving. It is critical to revive

public concern as well as policymaker attention and resolve into decisive action to address this tragic and preventable problem.

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