

# Strategies to Address Shared Risk and Protective Factors for Driver Safety

SEPTEMBER 2019



SAFE STATES



# About the Safe States Alliance

The Safe States Alliance is a national non-profit organization and professional association whose mission is to strengthen the practice of injury and violence prevention.

To advance this mission, Safe States Alliance engages in activities that include:

- Increasing awareness of injury and violence throughout the lifespan as a public health problem;
- Enhancing the capacity of public health agencies and their partners to ensure effective injury and violence prevention programs by disseminating best practices, setting standards for surveillance, conducting program assessments, and facilitating peer-to-peer technical assistance;
- Providing educational opportunities, training, and professional development for those within the injury and violence prevention field;
- Collaborating with national organizations and federal agencies to achieve shared goals;
- Advocating for public health policies to advance injury and violence prevention;
- Convening leaders and serving as the voice of injury and violence prevention programs within state health departments; and
- Representing the diverse professionals within the injury and violence prevention field.

For more information about the Safe States Alliance, contact the national office:

**Safe States Alliance**  
**5456 Peachtree Blvd. #244**  
**Atlanta, Georgia 30341**  
**770.690.9000**  
[www.safestates.org](http://www.safestates.org)

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**Shannon Brietzman, MA (Workgroup Chair)**

Principal  
Health Management Associates

**Patrick Carter, MD**

Assistant Professor, Department of Emergency Medicine; Assistant Director, University of Michigan Injury Prevention Center

**Laura Dunn, MPH, CPST-I**

Highway Safety Specialist  
National Highway Traffic Safety Administration  
Office of Occupant Protection

**Mighty Fine, MPH, CHES**

Director, Center for Public Health Practice and Professional Development  
American Public Health Association

**Tara Gill**

Senior Director Advocacy and State Legislation  
Advocates for Highway and Auto Safety

**Sharon Gilmartin, MPH**

Deputy Director  
Safe States Alliance

**Tony Gomez**

Manager, Violence and Injury Prevention  
Public Health - Seattle & King County  
Project Director, Seattle/King County Target Zero  
Traffic Safety Task Force

**Jessica Hopkins**

Regional Program Manager  
National Highway Traffic Safety Administration,  
Region 5

**Ginna Jones**

Motor Vehicle Safety Coordinator  
Colorado Department of Public Health and Environment

**Annie Kirk**

Violence and Injury Prevention Program Manager  
Public Health - Seattle and King County

**J. Peter Kissinger (deceased)**

Consultant  
Retired, AAA Foundation

**Jennifer Martin, MSW**

Manager, Injury and Violence Prevention Project  
Illinois Department of Public Health

**Eileen M. McDonald, MS**

Senior Scientist  
Johns Hopkins Center for Injury Research and Policy  
Johns Hopkins Bloomberg School of Public Health

**Ina Robinson, MPH (Technical Writer)**

Program Manager  
Safe States Alliance

**Stephanie Shaw**

Safety Advocate  
National Transportation Safety Board

**David Sleet, PhD**

Senior Researcher and Traffic Safety Consultant  
TJFACT (Formerly at CDC)

**Merissa A. Yellman, MPH**

Epidemiologist, Synergy America, Inc.  
National Center for Injury Prevention and Control;  
Centers for Disease Control and Prevention (CDC)

*This resource document is dedicated to the memory of our colleague, J. Peter Kissinger, who passed away in February 2019. His significant contributions to the transportation safety field have been paramount and his direct contributions to the Behavioral Health Workgroup were highly instrumental toward framing the content in this document.*

Report design and layout: Julie Alonso, Safe States Alliance



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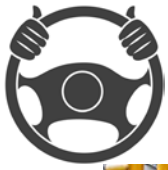
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# Preface



Motor vehicle-related fatalities and injuries could be significantly reduced if proven strategies to reduce risky driving behaviors were widely adopted and implemented across the United States. Given the scarcity of resources and competing issues in the public health injury prevention and traffic safety communities, practitioners have the opportunity to have the biggest impact by applying evidence-based strategies to traffic safety challenges that also address shared risk or protective factors among different audiences. The Behavioral Health Workgroup (Workgroup) examined shared risk and protective factors across a set of risky driving behaviors and then compiled a list of evidence-based strategies that successfully address those factors. Strategies used to address these same risk and protective factors when applied to other high-risk health behaviors were considered for application to reducing risky driving behaviors. The emphasis on shared risk and protective factors provides opportunities for public health and transportation safety agencies to work collaboratively across sectors to maximize impact and leverage funds efficiently. This approach also emphasizes the social determinants of health, recognizing that

individuals' behaviors and environments influence their decision-making across the lifespan. The Workgroup focused their activities on the following topic areas related to risky driving behavior:

- *aggressive driving and speeding,*
- *alcohol-impaired and other drug-impaired driving,*
- *distracted driving,*
- *drowsy and fatigued driving, and*
- *seat belt nonuse by adults.*

The recommendations, developed from collaborative contributions of the Behavioral Health Workgroup, bring a new perspective to traffic safety efforts by promoting behavior change strategies and interventions that reduce known risk factors and/or strengthen protective factors associated with safe driving behavior. This resource document provides a foundation to expand efforts beyond high-visibility enforcement toward a population-based behavior change model that addresses factors at the individual, relationship, community, and societal levels.



# Executive Summary

Motor vehicle crashes currently rank as the second leading cause of death and the fourth leading cause of injury among the adult population (National Center for Statistics and Analysis, 2018). Because motor vehicle-related deaths affect the young, they are also responsible for significant years of productive life lost. Rather than focusing specifically on the driving behaviors themselves, this resource document examines underlying risk factors (e.g., those that make it more likely for an individual to engage in risky driving behaviors) and protective factors (e.g., those that make it more likely for an individual to engage in safe driving behaviors) to identify high-leverage opportunities for reducing the burden of motor vehicle-related injuries and fatalities. These approaches extend beyond the individual-level to include an understanding of the interconnectedness of social elements in an environment across the lifespan. These approaches also highlight effective strategies for facilitating behavior change and for the use of data to support surveillance and evaluation activities.

***The purpose of this resource is to provide public health and traffic safety professionals with recommendations for: applying the shared risk and protective factors approach to reduce risky driving behavior, identifying interventions that can address these risk and protective factors to prevent motor vehicle-related injuries and fatalities, and utilizing data resources to measure the impact of these strategies.***

To achieve this purpose, a variety of concepts are presented throughout the report, including:

- A brief overview of how the public health approach is a useful framework for investigating and understanding the causes of motor vehicle-related injuries and fatalities ([p.10](#)).
- [Key definitions](#) of *risk factors*, *protective factors*, *behavior change strategies*, and *evidence-based strategies* that have been adapted from agencies that represent international and federal-level perspectives on public health, mental health, and public safety ([p. 14](#)).
- An explanation of the benefits associated with connecting shared risk and protective factors across the various levels of social ecology, including broad examples of strategies that can address risk factors and promote protective factors within each level of the social ecological model ([p. 16](#)).
- An explanation of how to apply the shared risk and protective factors approach to driver safety to address multiple health outcomes across the lifespan of an individual ([p. 18](#)).
- A shared *risk factors* grid that observes the trends that exist among the social ecological model and displays the connections between *risk factors* and unsafe driving behaviors ([p. 20](#)).
- A shared *protective factors* grid that observes the trends that exist among the social ecological model and displays the connections between *protective factors* and driving behaviors ([p. 24](#)).
- An explanation of how behavior change can occur when aligning evidence-based strategies to a shared risk and protective factors approach, including guidance on distinguishing between levels of evidence, tailoring interventions or strategies to the

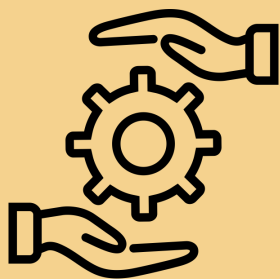


specific needs of an individual or population group, and a table of evidence-based strategies that specifically address risky driving behaviors and promote driver safety ([p. 27](#)).

- A collection of recommendations with special emphasis on applying a shared risk and protective factors approach to promoting safe and healthy driving practices ([p. 41](#)).
- A problem identification guide highlighting the role of data in demonstrating trends in motor vehicle-related injuries over time and a table of resources related to identifying, monitoring, and evaluating risky driving behaviors ([p. 55](#)).
- An exploration of key factors that impact risky driving behaviors, including underlying causes that influence such behaviors ([p. 60](#)).

## Summary of Recommendations

### ***Recommendations for Applying the Shared Risk and Protective Factors Approach to Reduce Risky Driving Behavior***



- Use and share the definitions for risk factor, protective factor, behavior change strategies, and evidence-based strategies established by this resource document and consistent with instituted definitions from global public health organizations.
- Identify any biological and personal history factors that protect against risky driving behaviors and promote driver safety.
- Identify any relational or social factors that increase risky driving behaviors and promote safe driving practices.
- Identify the settings, such as schools, workplaces, and neighborhoods, in which social relationships occur that encourage or discourage risky driving behaviors and safe driving practices.
- Identify the broad societal factors that help create a climate in which engaging in risky driving behaviors is encouraged or inhibited.
- Prioritize shared risk and protective factors when selecting strategies or interventions to address risky driving behaviors.
- Collaborate with researchers to operationalize and examine how social determinants of health increase the risk of unsafe driving practices or protect individuals, families, or communities from risky driving behaviors.
- Collaborate with research institutions to examine associations between psychosocial factors, environmental influences, social inequity, risky driving behaviors, and multiple health outcomes.





### ***Recommendations for Implementing Behavior Change Strategies and Interventions that Reduce Motor Vehicle-Related Injuries and Fatalities***

- Implement strategies and interventions that are multi-sector and have the potential to simultaneously address risk and protective factors that are shared across multiple risky driving behaviors.
- Collaborate with non-traditional partners to implement behavior change strategies.
- Combine available funding or apply for joint funding across traffic safety and public health agencies to implement strategies that address shared risk and protective factors.
- Collaborate with partners and researchers to implement educational and intervention efforts that are culturally appropriate.
- Collaborate with researchers to advance strategies that focus on behavior change as a mechanism to encourage safe driving practices.
- Collaborate with implementation partners to assure widespread adoption of behavior change strategies and interventions that consider any relevant factors that either influence risky driving behavior or protect against unsafe driving practices.



### ***Recommendations for Utilizing Data to Measure the Impact of Shared Risk and Protective Factors on Strategies that Promote Driver Safety***

- Identify data sources that can measure the key variables associated with unsafe driving behaviors and connect any relevant individual, relationship, community, or societal level factors to intervention activities specific to reducing risk and promoting driver safety.
- Collaborate with implementation partners to link data across various sources.
- Collect or access data on variables that highlight key characteristics of a motor vehicle injury related to risky driving behaviors.
- Facilitate partnerships across multiple disciplines to consistently analyze, interpret, disseminate, and use motor vehicle injury data sources.
- Make data collection a routine practice when developing and implementing behavior change strategies and interventions.



# Intended Audience

The primary audiences for the resource document include state-level injury prevention public health professionals and state highway safety office professionals. Secondary audiences for this document are researchers, local-level injury prevention public health professionals, local-level traffic safety professionals, special interest/advocacy groups or non-profit organizations (e.g., Vision Zero groups, transportation safety groups, and safety planning commissions), mental health service providers, substance abuse treatment providers, public health and public safety decision makers, policymakers at regional and local levels, and law enforcement agencies.

Readers can use this resource document to:

- identify risk or protective factors they would like to address in their communities;

- identify and determine the quality of behavior change strategies that reduce risk factors and/or promote protective factors;
- coordinate efforts that consider the individual in the context of their home, neighborhood, and communities; and
- identify the most appropriate data sources to assess the effectiveness of these strategies.

Readers can also use the recommendations to coordinate and integrate efforts to address shared risk and protective factors into existing or new program strategies or to identify new partners for collaboration, such as law enforcement, mental health service providers, or public policy officials.





## How to Use This Resource Document:

<b><i>If You Are:</i></b>	<b><i>You Can Use This Resource Document To:</i></b>
<b><i>An injury prevention public health or traffic safety professional</i></b>	<ul style="list-style-type: none"><li>• Apply a working definition of risk factors, protective factors, behavior change strategies, and evidence-base to the culture of reducing motor-vehicle related injuries while implementing behavior change strategies to promote driver safety on the state and local level.</li><li>• Select, design, and implement program strategies and interventions to reduce risky driving behaviors that:<ul style="list-style-type: none"><li>◦ assess needs at the population-level</li><li>◦ apply a shared risk and protective factors approach to address a variety of risky driving behaviors simultaneously,</li><li>◦ apply a theoretical framework(s) that directly addresses individual behavior change,</li><li>◦ identify relationship, community, environmental and societal factors that influence individual behavior,</li><li>◦ coordinate across multiple public and private sectors (traditional and non-traditional), and</li><li>◦ address the multi-level systems that either enable risky driving behaviors or promote safe driving practices.</li></ul></li><li>• Identify potential data sources to support program monitoring, surveillance, evaluation and widespread adoption.</li><li>• Support the coordination of research to practice initiatives between public health, transportation safety, mental health, substance abuse prevention, policy and law enforcement professionals.</li></ul>
<b><i>A researcher (e.g., injury prevention, behavioral science, etc.)</i></b>	<ul style="list-style-type: none"><li>• Examine the relevance of a shared risk and protective factors approach when researching the effectiveness of strategies to reducing motor vehicle-related injuries and promoting driver safety.</li><li>• Identify research priorities that can advance the fields of motor vehicle injury prevention and transportation safety.</li><li>• Support the identification of program or policy evaluation priorities that have the potential to advance the fields of motor vehicle injury prevention and transportation safety.</li><li>• Identify opportunities to further the evidence-base of behavior change strategies specific to reducing risky driving behaviors and promoting driver safety through continued systematic reviews, meta-analyses, studies, and experimentation.</li><li>• Support the coordination of research to practice initiatives between public health, transportation safety, mental health, substance abuse prevention, policy and law enforcement professionals.</li></ul>



<b><i>If You Are:</i></b>	<b><i>You Can Use This Resource Document To:</i></b>
<b><i>An advocacy group or non-profit organization</i></b>	<ul style="list-style-type: none"> <li>• Identify additional tools or resources that can guide the activities of implementation partners or educate policymakers.</li> <li>• Support the coordination of research to practice initiatives between public health, transportation safety, mental health, substance abuse prevention, policy and law enforcement professionals.</li> </ul>
<b><i>A mental health service or substance abuse treatment provider</i></b>	<ul style="list-style-type: none"> <li>• Identify the appropriate channels to coordinate direct service that is adequate and accessible.</li> <li>• Support the coordination between research and practice.</li> </ul>
<b><i>A public health or public safety decision maker or policymaker</i></b>	<ul style="list-style-type: none"> <li>• Understand the multi-level and systematic influences that contribute to the incidence and prevalence of injuries related to risky driving behaviors.</li> <li>• Identify multi-sector opportunities to reduce the burden of motor vehicle injuries and promote the public safety of communities, districts, or jurisdictions.</li> <li>• Support the coordination of research and practice initiatives between public health, transportation safety, mental health, substance abuse prevention, policy and law enforcement professionals.</li> </ul>
<b><i>A law enforcement professional</i></b>	<ul style="list-style-type: none"> <li>• Understand the multi-level and systematic influences that contribute to the incidence and prevalence of injuries related to risky driving behaviors.</li> <li>• Increase opportunities for continued enforcement activities that incentivize individuals, families, and communities to engage in safe driving practices. Identify opportunities to work with policymakers to reduce the incidence of injuries related to risky driving behaviors.</li> <li>• Support the coordination of research and practice initiatives between public health, transportation safety, mental health, substance abuse prevention, policy and law enforcement professionals.</li> </ul>





# Methods

A preliminary literature review was conducted on the topic of risky driving to identify shared risk and protective factors across six risky driving behaviors (aggressive driving and speeding, distracted driving, alcohol-impaired and other drug-impaired driving, drowsy and fatigued driving, and seat belt nonuse by adults). The review included peer-reviewed articles from 2008-2019, technical reports, gray literature, and seminal literature pertinent to risky driving behaviors. The review identified individual studies, meta-analyses, and systematic reviews. There were 79 articles pulled during the preliminary review. A secondary review was conducted with input from members of the Behavioral

Health Workgroup. A total of 15 non-duplicated peer-reviewed articles were identified by the Workgroup and added to the research findings from the preliminary review, which resulted in a total of 94 articles. Although the Workgroup made a concerted effort to include a wide variety of articles and focused especially on including meta-analyses and systematic reviews, it does not include all existing literature related to risk and protective factors.





# Public Health Approach

The principles of public health provide a useful framework for investigating and understanding the causes and consequences of a public health problem – including motor vehicle crash injuries and fatalities. The public health approach consists of four key steps. Below is an explanation of how this could be applied to the prevention of motor vehicle-related injuries, reduction of motor-vehicle related fatalities, and promotion of safe driving practices:

Step 1: Define the Problem	Step 2: Identify Risk and Protective Factors
Before addressing any injury-related problem, it is important to know the magnitude and scope of a problem, where the issue is, and whom it affects. This information can be obtained by gathering and analyzing data – through a process known as “surveillance”. Data can show how an injury problem changes over time, demonstrate trends among injury types, and highlight the impact of prevention programs. Decision makers often use data when allocating resources to programs in areas of need.*	Once data have been used to define an injury-related topic, the identification of factors that put people at risk for injury should be explored. Conversely, the factors that protect from injury should be explored. Once the risk and protective factors are identified, practitioners can develop and implement programs to reduce or eliminate risk factors for injuries, and promote or increase factors that protect against injuries.
Step 3: Develop and Test Prevention Strategies	Step 4: Assure Widespread Adoption
This step involves putting knowledge into action to find out what works. Using information gathered through research and evaluation, strategies can be developed, implemented, and tailored toward the specific needs of communities that are experiencing the problem. The information feedback loop created by designing, implementing, and evaluating strategies or interventions help assess how well they are working. This approach allows for processes to be improved, addresses any barriers or challenges, and strengthens the effectiveness of strategies or interventions.	In this final step, knowledge is shared to implement effective and promising interventions in a wide range of settings. The effects of these interventions on risk factors and the target outcome should be monitored and evaluated for impact and cost-effectiveness. Techniques to promote widespread adoption can include training, networking, technical assistance, and evaluation.

While not all persons or populations exhibit the same levels of a risky driving behavior, it is important to understand what factors protect people from or put them at risk for engaging in unsafe driving practices. Risk and protective factors are extremely useful in helping public health-related or traffic safety professionals identify where prevention efforts need to be focused. Risk and protective factors are an essential piece for developing, implementing, and evaluating programs or policies. They also inform continued surveillance and adoption of evidence-based programs across communities. While this resource is not designed to focus on each step of the public health approach, it does provide guidance on identifying shared risk and protective factors when considering strategies and interventions – through the lens of behavior change – that promote driver safety.

\*For more information on “*Step 1: Define the Problem*” of the public health approach, see [Appendix A for a Problem Identification Guide](#).



# INTRODUCTION



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## Burden of Motor Vehicle-related Injuries and Fatalities

Unintentional injury is one of the top leading causes of death across the lifespan. Motor vehicle crashes currently rank as the primary leading cause of non-fatal injury among individuals 24 years of age or younger and the second leading cause of non-fatal injury among adults 25 years of age and older (Centers for Disease Control and Prevention, 2016). Reversing a nearly decade-long trend, fatalities from motor vehicle crashes rose in 2015 and 2016, an increase of 14.4 percent over 2014. Traffic fatalities in 2017 remained high, with 37,133 deaths occurring on the nation's roads. The profile of motor vehicle-related fatalities in 2017 reveals risky driver behaviors as influential factors, including:

- Nearly half (47 percent) of all passenger vehicle fatalities involved people that were unrestrained (National Highway Traffic Safety Administration, 2018)
- Alcohol-impaired driving fatalities decreased by 1.1 percent from the previous year, accounting for 29 percent of 2017 overall fatalities;
- The number of fatalities in distraction-related crashes was 8.5 percent of total fatalities in 2017;
- Speeding-related fatalities decreased by 5.6 percent; and
- The number of fatalities involving a drowsy driver was 2.1 percent of total fatalities in 2017.

Driver behaviors are directly implicated in the profile of motor vehicle-related injuries and fatalities.

- For more than two decades, speeding has been involved in approximately one-third

of all motor vehicle fatalities. In 2017, speeding was a contributing factor in 26 percent of all fatal crashes. Of the fatal crashes that were attributed to speeding, half of those drivers were also unrestrained by a seat belt (National Highway Traffic Safety Administration, 2018).

- Every day, almost 30 people in the United States die in alcohol-impaired-driving crashes—that's one person every 48 minutes. Alcohol-impaired-driving fatalities have fallen by one third in the last three decades; however, crashes due to alcohol impairment claim more than 10,000 lives per year (National Highway Traffic Safety Administration, 2017).
- In 2017, distracted driving was reported in crashes that claimed 3,166 lives – although many instances may go unreported. Each day in the United States, approximately 9 people are killed and more than 1,000 injured in crashes that are reported to involve a distracted driver (National Highway Traffic Safety Administration, 2019).
- The [2013-2014 Roadside Survey of Alcohol and Drug Use by Drivers](#) found an increase in the number of drivers testing positive for marijuana and other drugs that can impair driving skills compared to the 2007 survey findings. In the 2013-2014 survey, nearly one in four drivers tested positive for at least one drug that could potentially affect safe driving skills. Prescription drugs, over-the-counter medications, and illegal drugs may cause impairment alone or in combination with each other and/or with alcohol. Whether by drugs – legal or illegal – alcohol, or a combination of both alcohol and other







drugs, impaired driving puts the driver, their passengers, and other road users at risk (National Highway Traffic Safety Administration, 2015).

- Fatigued and drowsy driving claimed 795 lives in 2017, but drowsy driving continues to be underreported. Fatigued driving can lead to a variety of negative outcomes such as impaired cognition and performance, motor vehicle crashes, work-related injuries, and health consequences. Effectively dealing with the drowsy driving problem requires changes to societal norms and attitudes about drowsy driving (National Highway Traffic Safety Administration, 2019).
- One of the safest choices drivers can make is to use a seat belt. Many Americans understand the life saving value of the seat belt – the national daytime use rate in 2017 was 89.7 percent and 89.6 percent in 2018– but nearly 27.5 million people rode unbuckled. In 2016, seat belt use in vehicles saved an estimated 14,668 lives (National Highway Traffic Safety Administration, 2019).

The U.S. Department of Transportation and the National Highway Traffic Safety Administration (NHTSA) have successfully led numerous initiatives to address motor vehicle-related injuries and fatalities, including those related to driver behavior. Some have seen great success, like the [Click It or Ticket](#) program, a high-visibility enforcement campaign that has been credited as “an important factor in increasing seat belt use nationwide and in virtually all States” (National Highway Traffic Safety Administration, 2010). However, recent discussions have centered around the need to expand efforts to reduce the number of deaths each year due to motor vehicle crashes. Experts have called for campaigns and interventions to address the complex

set of factors that influence driver behavior, moving beyond the individual level to include those at the inter-personal, community, and societal levels.

In addition to traditional traffic safety efforts, public health injury prevention programs have long been invested in reducing the burden of motor vehicle-related injuries and fatalities. In fact, motor vehicle safety has been named one of the top ten public health achievements in the 21<sup>st</sup> century (Centers for Disease Control and Prevention, 2011). While both professional communities engage in this important work, there is a need for enhanced collaboration across the two sectors.

The complexity of the problem -- involving a network of environmental, social, and individual characteristics – requires strong partnership in order to truly address the underlying systems that influence motor vehicle-related injuries and fatalities. Moreover, resources are limited across both public health and traffic safety communities, and a strong coordinated approach that involves intentional collaboration and proven strategies is the most promising approach for achieving progress and reducing the burden of injuries and fatalities. Such partnerships have led to past successes (e.g., primary seat belt laws, child passenger safety laws, graduated driving licensing, etc.), and the setting is ripe for identifying future opportunities.

This resource document examines those underlying systems by identifying shared risk and protective factors for risky driving behaviors at the individual, relationship, community, and societal levels. It also highlights effective strategies for addressing those risk and protective factors so that communities can come together and maximize available resources across traffic safety and public health agencies to reduce motor vehicle-related injuries and fatalities.





## Key Definitions

Terms such as risk factors, protective factors, behavior change strategies, and evidence-based strategies can vary across disciplines. This resource uses the definitions for these terms that appear in the table below.

Key Definitions Relevant to Report <sup>i</sup>
<p><b>Risk Factors:</b> Any attribute, characteristic, or exposure at the biological, psychological, family, community, or cultural level that precedes and is associated with a higher likelihood of negative outcomes. These attributes, characteristics, or exposures may increase the likelihood of individuals engaging in risky driving behaviors. Examples of risk factors include not using seat belts, substance use, high risk tolerance, or insufficient sleep.</p>
<p><b>Protective Factors:</b> Any attribute, characteristic or influence at the biological, psychological, family, community, or cultural level that precedes and is associated with a higher likelihood of positive outcomes and lessens the likelihood of negative consequences. These attributes, characteristics, or influences may decrease the likelihood of individuals engaging in risky driving behaviors. Examples of protective factors include positive parenting models, more driving experience, driving while alert, or resistance to peer pressure.</p>
<p><b>Behavior Change Strategies:</b> Interventions and countermeasures, informed by social and behavioral science theory, to promote healthy/safe behaviors or reduce unhealthy/unsafe behaviors. Behavior change strategies may emanate from modern-day behavioral models and theories including a range of approaches, or within the framework of the four E's of injury prevention (education, engineering, enforcement, and emergency medical systems) to address risk and protective factors.</p>
<p><b>Evidence-Based Strategies:</b> Interventions and countermeasures that have been successfully tested and found to be effective and efficacious. Strategies can be categorized into a variety of levels such as effective, promising, or emerging (Brownson, Fielding, &amp; Maylahn, 2009).</p>

<sup>i</sup>These definitions were adapted from the following agencies: [World Health Organization](#), [Centers for Disease Control and Prevention](#), [Substance Abuse and Mental Health Services Administration](#), [The Australian Government Department of Health](#) and [Canada Department of Public Safety and Emergency Preparedness](#)

This report also examines six aspects of risky driving behaviors: *aggressive driving and speeding, alcohol-impaired and other drug-impaired driving, distracted driving, drowsy and fatigued driving, and seat belt nonuse by adults*. A broader swath of factors influences an individual's likelihood to engage in risky driving behavior, including driver's age, gender, income, marital status, social standing, personality and emotional state. For a more detailed explanation of these factors, please see [Appendix B](#).



# RISK AND PROTECTIVE FACTORS



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## Shared Risk and Protective Factors Across the Social Ecological Model

This resource document uses the Social Ecological Model to organize shared risk and protective factors across behaviors. The Social Ecological Model illustrates the interconnectedness of social elements in an environment across the lifespan. Each of the levels observed in the social ecology

operates within and is influenced by the other levels in the model (National Research Council (US) and Institute of Medicine (US), 2009). Figure 1 illustrates the Social Ecological Model, and Table 1 defines each level of the social ecology.

**Figure 1. Social Ecological Model**







**Table 1. Level of Social Ecology and Corresponding Definitions**

<b>Level of Social Ecology</b>	<b>Definition<sup>§</sup></b>
<b>Individual</b>	<p>Biological and personal history factors that increase the likelihood of engaging in a risky driving behavior. Some of these factors are age, education, income, or substance use.</p> <p>Prevention strategies at this level promote attitudes, beliefs, and behaviors that prevent risky driving behaviors. Specific approaches may include education and life skills training.</p>
<b>Relationship</b>	<p>Close relationships may increase the risk of participating in risky driving behaviors. A person's closest social circle - peers, partners and family members - influence their behavior and contribute to their experience.</p> <p>Prevention strategies at this level may include parenting or family-focused prevention programs, mentoring and peer programs designed to reduce stress and foster problem-solving skills, programs that promote healthy relationships and provide healthy alternatives for negative coping strategies.</p>
<b>Community</b>	<p>The settings in which social relationships occur, such as schools, workplaces, hospitals/health systems, and neighborhoods, affect behavior. This level of ecology seeks to identify the characteristics of these settings that are associated with engaging in risky driving behaviors.</p> <p>Prevention strategies at this level impact the social and physical environment by: reducing social isolation, improving economic and housing opportunities in neighborhoods, refining processes and policies within local jurisdictions, schools, and workplace settings that reduce risk and promote safety.</p>
<b>Societal</b>	<p>The broad societal factors that help create a climate in which engaging in risky driving behaviors is encouraged or inhibited. These factors include social and cultural norms that support aggressive or risky behavior as acceptable. Other large societal factors include the health, economic, educational and social policies that help to maintain economic or social inequities between groups in society.</p> <p>Prevention strategies at this level include primary seat belt laws, technology features in vehicles, mobile phone use policies for drivers, and reducing the availability of or access to alcohol, illicit or prescription drugs.</p>

<sup>§</sup>Dahlberg LL, Krug EG. (2002). Violence-A Global Public Health Problem. (Krug E, Dahlberg LL, Mercy JA, Zwi AB, Lozano R, Eds). *World Report on Violence and Health*, 1-56. Geneva, Switzerland: World Health Organization.



## Shared Risk and Protective Factors Approach to Driver Safety

As illustrated above, multiple factors interact to influence behavior, including those that qualify as risky driving behaviors. Effective prevention focuses on addressing factors across all levels of the ecology, with a focus on reducing risk factors and strengthening protective factors. While some risk and protective factors are fixed and do not change over time, others are considered variable and do change over time, such as income level, educational level, or adverse childhood experiences. When designing and evaluating intervention and prevention strategies, these facets should be considered, along with the following considerations noted below.

### RISK AND PROTECTIVE FACTORS EXIST IN MULTIPLE CONTEXTS

All individuals have biological and psychological characteristics that make them vulnerable to, or resilient in the face of, potential behavioral health issues. However, as noted in the Social Ecological Model, people also exist in relationships within their communities and society at large. Based on this notion, there are several risk and protective factors operating and influencing one another within each of these contexts. Targeting only one layer of the ecology when addressing a person's risk or protective factors is unlikely to be successful, because people do not exist in isolation.

### RISK AND PROTECTIVE FACTORS ARE CUMULATIVE

Risk and protective factors have a cumulative effect on the development – or lack of development – of behavioral issues. Understanding this cumulative nature of risk and protective factors highlights the importance of early intervention and strategies that address

multiple factors that influence individual behavior. Programmatic strategies are often designed to address one issue and produce a single outcome (e.g., ignition interlocks to address alcohol-impaired driving). A risk and protective factors approach inherently lends itself to addressing multiple outcomes simultaneously.





## Shared Risk and Protective Factors Across Driving Behaviors

Based on the interconnected relationships of risk and protective factors across various levels of the social ecology and across driving behaviors, this resource document highlights the relationship between these factors in the grids beginning on the next page. Several trends emerge when reviewing risk and protective factors through this lens. For example, an individual with low risk perception, polysubstance use behaviors, or depression/anxiety is more likely to engage in several of the examined risky driving behaviors (listed in Table 2).

An “X” in the tables denotes the existence of at least one study published in an academic, peer-reviewed journal that demonstrates an association between the identified risk or protective factor and the risky driving behavior of interest. It is important to note that since this document does not include all existing literature related to these risk and protective factors, it is possible that studies documenting associations between certain risk factors/protective factors and the risky driving behaviors are not included. It is

possible that there are associations between certain risk factors/protective factors and certain risky driving behaviors but these associations have not yet been studied. A lack of an “X” in these tables does not indicate that there was not an association between a risk factor/protective factor and a risky driving behavior but rather that we did not find any studies documenting an association in the literature.

**Risk factors** highlighted in **red** are associated with three or more driving behaviors at the individual and relationship levels or two or more driving behaviors at the community and societal levels. **Protective factors** highlighted in **green** are associated with three or more driving behaviors at the individual and interpersonal levels or two or more driving behaviors at the community and societal levels. Table 2, beginning on page 20, focuses specifically on risk factors, and Table 3, beginning on page 24, focuses specifically on protective factors.



Table 2. Shared RISK FACTORS Across Driving Behaviors

		Aggressive Driving and Speeding	Distracted Driving	Drowsy and Fatigued Driving	Impaired Driving - Alcohol	Impaired Driving - Other Drugs	Seat Belt Nonuse by Adults
Risk Factors							
Individual	Age (younger populations/16-34 years old)	X <sup>22,75,91</sup>	X <sup>26,44,74, 77, 92</sup>	X <sup>65</sup>	X <sup>15,24,27,62,68</sup>	X <sup>15,28,62</sup>	X <sup>9,20</sup>
	Alcohol-dependence	X <sup>91</sup>			X <sup>27,62,66,67,85</sup>	X <sup>4</sup>	
	Anger (increased level of aggression)	X <sup>36,72,76</sup>					
	Binge drinking				X <sup>27,41,43,66,69,86</sup>	X <sup>41,43</sup>	
	Cannabis use-lifetime and high-frequency cannabis use (daily or weekly)	X <sup>91</sup>			X <sup>27,46,62</sup>	X <sup>28,46,62</sup>	
	Childhood trauma (e.g., adverse childhood experiences)				X <sup>24,62</sup>	X <sup>61</sup>	
	Depression and/or anxiety	X <sup>91</sup>			X <sup>62,67</sup>	X <sup>62</sup>	
	Driving after cannabis use	X <sup>91</sup>					
	Driving after consuming alcohol	X <sup>90</sup>	X <sup>44</sup>		X <sup>24,67</sup>		X <sup>44</sup>
	Education Level (low attainment)				X <sup>24</sup>	X <sup>41</sup>	
	Five+ drinks monthly	X <sup>91</sup>			X <sup>46</sup>	X <sup>46</sup>	
	Frequent driving (daily)		X <sup>26,74</sup>				
	High education level (college graduate or higher)		X <sup>74</sup>				





		Aggressive Driving and Speeding	Distracted Driving	Drowsy and Fatigued Driving	Impaired Driving - Alcohol	Impaired Driving - Other Drugs	Seat Belt Nonuse by Adults
Risk Factors							
Individual	High income (>\$100K)	X <sup>5,91</sup>	X <sup>74</sup>				
	Living alone					X <sup>41</sup>	
	Low risk perception (e.g., seeking intense social experiences, thrill and adventure seeking)	X <sup>22,31</sup>	X <sup>14,26</sup>	X <sup>39,65</sup>	X <sup>35,66</sup>	X <sup>11</sup>	X <sup>20</sup>
	Low sensitivity to punishment (under-estimate danger, high risk takers)	X <sup>22,31</sup>			X <sup>35,66</sup>	X <sup>11</sup>	X <sup>20</sup>
	Mistrust of legal and parental authority						X <sup>59</sup>
	Personality and disposition (hostility, high sensation seeking, competitiveness)	X <sup>22,31</sup>	X <sup>64</sup>				
	Polysubstance use	X <sup>91</sup>			X <sup>46,62,91</sup>	X <sup>46,70, 91</sup>	
	Poor social functioning (among females)	X <sup>91</sup>					
	Poor vision in older adult populations		X <sup>61</sup>				
	Pre-existing medical conditions (e.g., ADHD, obesity, etc.)	X <sup>38</sup>		X <sup>86</sup>			X <sup>7,10,37,60,68,80</sup>
	Prior alcohol/drug treatment admissions				X <sup>46</sup>	X <sup>46</sup>	
	Race/ethnicity (White)		X <sup>44</sup>		X <sup>4</sup>	X <sup>4</sup>	X <sup>9,80</sup>



		Aggressive Driving and Speeding	Distracted Driving	Drowsy and Fatigued Driving	Impaired Driving - Alcohol	Impaired Driving - Other Drugs	Seat Belt Nonuse by Adults
Risk Factors							
	Sex (male)	X <sup>22</sup>	X <sup>92</sup>		X <sup>15,24,25,48,66,67</sup>	X <sup>4,15,46</sup>	X <sup>80</sup>
	Sleep duration/reduced sleep (e.g., insufficient sleep possibly related to medical conditions such as sleep apnea)			X <sup>83,86,90</sup>			
	Texting while driving		X <sup>26,46,53,77,92</sup>				X <sup>44</sup>
	Trip length (< 2.5 miles)						X <sup>3</sup>
	Unemployment				X <sup>41</sup>	X <sup>41</sup>	
Relationship	Driver's marital status (unmarried and/or divorced)	X <sup>91</sup>				X <sup>41</sup>	X <sup>80</sup>
	Obligation to take work calls while driving		X <sup>26</sup>				
	Risky driving or health behavior modeled by a parent or caregiver		X <sup>14</sup>		X <sup>24</sup>		
	Injunctive peer norms that model risky behaviors (e.g., alcohol use, marijuana use, etc.)				X <sup>43</sup>	X <sup>43</sup>	
	Single parent household				X <sup>24</sup>		
Community	Difficulty finding alternative transportation				X <sup>27</sup>		
	Driving in low speed environments			X <sup>89</sup>			
	Iraq/Afghanistan War Veterans and PTSD (male veterans)	X <sup>42</sup>			X <sup>42</sup>		X <sup>42</sup>



		Aggressive Driving and Speeding	Distracted Driving	Drowsy and Fatigued Driving	Impaired Driving - Alcohol	Impaired Driving - Other Drugs	Seat Belt Nonuse by Adults
Risk Factors							
	Roadside advertisements		X <sup>8</sup>				
	Rural, non-metropolitan areas						X <sup>9,10</sup>
Societal	Absence of universal seatbelt laws						X <sup>7,60,80</sup>
	Driving on busy roads	X <sup>91</sup>					
	Driving on wider lanes			X <sup>89</sup>			
	Driving in low speed environments			X <sup>89</sup>			
	Environmental variables (e.g., type of road, traffic, and weather)	X <sup>31</sup>	X <sup>71</sup>	X <sup>69,89</sup>			
	High Alcohol outlet density				X <sup>84</sup>		
	Illegal alcohol sales				X <sup>85</sup>		
	Use of mobile devices		X <sup>26,34,74,92</sup>	X <sup>63</sup>			
	Temporal variables (e.g., short trip length (< 2.5 miles) and driving at night)			X <sup>69</sup>			X <sup>3</sup>



Like the risk factors above, several trends emerge among the connections between protective factors and unsafe driving behaviors (Table 3).

**Table 3. Shared PROTECTIVE FACTORS Across Driving Behaviors**

		Aggressive Driving and Speeding	Distracted Driving	Drowsy and Fatigued Driving	Impaired Driving - Alcohol	Impaired Driving - Other Drugs	Seat Belt Nonuse by Adults
Protective Factors							
Individual	Age (older, 55+)	X <sup>91</sup>	X <sup>74</sup>				X <sup>9,20,80</sup>
	Age range (young adult to older adult; not inclusive of teenage or older adult drivers)		X <sup>26</sup>		X <sup>4</sup>	X <sup>4</sup>	X <sup>80</sup>
	Educational Level (some college education or greater)						X <sup>80</sup>
	Emotional Stability (e.g., high level of emotional stability, high rate of agreeableness, high level of conscientiousness)	X <sup>13,21,92</sup>					
	Higher sensitivity to punishment (low risk taker)	X <sup>22</sup>			X <sup>27,76</sup>	X <sup>27</sup>	X <sup>3,20,60</sup>
	Low levels of anxiety or depression				X <sup>62</sup>	X <sup>63</sup>	
	Personality and disposition (low sensation seeking, low impulsivity)		X <sup>12,14,66</sup>		X <sup>27</sup>	X <sup>27</sup>	
	Race/ethnicity (Non-White)				X <sup>4</sup>	X <sup>4</sup>	X <sup>80</sup>
	Recently ticketed						X <sup>60</sup>
	Rest (before feeling fatigued or drowsy)			X <sup>45,65,83,88</sup>			
	Self-reported mindfulness to lessen aggressive driving	X <sup>78</sup>					
	Sex (female)						X <sup>81</sup>





		Aggressive Driving and Speeding	Distracted Driving	Drowsy and Fatigued Driving	Impaired Driving - Alcohol	Impaired Driving - Other Drugs	Seat Belt Nonuse by Adults
Protective Factors							
	Sleep duration (at least 7hrs of sleep)			X <sup>45,65,83,88</sup>			
	Using air-conditioning to keep cool			X <sup>88</sup>			
Relationship	Father's education level (college degree or higher)				X <sup>24</sup>		
	Group norms that promote safe driving practices (e.g., attitudes against texting while driving, positive values that promote safe driving behaviors)		X <sup>58</sup>				
	Marital status (married)	X <sup>5</sup>					X <sup>80</sup>
Community	Increased access to community-based youth programs/after-school programs	X <sup>78</sup>			X <sup>70,85</sup>	X <sup>11</sup>	
	Low socioeconomic status (e.g., high school education or less, income < 50K)	X <sup>5</sup>	X <sup>74</sup>				
	Urban/metropolitan area						X <sup>9,10</sup>
Societal	Alcohol marketing policies/regulations				X <sup>70,85</sup>		
	Alcohol taxes				X <sup>70,85</sup>		
	Blood Alcohol Content (BAC) laws				X <sup>70,85</sup>		
	States that enforce mobile device use laws		X <sup>34</sup>				
	States that enforce universal primary seat belt laws					X <sup>70,85</sup>	X <sup>7,9,10,80</sup>



# BEHAVIOR CHANGE STRATEGIES AND INTERVENTIONS



SAFE STATES





## Behavior Change Strategies and Interventions

Traditional programs and efforts to reduce motor vehicle-related injuries and fatalities have been directly linked to specific risky driving outcomes (e.g., sobriety checkpoints to reduce alcohol-impaired driving). This resource document highlights underlying risk and protective factors that can address multiple risky driving behaviors and outcomes simultaneously, and thus, it is important for traffic safety and public health professionals to understand how to identify strategies that can affect these shared factors – ultimately, preventing injuries and fatalities across risky driving behaviors.

Many of the risk and protective factors noted in [Table 2](#) (page 20) and [Table 3](#) (page 24) require strategies and partnerships beyond those historically used to prevent motor vehicle-related injuries and fatalities. One key consideration when selecting a new intervention or a new countermeasure practice is assessing how well it will work to create the outcome of interest. For this reason, it is important for traffic safety and public health injury prevention professionals to seek out strategies that have been shown to be effective in order to maximize their benefit. Many of the costs to implement strategies that address shared risk and protective factors can be justified from both traffic safety and public health funding sources, which allows partners to combine and share funding in order to pursue a common goal.

### UNDERSTANDING EVIDENCE-BASED BEHAVIOR CHANGE STRATEGIES

In order to understand evidence-based change strategies, the resource document first provides a set of terms and criteria used to distinguish among levels of evidence (see [Table 4](#) on page 28). The table clarifies how strategies are categorized so that users

understand the strength of evidence used to determine the “level of effectiveness” observed in the strategies that appear in [Table 5](#) (page 30). The term “Effective” means different things for different people; the strategies are organized by level of evidence first and then by risky driving behavior. Where possible, strategies with the strongest evidence base should be used. However, there may be circumstances that require the use of promising or emerging strategies. The use of promising or emerging strategies can be helpful to grow and expand the evidence-base in the field. It is important to note that strategies with no evidence base or those that have been proven as ineffective should not be used.







**Table 4. Distinguishing Among Levels of Evidence**

Category	How Established	Considerations for the level of scientific evidence	Data source examples
<b>Effective</b>	<ul style="list-style-type: none"> <li>• Meta-analyses</li> <li>• Systematic or literature review</li> <li>• Peer review</li> </ul>	<ul style="list-style-type: none"> <li>• Based on study design and execution</li> <li>• External validity</li> <li>• Potential side benefits or harms</li> <li>• Costs and cost-effectiveness</li> </ul>	<ul style="list-style-type: none"> <li>• <a href="#">The Community Guide</a></li> <li>• <a href="#">Cochrane Reviews</a></li> <li>• Articles in the peer reviewed scientific literature</li> <li>• Research-tested intervention programs</li> <li>• Technical reports with peer review</li> </ul>
<b>Promising</b>	<ul style="list-style-type: none"> <li>• Written program evaluation without formal peer review</li> <li>• Study outcomes needing replication</li> </ul>	<ul style="list-style-type: none"> <li>• Formative evaluation data</li> <li>• Summative evidence of effectiveness</li> <li>• Theory-consistent</li> <li>• Plausible</li> <li>• Potentially high reaching</li> <li>• Low-cost</li> <li>• Replicable</li> </ul>	<ul style="list-style-type: none"> <li>• State or federal government reports (without peer review)</li> <li>• Conference presentations</li> <li>• Replicated studies in peer reviewed journals</li> </ul>
<b>Emerging</b>	<ul style="list-style-type: none"> <li>• Ongoing work</li> <li>• Practice-based summaries</li> <li>• Evaluation works in progress</li> </ul>	<ul style="list-style-type: none"> <li>• Formative evaluation data</li> <li>• Theory-consistent</li> <li>• Plausible</li> <li>• Potentially high reaching</li> <li>• Low-cost</li> <li>• Replicable</li> <li>• Face validity</li> </ul>	<ul style="list-style-type: none"> <li>• Evaluability assessments</li> <li>• Pilot studies</li> <li>• <a href="#">NIH Research Portfolio Online Reporting Tools (RePORT)</a></li> <li>• Projects funded by health foundations</li> </ul>



## SELECTING STRATEGIES TO ADDRESS BEHAVIOR CHANGE

It is important to understand the scope of a strategy to ensure it is addressing behavior change in the appropriate context. [Table 5](#) (pages 30-38) includes a wide variety of effective, promising, and emerging strategies that can address the risk factors and protective factors associated with the six risky driving behaviors. However, it is not an all-encompassing or exhaustive list of all effective, promising, and emerging strategies that exist for these risky driving behaviors identified in [Table 2](#) (page 20) and [Table 3](#) (page 24). For example, some technological solutions are not included (e.g., autonomous vehicles and passive alcohol sensors). The risk factors identified in [Table 2](#) (page 20) and protective factors identified [Table 3](#) (page 24), can help traffic safety and public health professionals select strategies to use in their communities. **Strategies highlighted in green are considered “effective”.** **Strategies that are highlighted in orange are considered**

**“promising”.** **Strategies that are highlighted in blue are considered “emerging”.** Some interventions will need to be broader in nature in order to reach entire groups or populations, such as schools, neighborhoods, or the workplace. Examples include educational campaigns highlighting the dangers of behaviors like texting or driving impaired. Others will need to be more selective in addressing behavioral issues. Examples include prevention education for parents of teenagers on safe driving practices or support groups for adults with a history of trauma or substance use disorders. Finally, targeted preventive interventions are needed for persons who show signs of being at risk for unsafe driving behaviors. These interventions include direct referrals to support services for substance use associated with impaired driving or counseling for post-traumatic therapy.





Table 5. Behavior Change Strategies and Interventions to Promote Driver Safety

Behavior Change Strategies and Interventions				
	Strategy Name	Strategy Description	Applicable Driving Behavior(s)	References
<i>OVERALL (more than one driving behavior)</i>				
Effective Strategies	Physician requirements for reporting to DOT based on a medical condition of a driver	<ul style="list-style-type: none"> <li>A highly confidential system of physician reporting for patients with ADHD, or other medical conditions, to DOT</li> </ul>	<ul style="list-style-type: none"> <li>Aggressive Driving and Speeding</li> <li>Drowsy and Fatigued Driving</li> </ul>	<a href="#">(Jerome, Segal, &amp; Habinski, 2006)</a>
	Policy	<ul style="list-style-type: none"> <li>Distracted driving laws that prohibit the use of cell phones or other devices while operating a vehicle</li> <li>Modify Graduated driver licensing (GDL) policies that include a distracted driving component</li> <li>Primary seat belt laws that require drivers to wear a seat belt</li> <li>BAC Laws</li> <li>Employer-based programs safety programs that require consistent seat belt use at all time</li> </ul>	<ul style="list-style-type: none"> <li>Distracted Driving</li> <li>Impaired Driving - Alcohol</li> <li>Seat Belt Nonuse by Adults</li> </ul>	<a href="#">(Behzad, King, &amp; Jacobson, 2014; Bhat, Beck, Bergen, &amp; Kresnow, 2015; Boal, Li, &amp; Rodriguez-Acosta, 2016; Hill, et al., 2017; Schroeder, Wilbur, &amp; Peña, 2018; Strine, et al., 2010; The National Academies of Sciences, Engineering, Medicine, 2018)</a>
	Visible enforcement of state or local policy	<ul style="list-style-type: none"> <li>Sobriety checkpoints</li> <li>Ignition interlocks</li> <li>Roadside drug testing</li> <li>Incorporate substance related traffic-risk behaviors into early prevention/intervention strategies</li> <li>Fines and penalties for violations</li> <li>Interventions that address risk perception</li> </ul>	<ul style="list-style-type: none"> <li>Aggressive driving and speeding</li> <li>Distracted driving</li> <li>Impaired Driving - Alcohol</li> <li>Impaired Driving - Other Drugs</li> <li>Seat Belt Nonuse by Adults</li> </ul>	<a href="#">(Arria, Caldeira, Vincent, Garnier-Dykstra, &amp; O'Grady, 2011; Duarte, Escario, &amp; Molina, 2016; Richard, et al., 2018; Sloan, McCutchan, &amp; Eldred, 2017)</a>





Behavior Change Strategies and Interventions				
	Strategy Name	Strategy Description	Applicable Driving Behavior(s)	References
<i>OVERALL (more than one driving behavior)</i>				
Effective Strategies	Theoretical frameworks that explore behavioral intention within and across one or more risky driving behaviors	<ul style="list-style-type: none"> <li>• Theory of Reasoned Action</li> <li>• Theory of Planned Behavior</li> <li>• Theory of Normative Social Behavior</li> </ul>	<ul style="list-style-type: none"> <li>• Aggressive Driving and Speeding</li> <li>• Distracted Driving</li> <li>• Drowsy and Fatigued Driving</li> <li>• Impaired Driving - Alcohol</li> <li>• Impaired Driving - Other Drugs</li> <li>• Seat Belt Nonuse by Adults</li> </ul>	( <a href="#">Atombo, Wu, Tettehfiio, &amp; Agbo, 2017</a> ; <a href="#">Carter, Bingham, Zakrajsek, Shope, &amp; Sayer, 2014</a> ; <a href="#">Elias, Bord, Baron-Epel, Gesser-Edelsburg, &amp; Shifan, 2017</a> ; <a href="#">Fishbein &amp; Ajzen, 2011</a> ; <a href="#">Gielen, Sleet, DiClemente, 2006</a> ; <a href="#">Jiang, Ling, Feng, Wang, &amp; Shao, 2017</a> ; <a href="#">Okamura, Fujita, Kihira, Kosuge, &amp; Mitsui, 2012</a> ; <a href="#">Nemme &amp; White, 2010</a> )
	Behavioral psychotherapies in addressing maladaptive and destructive behaviors	<ul style="list-style-type: none"> <li>• The 'Big Five Personality Factors' is a model that can be mitigated to address behaviors as they relate to risky driving outcomes. These factors include the following personality traits:               <ul style="list-style-type: none"> <li>○ Openness to experience,</li> <li>○ Conscientiousness,</li> <li>○ Extraversion-introversion,</li> <li>○ Agreeableness, and</li> <li>○ Neuroticism.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Aggressive Driving and Speeding</li> <li>• Drowsy and Fatigued Driving,</li> <li>• Impaired Driving - Alcohol</li> <li>• Impaired Driving - Other Drugs</li> <li>• Seat Belt Nonuse by Adults</li> </ul>	( <a href="#">Burtăverde, Chraif, Anîței, &amp; Dumitru, 2017</a> ; <a href="#">Chraif, Anîței, Burtăverde, &amp; Mihăilă, 2016</a> ; <a href="#">Iancu, Hogeia, &amp; Olteanu, 2016</a> ; <a href="#">Parr, Ross, McManus, Wittig, &amp; Stavrinis, 2016</a> )



## Behavior Change Strategies and Interventions

	Strategy Name	Strategy Description	Applicable Driving Behavior(s)	References
<i>OVERALL (more than one driving behavior)</i>				
Promising Strategies	Driver education (except for programs that enable young/novice drivers to obtain their license at an earlier age because of enrollment in drivers education).	<ul style="list-style-type: none"> <li>Educate drivers on scope of problem (e.g., drowsy and fatigued driving)</li> <li>Educate drivers on the dangers of unsafe driving practices (e.g., distracted driving, impaired driving)</li> <li>Education on the benefits of reducing risky driving behaviors</li> <li>Psychoeducational interventions</li> <li>Motivational approaches (e.g., motivational interviewing)</li> </ul>	<ul style="list-style-type: none"> <li>Aggressive Driving or Speeding</li> <li>Distracted Driving</li> <li>Drowsy and Fatigued Driving</li> <li>Impaired Driving - Alcohol Driving,</li> <li>Impaired Driving - Other Drugs</li> <li>Seat Belt Nonuse by Adults</li> </ul>	( <a href="#">Bonar, et al., 2018</a> ; <a href="#">Engelberg, Hill, Rybar, &amp; Styer, 2015</a> ; <a href="#">Hill, et al., 2017</a> ; <a href="#">Ortiz, Ortiz-Peregrina, Castro, Casares-López, &amp; Salas, 2018</a> ; <a href="#">Owens, et al., 2018</a> ; <a href="#">Parr, Ross, McManus, Wittig, &amp; Stavrinou, 2016</a> ; <a href="#">Strine, et al., 2010</a> ; <a href="#">Tefft, 2016</a> ; <a href="#">Tefft, 2014</a> ; <a href="#">Vanlaar, Simpson, Mayhew, &amp; Roberston, 2008</a> ; <a href="#">Wickens, et al., 2012</a> )
	Mindfulness training	<ul style="list-style-type: none"> <li>Mindfulness training encourages emotion-regulation and involves acceptance of, but not reaction to, the current situation</li> </ul>	<ul style="list-style-type: none"> <li>Aggressive Driving and Speeding</li> <li>Distracted Driving</li> </ul>	( <a href="#">Koppel, et al., 2019</a> ; <a href="#">Stephens, Koppel, Young, Chambers, &amp; Hassed, 2018</a> )



Behavior Change Strategies and Interventions				
	Strategy Name	Strategy Description	Applicable Driving Behavior(s)	References
<i>OVERALL (more than one driving behavior)</i>				
Promising Strategies	Comprehensive approaches to reduce risky driving	<ul style="list-style-type: none"> <li>Multi-sector strategies that involve:               <ul style="list-style-type: none"> <li>Primary seat belt laws and enforcement</li> <li>Distracted driving laws</li> <li>Improved road design</li> <li>Improved emergency response</li> <li>Lower BAC limits set by state law</li> <li>Increased alcohol taxes</li> <li>Use of ignition interlocks</li> <li>Use of Driver Alcohol Detection System for Safety (DADSS)</li> </ul> </li> <li>Interventions that address drug-impaired driving more assertively and simultaneously with alcohol-impaired driving</li> </ul>	<ul style="list-style-type: none"> <li>Aggressive Driving and Speeding</li> <li>Distracted Driving</li> <li>Drowsy and Fatigued Driving</li> <li>Impaired Driving - Alcohol</li> <li>Impaired Driving - Other Drugs</li> <li>Seat Belt Nonuse by Adults</li> </ul>	( <a href="#">Arria, Caldeira, Vincent, Garnier-Dykstra, &amp; O'Grady, 2011</a> ; <a href="#">Richard et. al., 2018</a> ; <a href="#">The National Academies of Sciences, Engineering, Medicine, 2018</a> )
Emerging Strategies	Reward-based programs	<ul style="list-style-type: none"> <li>Auto insurance rate discounts</li> <li>Reduced fees for license renewal</li> </ul>	<ul style="list-style-type: none"> <li>Aggressive Driving and Speeding</li> <li>Distracted Driving</li> <li>Drowsy and Fatigued Driving</li> <li>Impaired Driving - Alcohol</li> <li>Impaired Driving - Other Drugs</li> <li>Seat Belt Nonuse by Adults</li> </ul>	( <a href="#">Constantinou, Panayiotou, Konstantinou, Loutsiou-Ladd, &amp; Kapardis, 2011</a> )





Behavior Change Strategies and Interventions				
	Strategy Name	Strategy Description	Applicable Driving Behavior(s)	References
<i>SPECIFIC (one identified driving behavior)</i>				
Effective Strategies	Campaigns targeted at changing group norms	<ul style="list-style-type: none"> <li>• Social marketing campaigns designed to reset perceived social norms associated with distracted driving behavior</li> <li>• Campaigns that focus on parental involvement, parental modeling and monitoring of adolescent distracted driving behavior (e.g., The Checkpoints Program)</li> </ul>	Distracted Driving	( <a href="#">Carter, Bingham, Zakrajsek, Shope, &amp; Sayer, 2014</a> )
	Clinical observation and treatment of Obstructive Sleep Apnea (OSA)	<ul style="list-style-type: none"> <li>• Expedite treatment of diagnosed OSA to minimize risk of motor vehicle-related injury due to drowsy and fatigued driving</li> </ul>	Drowsy and Fatigued Driving	( <a href="#">Tregear, Reston, Schoelles, &amp; Phillips, 2009</a> ; <a href="#">U.S. Department of Transportation, 2008</a> ; <a href="#">Ward, et al., 2013</a> )
	Healthcare Screening & Referral Programs (e.g., SBIRT Model)	<ul style="list-style-type: none"> <li>• Include routine questions on drug-impaired driving (and riding) when screening for substance use problems</li> <li>• Law enforcement response that includes mandatory referral for evaluation and treatment of drug-impaired offenders</li> <li>• Revocation of driving privileges until treatment programs are complete</li> <li>• Community-based screening for substance use behaviors</li> </ul>	Impaired Driving - Other Drugs	( <a href="#">Arria, Caldeira, Vincent, Garnier-Dykstra, &amp; O'Grady, 2011</a> ; <a href="#">Richard et. al., 2018</a> ; <a href="#">Substance Abuse and Mental Health Services Administration, 2019</a> )



Behavior Change Strategies and Interventions				
	Strategy Name	Strategy Description	Applicable Driving Behavior(s)	References
<i>SPECIFIC (one identified driving behavior)</i>				
Promising Strategies	Gender-based education	<ul style="list-style-type: none"> <li>Intervention strategies that are designed to increase awareness of the consequences of aggressive driving and speeding and promote safe driving practices</li> <li>Intervention strategies that address gender as one of many moderating factors in aggressive driving behaviors</li> </ul>	Aggressive Driving and Speeding	( <a href="#">Constantinou, Panayiotou, Konstantinou, Loutsiou-Ladd, &amp; Kapardis, 2011</a> ; <a href="#">Kuhn, Drescher, Ruzek, &amp; Rosen, 2010</a> ; <a href="#">Wickens, et al., 2012</a> )
	Required annual recertification for commercial vehicle drivers with untreated obstructive sleep apnea (OSA)	<ul style="list-style-type: none"> <li>A Medical Expert Panel convened by The U.S. Department of Transportation's (DOT), Federal Motor Carrier Safety Administration (FMCSA) made specific recommendations for updating guidelines and standards related to the medical fitness of commercial motor vehicle drivers with OSA</li> </ul>	Drowsy and Fatigued Driving	( <a href="#">Tregear, Reston, Schoelles, &amp; Phillips, 2009</a> ; <a href="#">U.S. Department of Transportation, 2008</a> )
	Maintain or increase price/fees related to the purchase or consumption of alcohol	<ul style="list-style-type: none"> <li>Raise alcohol taxes to reduce impaired driving; suggest retail price restrictions and minimum alcohol pricing)</li> </ul>	Impaired Driving - Alcohol	( <a href="#">Richard et. al., 2018</a> ; <a href="#">The National Academies of Sciences, Engineering, Medicine, 2018</a> )
	Address physical availability of alcohol products	<ul style="list-style-type: none"> <li>Regulate alcohol outlet density, regulate hours and days of alcohol sales, and state monopolization of alcohol sales</li> </ul>	Impaired Driving - Alcohol	( <a href="#">Richard et. al., 2018</a> ; <a href="#">The National Academies of Sciences, Engineering, Medicine, 2018</a> )



## Behavior Change Strategies and Interventions

	Strategy Name	Strategy Description	Applicable Driving Behavior(s)	References
<i>SPECIFIC (one identified driving behavior)</i>				
Promising Strategies	Reduce illegal alcohol sales	<ul style="list-style-type: none"> <li>Develop minimum legal drinking age laws/enforcement procedures, dram shop liability laws, create liability standards for social hosts (where alcohol is served), responsible beverage service/server training, sales to intoxicated persons, alcohol law enforcement)</li> </ul>	Impaired Driving - Alcohol	( <a href="#">Richard et. al., 2018</a> ; <a href="#">The National Academies of Sciences, Engineering, Medicine, 2018</a> )
	Reduce the harmful effects of alcohol marketing	<ul style="list-style-type: none"> <li>Decrease the number of advertisements or standardize advertisement times to avoid youth exposure to alcohol marketing.</li> </ul>	Impaired Driving - Alcohol	( <a href="#">Richard et. al., 2018</a> ; <a href="#">The National Academies of Sciences, Engineering, Medicine, 2018</a> )
	Education/awareness	<ul style="list-style-type: none"> <li>School-based education programs, alcohol warning labels, and/or media campaigns.</li> </ul>	Impaired Driving - Alcohol	( <a href="#">Fairlie, Quinlan, Wood, Lawson, &amp; Witt, 2010</a> ; <a href="#">Richard et. al., 2018</a> ; <a href="#">The National Academies of Sciences, Engineering, Medicine, 2018</a> )
	Technological interventions	<ul style="list-style-type: none"> <li>Personal devices and technology for estimating BAC and other BAC estimation tools.</li> <li>Combine alcohol monitoring with behavior change that take advantage of smartphone connectivity:               <ul style="list-style-type: none"> <li>Ongoing feedback support</li> <li>Real-time notifications of peers and loved ones</li> <li>Leverage social norms</li> <li>Contingency management</li> <li>Prompts to use ride sharing services</li> <li>Pair in-vehicle devices with smartphone applications that monitor driving</li> </ul> </li> </ul>	Impaired Driving - Alcohol	( <a href="#">Richard et. al., 2018</a> ; <a href="#">The National Academies of Sciences, Engineering, Medicine, 2018</a> ; <a href="#">Sahabiswas, et al., 2016</a> )





Behavior Change Strategies and Interventions				
	Strategy Name	Strategy Description	Applicable Driving Behavior(s)	References
<i>SPECIFIC (one identified driving behavior)</i>				
Promising Strategies	Advocacy	<ul style="list-style-type: none"> <li>Educate stakeholders, key partners, and policymakers on the connections between and value of screening, intervention, and treatment of substance abuse issues</li> </ul>	Impaired Driving - Other Drugs	<a href="#">(Arria, Caldeira, Vincent, Garnier-Dykstra, &amp; O'Grady, 2011)</a>
	Personal decision-making policies	<ul style="list-style-type: none"> <li>Assess an individual's decision policy of wearing a seat belt while driving (full-time policy, part-time policy, or no policy at all)</li> </ul>	Seat Belt Nonuse by Adults	<a href="#">(Alattar, Yates, Eby, LeBlanc, &amp; Molnar, 2016)</a>
Emerging Strategies	Mobile phone technology solutions	<ul style="list-style-type: none"> <li>Mobile applications that auto-respond to text messages when operating a vehicle</li> <li>Programs that text drivers text messages when they're texting and driving (e.g., "BTW, Friends would prefer a late TXT to an early death")</li> </ul>	Distracted Driving	<a href="#">(Parr, Ross, McManus, Wittig, &amp; Stavrinis, 2016; Engelberg, Hill, Rybar, &amp; Styer, 2015; Stavrinis, Pope, Shen, &amp; Schwebel, 2018)</a>



## Behavior Change Strategies and Interventions

	Strategy Name	Strategy Description	Applicable Driving Behavior(s)	References
<i>SPECIFIC (one identified driving behavior)</i>				
Emerging Strategies	Car safety features	<ul style="list-style-type: none"> <li>Technology solutions based on the car make and model</li> <li><a href="#">Use of technology to detect or predict operator fatigue:</a> <ul style="list-style-type: none"> <li>Drowsy driving warning systems</li> <li>Driving simulators that detect drowsiness, temperature, time of day, lane width, average travel speed, driving time in heavy traffic and road types</li> <li>Forward collision warning</li> <li>Forward collision warning plus autobrake</li> <li>Lane departure warning</li> <li>Blind spot detection</li> <li>Rear automatic braking</li> <li>Rearview cameras</li> <li>Rear cross-traffic alert</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Drowsy and Fatigued Driving</li> </ul>	( <a href="#">Abe, Mollicone, Basner, &amp; Dinges, 2014</a> ; <a href="#">Balkin, Horrey, Graeber, Czeisler, &amp; Dinges, 2011</a> ; <a href="#">Owens, et al., 2018</a> ; <a href="#">Sahabiswas, et al., 2016</a> ; <a href="#">Wang, Sun, Fang, Fu, &amp; Stipancic, 2017</a> )
	New seat belt technology	<ul style="list-style-type: none"> <li>Make seat belts more comfortable and convenient to use for individuals who are obese.</li> </ul>	<ul style="list-style-type: none"> <li>Seat Belt Nonuse by Adults</li> </ul>	( <a href="#">Jehle, Doshi, Karagianis, Consiglio, &amp; Jehle, 2014</a> )



## Limitations of the Report

At the outset, the Workgroup acknowledged the revolutionary potential for autonomous vehicles related to reducing motor vehicle-related injuries and death. However, because this technology is evolving at such an extraordinary pace, the Workgroup decided to exclude this from the scope of work and literature review. Due to limitations with the scope of work and literature, the content of this resource document does not include all existing literature related to risk and protective factors associated with risky driving behaviors. However, it is important to note that there are many examples of readily available and widely used technology innovations that can improve driver safety.

For example, subject matter experts in the Workgroup noted the emergence of passive alcohol sensors. These sensors are in cars and are used to detect alcohol presence in the air near a driver's face if alcohol-impaired driving is suspected, or in some cases detected through the grip on the steering wheel. Traditionally they have been used by police officers and have been integrated into objects such as flashlights or clipboards. Readers of this resource document are encouraged to review these developments independently as they consider strategies to use in their communities to reduce motor vehicle-related injuries.



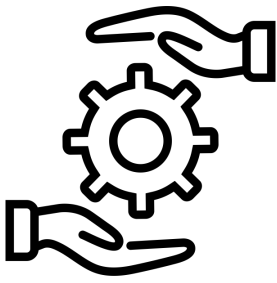


# RECOMMENDATIONS



SAFE STATES





## Recommendations for Applying the Shared Risk and Protective Factors Approach to Reduce Risky Driving Behavior

- A. Use and share the definitions for **risk factor**, **protective factor**, **behavior change strategies**, and **evidence-based strategies** established by this report and consistent with instituted definitions from global public health organizations.

All state and local public health, traffic safety, mental health, substance abuse, and public safety agencies that implement program strategies related to risky driving behaviors should use and share the definitions when collaborating with key stakeholders or implementation partners on program planning, implementation, and evaluation activities.

- B. Identify any biological and personal history factors that protect against risky driving behaviors and promote driver safety.

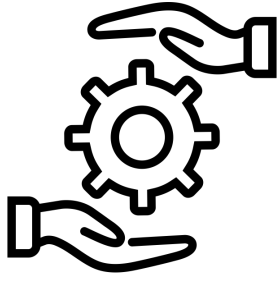
Some of these factors are age, education, income, or substance use. State and local public health, traffic safety offices, and public safety agencies can collaboratively implement prevention strategies that promote attitudes, beliefs, and behaviors that prevent risky driving behaviors. Specific approaches may include population-specific educational campaigns and life skills training.

- C. Identify any relational or social factors that increase risky driving behaviors and promote safe driving practices.

An individual's closest social circle-peers, partners, and family members influence their behavior and contributes to their experience. State and local public health, traffic safety, and public safety agencies can collaboratively implement interventions at this level that may include parenting or family-focused prevention programs, mentoring and peer programs designed to reduce stress and foster problem-solving skills, programs that promote healthy relationships, and provide healthy alternatives for negative coping mechanisms.

- D. Identify the settings, such as schools, workplaces, and neighborhoods, in which social relationships occur that encourage or discourage risky driving behaviors and safe driving practices.

State and local public health, traffic safety, and public safety agencies can work together to recognize the characteristics of these settings and how they are associated with engaging in risky driving behaviors and implement the appropriate strategies or interventions designed to impact social and physical environments. For example, reducing social isolation, improving economic and housing opportunities in neighborhoods, as well as enhancing the climate, processes, and policies within local jurisdictions, schools, and workplace settings.



## Recommendations for Applying the Shared Risk and Protective Factors Approach to Reduce Risky Driving Behavior - Continued

### E. Identify the broad societal factors that help create a climate in which engaging in risky driving behaviors is encouraged or inhibited.

These factors can include any social and cultural norms that support aggressive or risky behavior as acceptable. Other large societal factors include the health, economic, educational, and social policies that help to maintain economic or social inequities between groups in society. State and local public health, traffic safety, and public safety agencies can work together to implement prevention strategies such as the enforcement of primary seat belt laws, the introduction or testing of technology features in vehicles, enforcement of penalties related to mobile phone use policies for drivers, and reducing the availability of or access to alcohol, illicit or prescription drugs.

### F. Prioritize shared risk and protective factors when selecting strategies or interventions to address risky driving behaviors.

Consider addressing risk factors and/or protective factors that relate to more than one driving behavior. For example, high levels of depression and anxiety are known risk factors for aggressive driving and speeding, distracted driving, alcohol-impaired driving, and other drug-impaired driving. Low levels of depression and anxiety are known protective factors against alcohol-impaired driving and other drug-impaired driving behaviors.

### G. Collaborate with researchers to operationalize and examine how social determinants of health increase the risk of unsafe driving practices or protect individuals, families, or communities from risky driving behaviors.

Additional research can help state and local public health, traffic safety, and public safety agencies identify the appropriate partnerships (e.g., educational systems, the workplace, housing authorities, healthcare agencies, built environment, etc.) and scale-up program or policy strategies that support healthy behaviors and promote driver safety.

### H. Collaborate with research institutions to examine associations between psychosocial factors, environmental influences, social inequity, risky driving behaviors, and multiple health outcomes.

Future research can combine all these elements through theoretical models such as the [Social Ecological Model](#), [Theory of Planned Behavior](#) or [Theory of Change](#) to develop population-specific interventions that address risk factors and promote protective factors.



## Recommendations for Implementing Behavior Change Strategies and Interventions that Reduce Motor Vehicle-Related Injuries and Fatalities

**A. Implement strategies and interventions that are multi-sector and have the potential to simultaneously address risk and protective factors that are shared across multiple risky driving behaviors.**

Consider addressing risk factors and/or protective factors that relate to more than one driving behavior and that can build upon existing public health or traffic safety intervention activities. State and local practitioners with activities relevant to motor vehicle injury prevention and driver safety (public health, traffic safety, engineering, law enforcement, academia, mental health, substance abuse, health care, and public policy) could work with one another to implement and evaluate strategies and interventions on the local level. Primary seat belt laws and enforcement, improved road designs, graduated driver's licensing laws, improved emergency response, lower BAC limits set by state law, increased alcohol taxes, use of ignition interlocks, and sobriety checkpoints, among other interventions, have the potential to be effective when used together.

**B. Collaborate with non-traditional partners to implement behavior change strategies.**

State level professionals (health departments, traffic safety) should partner with each other, as well as other national level agencies or organizations (traffic safety, public health), engineers, scientists, and researchers to reduce risky driving behaviors.

**C. Combine available funding or apply for joint funding across traffic safety and public health agencies to implement strategies that address shared risk and protective factors.**

Using a shared risk and protective factors approach helps entities in both the public health and traffic safety sectors justify using their funds to implement interventions in their communities. By pooling funding or applying for joint funding, agencies can streamline efforts and maximize any available dollars.

**D. Collaborate with partners and researchers to implement educational and intervention efforts that are culturally appropriate.**

All state and local public health, traffic safety, mental health, and public safety agencies that implement program strategies related to risky driving behaviors could work alongside researchers (academic institutions, foundations, research-based organizations) to create effective messaging, educational resources, and strategies that improve the health of communities and their unique characteristics.



## Recommendations for Implementing Behavior Change Strategies and Interventions that Reduce Motor Vehicle-Related Injuries and Fatalities - *Continued*

**E. Collaborate with researchers to advance strategies that focus on behavior change as a mechanism to encourage safe driving practices.**

State and local level practitioners could work with researchers to contribute additional evidence to the public health and traffic safety fields supporting the intersections between motor vehicle injury prevention, driver safety practices, behavior change interventions, and shared risk and protective factors.

**F. Collaborate with implementation partners to assure widespread adoption of behavior change strategies and interventions that consider any relevant factors that either influence risky driving behavior or protect against unsafe driving practices.**

State and local level agencies (e.g., public health, traffic safety, law enforcement, substance abuse treatment professionals, and health care providers) could work with their key partners and stakeholders to identify who benefits from an intervention (parents, educators, policy makers, etc.), determine the delivery mechanisms of an intervention, provide support for implementing an effective strategy, and on-going evaluation of intervention strategies.







## Recommendations for Utilizing Data to Measure the Impact of Shared Risk and Protective Factors on Strategies that Promote Driver Safety

- A. Identify data sources that can measure the key variables associated with unsafe driving behaviors and connect any relevant individual, relationship, community, or societal level factors to intervention activities specific to reducing risk and promoting driver safety.**

For example, the Behavioral Risk Factor Surveillance System (BRFSS) collects behavioral health risk data at the state and local level on a variety of topics including but not limited to, seat belt use and drinking and driving. BRFSS is one of the premier surveillance systems in the United States and the data is used to build health promotion activities on the population level.

- B. Collaborate with implementation partners to link data across various sources.**

Primary data collection of motor vehicle-related injury data happens at the state and local levels (e.g., health departments, traffic safety agencies, health care organizations, hospitals/clinics, and law enforcement agencies). These agencies could coordinate to link data across a variety of sources (e.g., behavioral surveys, population-based surveys, emergency room data, police reports, hospital discharge data, EMS reports) to generate a dataset of variables to inform research, programs, and policies to integrate elements of the shared risk and protective factors approach with outcomes related to increasing driver safety.

- C. Collect or access data on variables that highlight key characteristics of a motor vehicle injury related to risky driving behaviors.**

Data analysts, epidemiologists, or research teams could collect or access data on variables that describe the injury: demographics, factors before, during, or after an incident, characteristics of the driver's behavior, social, and environmental elements.

- D. Facilitate partnerships across multiple disciplines to consistently analyze, interpret, disseminate, and use motor vehicle injury data sources.**

State and local practitioners with activities relevant to motor vehicle injury prevention and driver safety (public health, traffic safety, engineering, law enforcement, academia, mental health, substance abuse, health care, and public policy) could work with one another to analyze data findings, disseminate findings with key end-users, and use the data to advance continued preventive intervention strategies.

- E. Make data collection a routine practice when developing, implementing, and evaluating behavior change strategies and interventions.**

State and local professionals (state and local health departments, traffic safety offices) could collaboratively develop data collection instruments, work with implementation partners to obtain data sharing agreements, work with research partners to evaluate the impact of shared risk and protective factors on driver safety, and evaluate changes in behavior over time by promoting factors that protect against risky driving.



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# APPENDICES



SAFE STATES





## Appendix A: Problem Identification Guide

### RELEVANT DATA SOURCES THAT SUPPORT IDENTIFICATION AND EVALUATION OF DRIVER BEHAVIOR CHANGE INTERVENTIONS AND STRATEGIES

The first step in preventing any injury-related problem is understanding the magnitude and scope of the identified issue, where the issue is focused, and whom it affects. This information can be obtained by gathering and analyzing data – through a process known as “surveillance”. Data can show how frequently and in what ways motor vehicle-related injuries occur, reveal any changes in those injuries over time, demonstrate any trends across these injuries, emphasize any risk or protective factors influencing injury-related trends, and highlight the impact of programs that are designed to reduce injuries or fatalities. Data is often used by key decision makers when allocating

resources to programs in areas of need.

The table below provides a list of data sources for the risky driving behaviors highlighted in this resource document. This table also contains a list of resources that can be used to define an injury-related problem, plan program activities, develop survey instruments, monitor the effectiveness of programs or policies, evaluate program outcomes or policy impact, and identify additional evidence-based strategies that may not have already been mentioned in this document. This list, organized alphabetically, is not intended to be exhaustive, but serves as a helpful starting point for gathering data.

**Table 6. Resources Related to Identifying, Monitoring, and Evaluating Risky Driving Behaviors**

Data Sources for Identification & Evaluation of Driver Behavior
<a href="#"><u>The American Automobile Association (AAA)</u></a>
AAA provides safety articles and information for consumers and roadway advocates. Many of the reports and data AAA collects directly relate to risk and protective factors of risky driving behaviors (e.g., <a href="#"><u>Alcohol-impaired driving</u></a> ).
<a href="#"><u>The American Automobile Association's Foundation for Traffic Safety</u></a>
The AAA Foundation's mission is to prevent traffic death and injuries by conducting research into their causes and by education the public about strategies to prevent crashes and reduce injuries when they occur. The foundation has expanded its scope of work and has long been recognized as a leader in traffic safety, with a focus on four research priorities: <ul style="list-style-type: none"><li>• <a href="#"><u>Driving behavior and performance</u></a></li><li>• <a href="#"><u>Emerging technologies</u></a></li><li>• <a href="#"><u>Roadway systems and drivers</u></a></li><li>• <a href="#"><u>Vulnerable road users</u></a></li></ul>





## Data Sources for Identification & Evaluation of Driver Behavior

### [The Centers for Disease Control and Prevention \(CDC\), Behavioral Risk Factor Surveillance System \(BRFSS\)](#)

The Behavioral Risk Factor Surveillance System (BRFSS) is the nation's premier system of health-related telephone surveys that collect state data about U.S. residents (18+ years of age) regarding their health-related risk behaviors, chronic health conditions, and use of preventive services. BRFSS collects data in all 50 states and three U.S. territories. To support BRFSS data collection activities, CDC provides [state-level information on how BRFSS supports ongoing projects](#), access to [prevalence data and data analysis tools](#), and the [annual BRFSS questionnaires](#).

### [The Centers for Disease Control and Prevention \(CDC\), Youth Risk Behavior Surveillance System \(YRBSS\)](#)

Through CDC's Division of Adolescent and School Health (DASH), the Youth Risk Behavior Surveillance System (YRBSS) monitors six categories of health-related behaviors that contribute to the leading causes of death and disability among youth young adults, including behaviors that contribute to unintentional injuries and violence. YRBSS includes a national school-based survey conducted by CDC and state, territorial, tribal, and local surveys conducted by CDC as well as state, territorial, and local education and health agencies and tribal governments. Check out the [YRBSS Toolkit](#) for the latest data trends and for additional resources on educating partners, stakeholders and community members about adolescent health risk behaviors and experiences. The current and past [YRBSS questionnaires](#) are also available for viewing and download.

### [The Centers for Disease Control and Prevention \(CDC\), National Center for Injury Prevention and Control \(NCIPC\)](#)

One of CDC's National Center for Injury Prevention and Control priority areas is Motor Vehicle Safety. The CDC Injury Center provides state-based data, cost data related to motor vehicle injuries, and other resources for implementing motor vehicle injury prevention strategies.

[CDC's MV PICCS](#) (Motor Vehicle Prioritizing Interventions and Cost Calculator for States) includes 2015 state data and a graphical interface to help state decision makers prioritize and select from a suite of 14 effective motor vehicle injury prevention interventions. MV PICCS 3.0 calculates the expected number and monetized value of injuries prevented, lives saved, and the costs of implementation, while considering available resources. The updated tool includes easy access to [intervention fact sheets](#). Another new feature is the ability to save or print sharable reports with MV PICCS results.

[CDC's WISQARS™](#) (Web-based Injury Statistics Query and Reporting System) is an interactive, online database that provides fatal and nonfatal injury, violent death, and cost of injury data from a variety of trusted sources.

CDC tracks metrics across risk factors and protective factors related to risky driving behaviors, among other topics. Many analogous topics related to driving behaviors (e.g. [intimate partner violence](#)), where shared risk and protective factors can be adapted and applied to driving practices in the future.



## Data Sources for Identification & Evaluation of Driver Behavior

### [The Centers for Disease Control and Prevention \(CDC\), Program Performance and Evaluation Office \(PPEO\)](#)

The Evaluation Unit in CDC's PPEO sets standards for agency-wide evaluation, delivers tools, provides technical assistance and resources to enhance evaluation efforts, and provides support for evaluation capacity-building across CDC programs. CDC's PPEO provides many resources for [conducting evaluations](#). They provide access to many materials based on the [CDC Evaluation Framework](#). Materials include, [workbooks and tools](#), and access to a [self-study guide](#) on program evaluation.

### [The Community Guide - Motor Vehicle](#)

The Community Guide is a collection of evidence-based [findings](#) of the [Community Preventive Services Task Force \(CPSTF\)](#). It is a resource to help you select interventions to improve health and prevent disease in your state, community, community organization, business, healthcare organization, or school.

### [The Governor's Highway Safety Association \(GHSA\)](#)

The Governor's Highway Safety Association (GHSA) provides practical recommendations and strategies for states to employ to decrease unsafe driving behaviors and risk factors and increase protective factors. GHSA provides states guides on multiple risky driving behaviors (e.g. [drug-impaired driving](#)).

### [The Insurance Institute for Highway Safety \(IIHS\)](#)

The IIHS includes overviews of key highway safety issues, along with news and legal information on multiple risky driving behaviors. IIHS data and research resources related to [driver safety topic areas](#) including older drivers and seat belt use.

### [The National Highway Traffic Safety Administration \(NHTSA\)](#)

NHTSA provides deep expertise and experience in risky driving behaviors and studies behaviors and attitudes in highway safety, focusing on drivers, passengers, pedestrians, and motorcyclists and use that to develop and refine countermeasures to deter unsafe behaviors and promote safe alternatives. NHTSA works to eliminate risky behaviors on our nation's roads. It also provides access to data and resources on several [risky driving priority areas](#). NHTSA also provides information on research and data on a range of topics including: [Enhanced Safety of Vehicles, Crash Avoidance Techniques and Data](#). NHTSA previously worked with states to develop data linkage programs under the CODES effort. State CODES programs became autonomous in 2013. This data system links crash, vehicle, and behavior characteristics to their specific medical and financial outcomes providing a more comprehensive understanding of motor vehicle crash outcomes. The following resources are available from NHTSA: [CODES Contact List by State](#) and [NHTSA CODES Reports](#).



## Data Sources for Identification & Evaluation of Driver Behavior

### [The National Highway Traffic Safety Administration \(NHTSA\), National Center for Statistics and Analysis \(NCSA\)](#)

NCSA, is responsible for providing a wide range of analytical and statistical support to NHTSA and the highway safety community at large, in the general areas of:

- Human, vehicle, environmental, and roadway characteristics, as they relate to crash frequency and injuries
- Identifying injury mechanisms and associated crash dynamics in motor vehicle crashes
- Evaluating the effectiveness of crashworthiness, crash avoidance, and traffic safety efforts
- Monitoring the magnitude of the traffic safety problem
- Quantifying the benefits resulting from proposed agency rules.

In addition to its own data input sources NCSA uses data from other governmental agencies, as well as crash files from several states, to support analytical activities. NCSA conducts one-time and ongoing analyses on a wide range of safety issues. Examples of recent analyses include:

- Trends and Injuries in Non-Fatal Traffic Crashes.
- Statistics Analysis of Alcohol-Impaired Driving Trends.
- Seat Belt Use in the United States.
- Evaluation of primary enforcement and other provisions of safety belt use laws.

NCSA also regularly publishes a variety of Research Notes, Crash\*Stats, Traffic Safety Fact Sheets and Reports which provide information on crashes at the national and state levels. NCSA also produces many reports on Seat Belt Use in the States and Territories.

### [National Transportation Safety Board \(NTSB\)](#)

NTSB is an independent federal agency dedicated to making transportation safer by conducting independent investigations of transportation crashes, determining probable cause, and issuing recommendations for safety improvements. NTSB publishes recommendations for action and research reports on a variety of traffic safety issues. For example, they've published a [safety study on reducing speeding-related crashes with recommendations](#) and the NTSB [Most Wanted List of Transportation Safety Improvements](#).

### [The Substance Abuse and Mental Health Services Administration \(SAMHSA\)](#)

SAMHSA can provide population-level incidence and prevalence rates of many risk driving behaviors. The SAMHSA website includes multiple survey data on a range of topics which can be found in the National Survey on Drug Use and Health. SAMHSA covers multiple topics related to [prevention](#) including: Evidence-based practices and prevention strategies for substance abuse and mental illness.



## Data Sources for Identification & Evaluation of Driver Behavior

### [Transportation Research International Documentation](#)

The TRID/TRB/TRIS/ITRD databases cover multiple risky driving behaviors and potential strategies and interventions to address them in various settings. TRID covers all modes and disciplines of transportation and contains nearly 1.2 million records of published research. More than 236,000 records contain links to full-text documents. [Click here](#) to begin a database search.

### [The U.S. Preventive Services Task Force \(USPTF\)](#)

The USPTF provides clinical recommendations for screening or reporting a pre-existing medical condition. Certain pre-existing conditions of drivers can be found using this searchable database. The USPTF provides recommendations for primary care practice.







## Appendix B: Exploring Key Factors of Risky Driving Behaviors

Unhealthy family relationships, severity of post-traumatic stress, and negative emotions are also associated with risky driving and motor vehicle crash involvement (Atombo, Wu, Tettehio, & Agbo, 2017; Hayley, de Ridder, Stough, Ford, & Downey, 2017; Kuhn, Drescher, Ruzek, & Rosen, 2010). Environmental influences (e.g., road conditions, weather), a driver's health (e.g., ADHD, chronic pain, sleep apnea, obesity), life circumstances (e.g., veterans fresh from deployment, veterans age 65 and older), and psychosocial factors (e.g., stress) also affect the likelihood for risky driving behaviors. These factors combine into a complex and interconnected system that influence driving behaviors - extending even deeper to societal-level characteristics such as structures of inequity or repeat cycles of trauma. This complex network points to the need to examine the deeper, underlying risk and protective factors that address behavior across these six aspects of risky driving in order to truly address the root of the problem. A profile of the risk and protective factors for each of the six risky driving behaviors is below.

### Aggressive Driving and Speeding

According to numerous studies, age is a significant risk factor for aggressive driving and speeding. Younger drivers are at risk because they have heightened levels of personality traits that are associated with risky and aggressive behaviors (Constantinou, Panayiotou, Konstantinou, Loutsiou-Ladd, & Kapardis, 2011). Younger drivers (18-34 years) report the highest prevalence of perpetrated driver aggression, whereas older adult drivers (55+ years) report the lowest prevalence of perpetrated driver aggression (Wickens, et al., 2012). Research supports the

notion that sex is a key factor in assessing aggressive driving and speeding behaviors. According to Constantinou, et al. (2011) male drivers are more prone to accidents precisely because they have certain personality characteristics that make them under-estimate danger and take more risks (higher sensation seeking and lower sensitivity). For both male and female drivers, those who are unmarried or divorced report a greater prevalence of driver aggression than those who were married. Both male and female drivers with high and medium socioeconomic status (SES) reported more risky driving behaviors, intention, and attitude toward speeding than their peers with low SES (Wickens, et al., 2012; Atombo, Wu, Tettehio, & Agbo, 2017).

Aggressive driving can be related to personality variables such as feelings of anger, hostility, sensation seeking, and competitiveness. Social variables such as driving without passengers and characteristics of the target vehicle (e.g., passengers in the target vehicle, age of individual(s) in target vehicle, etc.) tend to increase aggressive driving behavior. When anger is coupled with other specific risk characteristics (e.g., age or high levels of hostility), it leads to maladaptive changes in driving parameters and worsens driving performance. Finally, environmental variables (e.g., type of road, traffic, and weather), and temporal variables (e.g., time constraints and time of day) can increase the risk for aggressive driving (Harris & Houston, 2010;2018; Sharkin, 2004; Roidl, Siebert, Oehl, & Höger, 2013).

### Alcohol-Impaired Driving

As supported by Duarte, Escario, & Molina (2016) and Fairlie, Quinlan, Wood, Lawson, & Witt (2010), older adolescents and young





adults (21 years or older) have a higher probability of participating in alcohol-impaired driving. Despite this trend, adolescents are less likely to participate in alcohol-impaired driving as the father's characteristics increase (e.g., education level, present in the home, drinking/smoking behaviors). Research suggests that there is an association between early substance abuse among young adults and relevant risk of driving under the influence of alcohol. The occurrence of high anxiety levels, binge drinking, and using marijuana may have combined influence and function as a significant predictor of impaired driving behaviors, specifically among males (Li, Simons-Morton, Gee, & Hingson, 2016; Oshri, Carlson, Bord, & Zeichner, 2017; Pogue, Hakes, & Sloan, 2017). Finally, a perceived difficulty in obtaining alternative transportation is associated with a greater likelihood of individuals drinking and driving (Fairlie et al., 2010).

### **Distracted Driving**

Multivariable analyses reveal that age significantly correlates with an increased risk for distracted driving behavior. More specifically, young white males are less likely to avoid distracting activities while driving (Engelberg, Hill, Rybar, & Styer, 2015; Li, et al., 2018; Young & Lenné, 2010). Developmental stages (adolescents and young adults), type of distracting task (e.g., texting), and the use of mobile technology impairs youth safety on the road (Stavrinos, Pope, Shen, & Schwebel, 2018). Several research studies confirm the high prevalence of this behavior among adolescents. Findings from a study conducted by Carter, Bingham, Zakrajsek, Shope, & Sayer (2014) revealed that ninety-two percent of adolescents reported regularly engaging in distracted driving behavior. Young drivers (18-25 years) are significantly more likely to engage in

certain distracting activities, such as: using a mobile phone, using a CD player, eating, and drinking. While older drivers are the most adversely affected by distraction while driving, younger drivers have a higher risk of deliberately violating safe driving practices (Ortiz, Ortiz-Peregrina, Castro, Casares-López, & Salas, 2018; Young & Lenné, 2010).

While there are several demographic factors that lead to distracted driving, there are several social and environmental factors that influence these behaviors. Studies show that parent role modeling of distracted driving determines an adolescent's perceived risk of engaging in distracted driving behaviors. If a teen observed their parent engaging in distracted driving behaviors, they were more likely to repeat the behavior. Additionally, if teens observe their peers engaging in distracted driving behaviors, they are more likely to engage in the same behaviors (Carter, Bingham, Zakrajsek, Shope, & Sayer, 2014; Hartos, Eitel, & Simons-Morton, 2002). A study conducted by Li et al. (2018) revealed that the prevalence of texting while driving was higher in states with a lower minimum learner's permit age and in states where a larger percentage of teenagers (specifically high school students) drove. Seat belt use by teens correlated with distracted driving behavior. Infrequent seat belt use increased the likelihood of teens texting while driving. This study also revealed a relationship between alcohol-impaired driving and texting while driving among teens. Regarding older adults (30-64 years), other variables for an increased risk of distracted driving include having children at home, the average number of days a week spent driving, and the obligation felt to take work calls while driving (Engelberg, et al., 2015).



### Fatigued and Drowsy Driving

Jiang, Ling, Feng, Wang, & Shao (2017) found age to be the only significant predictor of fatigued driving behavior among other demographic variables. Regarding individual demographic factors, being a male is positively associated with an increased likelihood of driving while fatigued (Paterson, Browne, Ferguson, & Dawson, 2016). Paterson et al. (2016) also found that younger age is associated with an increased likelihood of reporting having driven despite feeling too tired.

There are several normative beliefs and underlying causes that influence drowsy and fatigued driving. Drivers with poor sleep quality or a history of fatigue all demonstrate a greater tendency to continue driving while fatigued, have a more positive attitude towards driving while fatigued, and perceive a higher level of control while driving fatigued (Jiang et al., 2017). Individuals that report very short (less than 5 hours) and short (6 hours) sleep durations, are more likely to be associated with drowsy driving. Very short sleepers were more likely to report drowsy driving than those that got at least 7 hours of sleep. Very little sleep duration and insufficient sleep place individuals at risk for driving while drowsy or fatigued. Additionally, the physical health of an individual can influence drowsy and fatigued driving behavior. Obstructive sleep apnea increases the likelihood of insufficient sleep. Characteristics that may predict a crash in drivers with obstructive sleep apnea include a high body mass index (BMI), apnea plus hypopnea index, oxygen saturation, and possibly daytime sleepiness (Maia, Grandner, Findley, & Gurubhagavatula, 2013; Tregear, Reston, Schoelles, & Phillips, 2009). Another underlying factor influencing fatigued driving is navigating in a congested traffic flow (Wang, Sun, Fang, Fu, & Stipanovic, 2017).

### Other Drug-Impaired Driving

According to the 2016 National Survey on Drug Use and Health, men are more likely than women to drive under the influence of alcohol or other drugs. Although illicit drug use has increased among older adults aged 50 to 59, findings also show a higher percentage of young adults aged 18 to 25 driving after taking drugs and/or drinking when compared to the behaviors of adults 26 or older. While age and sex are strong individual factors of drug-impaired driving behavior, there are several other factors that pose a relevant risk for driving under the influence of drugs in all substance groups. These factors include early initiation of lifetime substance use, low education level, unemployment, receiving a disability pension, being divorced, and living alone (Karjalainen, et al., 2011; Li et al., 2016).

### Seat Belt Nonuse by Adults

Self-reported seat belt use by adults increases with age. Older adults are more likely to wear a seat belt, specifically adults 45 years of age and older (Bhat, Beck, Bergen, & Kresnow, 2015; Chao, Szrek, Leite, Peltzer, & Ramlagan, 2015). Based on findings from (Strine, et al., 2010), significant sociodemographic characteristics among those who reported always wearing seat belts include: being female, being Hispanic or non-white, having some college education or greater; being currently married, being retired, being a homemaker, or being a full-time student. Seat belt use is significantly less likely in obese individuals compared with their normal-weight counterparts (Jehle, Doshi, Karagianis, Consiglio, & Jehle, 2014; Strine, et al., 2010).

Behavioral intention to wear a seat belt can be predicted by self-efficacy, instrumental attitudes towards using a seat belt, and social norms around seat belt use. Enforcement







of seat belt laws plays a critical role in seat belt use by adults (Okamura, Fujita, Kihira, Kosuge, & Mitsui, 2012). Geographic characteristics also have an impact on seat belt use by adults. As the location became more rural, the prevalence of persons who reported always wearing seat belts became less. After adjusting for all other factors, persons in the largest metropolitan areas were significantly more likely to report always wearing a seat belt than those in the smallest rural areas.





5456 Peachtree Blvd. #244  
Atlanta, Georgia 30341

770.690.9000

[info@safestates.org](mailto:info@safestates.org)

[www.safestates.org](http://www.safestates.org)