

TOWARD ZERO DEATHS:

A NATIONAL STRATEGY ON HIGHWAY SAFETY



Toward Zero Deaths®

National Strategy on Highway Safety

TowardZeroDeaths.org

June 2014

Dear Highway Safety Stakeholder:

As associations that represent government agencies with a professional role in highway safety, we are pleased to present this document, *Toward Zero Deaths: a National Strategy on Highway Safety*, as a tool for helping to unite and mobilize our efforts to reduce fatalities and serious injuries relating to traffic crashes. We are also asking for your assistance in participating in this initiative.

The *Toward Zero Deaths National Strategy* was developed with input from numerous stakeholders, along with support from several agencies within the United States Department of Transportation, and is intended to represent a consensus-based document. While each organization individually will not be able to further develop or implement every countermeasure and program discussed in this document, the hope and expectation is that we should each see a place and role for our own organizations in this national effort. A sustainable, collaborative movement to eliminate highway fatalities requires contributions, collaboration and commitment from all of us.

This document discusses a wide range of challenges and strategies, and participating in this national initiative should not be interpreted to mean that any given stakeholder, or even each member of the organizations listed below, endorses all of the information and ideas in this document, but rather that the stakeholders acknowledge that it is imperative that we work toward the vision of a highway system free of fatalities. The TZD National Strategy is intended to unite safety stakeholders and motivate partners to reinforce partnerships, increase collaboration, create new opportunities, and focus on aggressively working to reach the TZD vision.

We urge you to accept the challenge - participate in the national dialogue on highway safety, identify next steps and develop a long term strategy for your own programs, and share your ideas, best practices, and lessons learned with others. Visit www.towardzerodeaths.org for additional information. We look forward to working with you.

Sincerely,

The Toward Zero Deaths Steering Committee:



TowardZeroDeaths.org

TABLE OF CONTENTS

SECTION 1: THE TOWARD ZERO DEATHS VISION

SECTION 2: THE CHALLENGES AHEAD

SECTION 3: KEY AREAS

- 1. Safer Drivers and Passengers**
- 2. Safer Vulnerable Users**
- 3. Safer Vehicles**
- 4. Safer Infrastructure**
- 5. Enhanced Emergency Medical Services**
- 6. Improved Safety Management**

SECTION 4: SAFETY CULTURE

SECTION 5: LET'S GET TO WORK

ACKNOWLEDGEMENTS

APPENDIX

REFERENCE



SECTION 1 THE TOWARD ZERO DEATHS VISION

Looking at the number of highway fatalities in the United States over the past century gives one view of the nature of highway safety in this country. Figure 1 shows how fatalities increased for many years as vehicular travel became more common, and then declined as efforts to combat these numbers were developed, refined, strengthened and coordinated. The fatality rate trend shown in the figure demonstrates the effect of safety efforts even more dramatically by incorporating the increase in vehicular travel over the decades.

From a safety perspective, Americans' experience with using our roads is much different now than it was decades ago. However, from a different view, each data point on that chart represents thousands of friends, family members, and colleagues whose lives ended too soon because of a traffic crash. In 2012, there were 33,561 fatalities and 2.36 million injuries on our roads. Through 2011, fatalities had decreased 26 percent over the previous 6 years, resulting in the lowest number of fatalities since 1949. Though 2012 saw an increase in fatalities (3.3 percent) and injuries (6.5 percent), this recent trend reflects progress that provides the motivation to sustain this progress and aggressively push the trend downward (44).

While so much progress has been made in efforts to prevent fatalities, traffic safety professionals and advocates nationwide understand the magnitude of both the challenge and the efforts necessary to continue to make significant progress. Highway safety stakeholders—including government agencies, private industry, safety advocates, associations representing professionals, and individuals—are committed to reducing fatalities to zero. These stakeholders continuously expand their efforts to improve highway safety and they are committed to do more of what stakeholders know works, while also using new approaches, materials, and technologies to reach safety goals sooner.



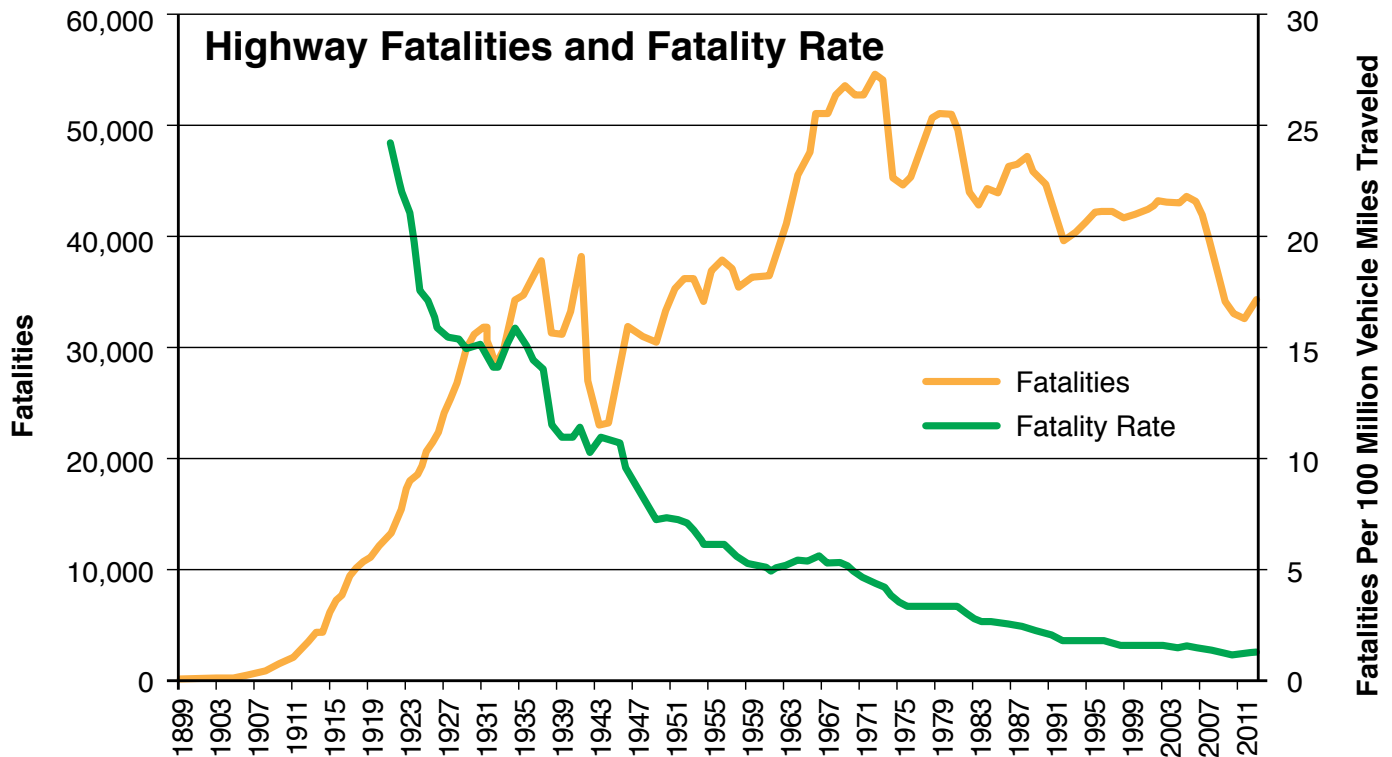


Figure 1. Highway Fatalities and Fatality Rate (per 100 million vehicle miles traveled) in the United States (27, 34)

A National Safety Strategy

There are currently many diverse initiatives and programs to increase safety on the nation's roadways. Many stakeholders have their own strategic plans that guide their individual activities, and many of these organizations involve their highway safety partners as they develop coordinated safety plans to and put them into action. Federal transportation laws require each state to develop a strategic highway safety plan that focuses the efforts of all state safety partners on the highest priority traffic safety needs statewide. What is missing, however, is a specific single vision that brings together all the various stakeholders nationwide with a role in highway safety. The Toward Zero Deaths (TZD) National Strategy on Highway Safety (the National Strategy) will bring these stakeholders together, and defines the common vision that will drive their individual and collaborative efforts.

The National Strategy vision is a highway system free of fatalities through a sustained and even accelerated decline in transportation-related deaths and injuries. Safety organizations and professionals embracing this vision agree to aggressively work toward an intermediate goal specific to their jurisdiction or the safety issue on which they focus.





Uniting Safety Stakeholder Efforts

The National Strategy is intended to provide a roadmap for the future to identify the key safety focus areas to ensure the greatest progress, and unite all efforts of a wide array of stakeholders nationwide.

All safety stakeholders contribute in different ways to improving highway safety, for example, from:

- Building, operating, and maintaining roads to educating people about how to safely use them;
- Designing and manufacturing safer vehicles to providing emergency medical treatment to people in crashes;
- Enforcing traffic laws to advocating for new legislation;
- Inspecting large trucks and buses to licensing drivers and vehicles; and
- Reinventing traffic safety culture to coordinating efforts among many partners.

TZD builds on what these safety stakeholders already do, both as individuals and as a unified group, by encouraging continued use of proven programs and countermeasures in a very proactive, multidisciplinary manner.

Highway safety partners know that their individual efforts are effective when they collaborate with each other, join forces to attack a particular problem or problem spot from multiple directions, and take advantage of each other's experiences and knowledge. This multidisciplinary approach is the basis of the Toward Zero Deaths National Strategy, as it has been with states' and various other organizations' strategic plans for improving highway safety. TZD is a vehicle to further unite safety stakeholders nationwide and focus on the core elements necessary to bring this shared safety vision to reality.

A Worldwide Safety Effort

Highway fatalities are not just an American epidemic. Almost 1.3 million people die each year on roads around the world and as many as 50 million people are injured. Similar strategic highway safety efforts are occurring worldwide, including development of the Safe System approach and individual national safety plans. The United Nations Decade of Action for Road Safety is a program aimed at reducing the numbers worldwide between 2011 and 2020. For this program, a global action plan was developed and serves as a resource for countries and local agencies to develop customized plans for their own safety activities. The Toward Zero Deaths initiative can guide the United States' contribution to this worldwide effort (55).



Encouraging a Transportation Safety Culture

Road users need to make safety-driven decisions, as do transportation professionals, and a crucial tenet of the TZD National Strategy is to encourage change in the nation's highway safety culture. This involves exploring what influences road users who too often make unsafe decisions, and why and how these influences have such an impact. Road users who lack concern for how their actions affect other road users, who travel unsafely in order to save time, or who have the tendency to overestimate their abilities may end up harming themselves and/or others. Positively changing the safety culture among road users would lead them to understand the potential results of their actions or inactions and believe that they must base their decisions primarily on safety.

From a professional or organizational perspective, changing the safety culture would ensure safety impacts are considered during decision making that affects any portion of the roadway transportation network and its operation, as well as how employees within an organization are considering safety in their decisions about using roads. But changing the safety culture is a complex challenge. While individual strategies or initiatives such as public information campaigns contribute to changing the safety culture of road users and can target specific issues, the process for changing values and attitudes must involve safety as a valued factor in every transportation decision, whether personal or organizational.

The Long-Term TZD Commitment

This document highlights the key initiatives to prioritize over the coming decades to achieve the TZD vision. This long-term view is essential; while we are aggressively implementing shorter-term strategies, we also need to take an aggressive approach to researching and developing longer-term strategies. The National Strategy includes initiatives that are known to be—or are expected to be—effective in addressing specific factors contributing to crashes, have the potential to make a significant reduction in fatalities and serious injuries nationally, or address areas of growing concern. There are many proven safety strategies and the ones highlighted in this document are expected to have a high impact. This document does not provide an exhaustive list of all effective countermeasures and programs—although it does present numerous strategies for the organizations with a role in highway safety to consider. Refer to the Appendix for a more extensive list of strategies.

Additionally, stakeholders will need to identify, develop, and promote promising new initiatives that can accelerate progress. Stakeholders must leverage contributions from professionals in the fields outside of their own—highway infrastructure, road user behavior, public health, vehicle manufacturing, emergency medical services, law enforcement, and others—to address the circumstances that contribute to crashes in a more universal, holistic manner.



The National Strategy includes elements unique to the core function of individual stakeholders, such as driver licensing policies or improving emergency medical service communications technologies. However, the greatest benefit will be achieved by also using programs that reach across traditional boundaries between organizations and help the broader transportation safety community identify new ways to work together to make significant reductions in fatalities and serious injuries. Safety practitioners, researchers, advocates, and other professionals should use the National Strategy to identify potential partners and opportunities for closer working relationships to realize a common vision. For example, Section 3 discusses the countermeasures and programs that might be new ideas for an organization to consider. The discussion of safety culture in Section 4 could provide insights on whether an individual organization might identify ways to increase the focus on safety in business practices and in employee policies.

Finally, while many current practices are effective and will continue to reduce highway crashes, without a renewed and concerted push to expand these efforts, it will take much longer to achieve the vision of a highway system with zero fatalities. Unlike other plans or programs developed with input from stakeholders but intended for use by only one group, the National Strategy blends these initiatives to focus on an aggressive approach to highway safety in which all stakeholders can take a collaborative role.





SECTION 2 THE CHALLENGES AHEAD

The combination of recent trends in crashes combined with expected changes in travel in the future demonstrate the reasons for highlighting the key areas and individual strategies discussed in Section 3.

Current Challenges

The size of the nation's roadway network, the number of road users, the variety of road user types, and the complexity of the driving task—to say nothing about funding needs—combine to present significant challenges for eliminating traffic fatalities and serious injuries. A look at national data provides a picture of issues that are prevalent nationwide. For the purpose of developing a national agenda for reaching a vision of zero fatalities, data are used to identify strategies that need further research and development, or more widespread implementation, or policy changes.

Below is a table showing a sample of crash characteristics and contributing factors, and the percentage of fatalities that involved these characteristics in 2012, a year in which there were 33,561 fatalities. It is important to look at recent trends in crashes with specific characteristics, as this can indicate growing concerns. For example, there have been fewer alcohol impairment and speeding related crashes in recent years, following the trend in total fatalities, though the percentage of total fatalities in which these factors are involved has been holding steady. This indicates these are challenging problems that may need significant new technological, policy, or other countermeasures. Another example is that in 2012 motorcycle fatalities increased for the third year in a row, and the longer-term trend shows motorcycle fatalities have more than doubled since the mid-1990s.



	2012 Fatalities	Percent of 2012 Total
Roadway departure	18,887	56%
Unrestrained occupants	11,189	33%
Alcohol-impaired	10,322	31%
Speeding*	9,944	31%
Intersections	8,766	26%
Motorcycles	4,957	15%
Pedestrians	4,743	14%
Large trucks	3,921	12%
Distraction	3,328	10%
Bicyclists	726	2%

* 2011

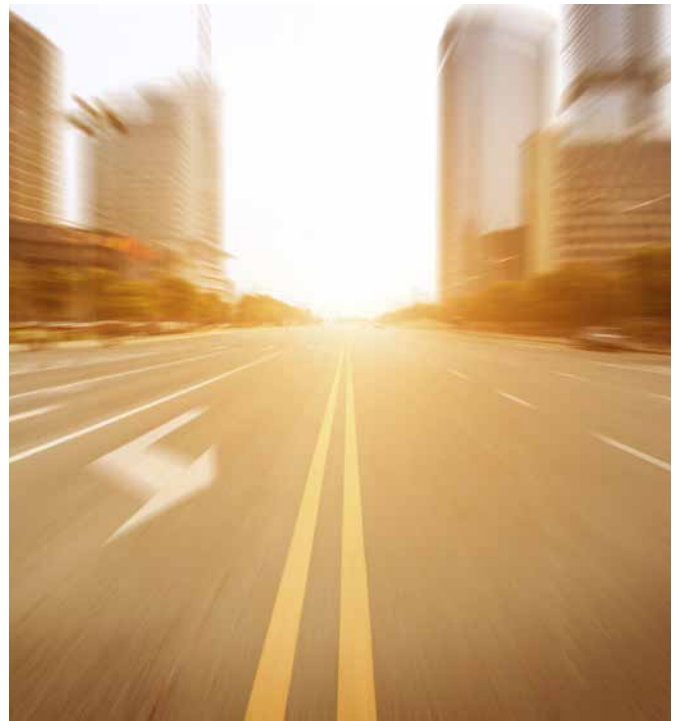
Table 1. Sample of crash contributing factors (44, 36)

As each stakeholder examines data related to specific crash or road user types, contributing factors, or type of location or roadway facility, the specific strategies that may be appropriate for addressing a particular issue become clearer. Since crashes frequently have multiple contributing factors, such as a combination of impaired driving and speeding, a more detailed look at localized crash data leads to a better understanding of the challenges and opportunities that the organization is facing, as well as supporting decisions that make the most effective use of limited funds.

Future View

As factors that affect transportation decisions change over time, it can be expected that these changes may affect highway safety. Demographics, economics, regional growth, travel behavior and activity, freight traffic, vehicles, and technology: these factors and more affect how people travel. Here are a few specific examples of changes we can expect:

- **Demographics:** Over the next 20 years, the number of people over age 65 will nearly double. How will the mobility needs of a larger population of older road users, with different abilities and needs, be accommodated? It is expected that the number of workers over age 65 will double in that same time period; how will the mobility needs of older workers be safely met?





- Travel behavior and activity: With incomes expected to grow more than 40 percent by 2030, increases in travel will result. Per capita annual vehicle miles traveled (VMT) are expected to increase from approximately 8,500 to 10,000. How can we counteract the increase in crashes that could result from an increase in travel? It is also expected that, due to job growth locations, trips between suburban areas will increase. How could the severity of crashes on higher speed non-interstate roads be lessened?
- Freight: Truck VMT is expected to grow at least as much as passenger vehicle VMT, and this increase would raise concerns about interactions between trucks and passenger vehicles. How will an increase in both long-haul and urban truck traffic affect congestion and safety? As manufacturing centers shift to different geographic regions, freight routes will also change. How can the routes that are likely to experience an increase in truck traffic be treated to accommodate more large vehicles?

Other factors expected to change in the future that could impact travel and therefore highway safety include:

- New technologies that modify the way people travel or reduce the need to travel.
- Environmental or energy issues that affect decisions on whether to travel, availability of transportation, or mode choice.
- Immigration and related policies that result in road users with a range of knowledge and skills.

While all of the exact details of the future of transportation and highway safety cannot be known, there are some changes ahead that are evident, such as the increasing number of older road users. It is also clear that if progress toward the TZD vision is not made with the challenges we are facing today and if development of new countermeasures, programs, and technologies does not continue in an aggressive and proactive manner, the expected changes in demographics, economics, and other factors will lead to an even higher loss of life on our nation's roads.





SECTION 3 KEY AREAS

There will always be some risk involved in travel. The basic elements of road transportation—the road users, the vehicles, and the roadway environment or infrastructure—contribute to the risk and also provide opportunities for mitigating the risk. Figure 2 below shows how often these elements factor into crashes.

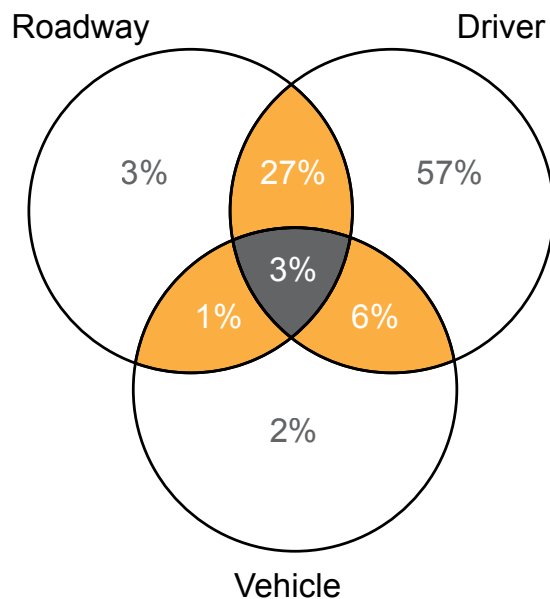


Figure 2: Crash Contributory Factors (54)

This section discusses the following key focus areas

- Safer drivers and passengers.
- Safer vulnerable users.
- Safer vehicles.
- Safer infrastructure.
- Enhanced emergency medical services (EMS).
- Improved safety management and data processes.

The Haddon Matrix is a tool developed to apply principles of public health to highway safety. The matrix allows for identifying factors contributing to a crash or crashes prior to, during, and after crashes. Figure 3 shows an example of a Haddon Matrix, and demonstrates how consideration of the variety of factors contributing to crashes potential provides a clearer picture of the challenges to preventing a particular crash type or improving the outcomes of these crashes. A detailed breakdown of contributing factors in this matrix supports the identification and consideration of potential multidisciplinary countermeasures that address these factors. The key area and strategies discussed in this section follow a similar approach (22).



Figure 3. Example of a Haddon Matrix (22)

	Human	Vehicle/ Equipment	Physical Environment	Socioeconomic
Pre-Crash	Poor vision or reaction time, alcohol, speeding, risk taking	Failed brakes, missing lights, lack of warning systems	Narrow shoulders, ill-timed signals	Cultural norms permitting speeding, red light running, DUI
Crash	Failure to use occupant restraints	Malfunctioning safety belts, poorly engineered air bags	Poorly designed guard-rails	Lack of vehicle design regulations
Post-Crash	High susceptibility, alcohol	Poorly designed fuel tanks	Poor emergency communication systems	Lack of support for EMS and trauma systems

The intent of this section is to draw attention to initiatives that will need to be undertaken or expanded to make significant progress toward the TZD vision. In each key area, this section presents high-impact strategies that are evidence-based and have promising potential, address a significant portion of fatalities and serious injuries on our roadways. In addition they aim to prevent a significant increase in fatalities and serious injuries that might occur due to changing demographic, economic, or other factors. Widespread implementation of these key strategies is expected to significantly reduce the number of traffic fatalities and serious injuries.

Because of the breadth and complexity of the highway transportation system, it is not possible to cover all of the specific issues and potential countermeasures. Even just by highlighting a very small portion of the strategies stakeholders do or could employ, this section demonstrates the magnitude of the effort required to reach the TZD vision. Stakeholders are encouraged to consider their role in implementing each key area and the activities they could undertake to integrate specific strategies into their own safety programs. This section provides ideas on new countermeasures to consider and new partners to engage. Traffic safety stakeholders can use this section as a guide to create programs specific to their own jurisdictions or areas of responsibility. Not every strategy may apply, and stakeholders will encounter implementation challenges, especially regarding cost, additional research needs, development needs, a lack of supporting legislation, or the time needed for full implementation. This document does not contain all of the information or discuss all of the issues a stakeholder will need to consider when determining whether to use a specific strategy, though information known on all of the strategies highlighted have been documented in other resources.



This section also presents an estimate of the amount of time it will take to fully implement these strategies. This implementation timeframe aids the stakeholder when planning involvement in the development and implementation of the various strategies. For example, is the next step to further develop a technology so that it performs reliably and consistently? Do we know enough about a particular countermeasure to determine if it is effective enough to pursue systematic use throughout an area? Is the next challenge to encourage states or localities to enact legislation to allow the use of a particular countermeasure?

The timeframes described below are broad estimates, developed from consensus of stakeholders providing input to this document, and are based upon the assumption that funding and resources are readily available:

- Short-term strategies are known to be effective and can be implemented within five years. Examples include targeted enforcement programs and pavement marking or sign installations.
- Mid-term strategies can be implemented in five to 15 years and may require legislative approval. An example would be incorporating vehicle-to-vehicle communications technology into planning and design efforts.
- Long-term strategies will take more than 15 years to implement. They can have a significant impact on safety but will require technology development, enactment of legislation, and implementation throughout entire roadway networks. An example of this type of strategy would be full implementation of vehicle-to-vehicle and vehicle-to-infrastructure communication.





SECTION 3.1: KEY AREAS

Safer Drivers and Passengers

The element of the transportation system that contributes most frequently to the occurrence of traffic crashes is the driver. Changing road user behavior is difficult and involves different but coordinated approaches: educating drivers on appropriate behaviors, requiring or prohibiting specific behaviors, warning drivers when their behavior may result in a crash or injury, and intervening to counteract or prevent the specific behavior.

Of all the risky behaviors that drivers and vehicle passengers demonstrate, the three most prevalent are traveling unrestrained, alcohol-impaired driving, and speeding—each of which consistently accounts for approximately 30 percent of total fatalities (see Table 1). Other significant driver safety issues are related to age, specifically younger or novice drivers and older drivers. The use of technological devices while driving has become a prominent concern in recent years as well.

A common element to all of these key concerns is the need for multidisciplinary strategies to eliminate risky behaviors. Different—and multiple—methods are needed to reach each individual and bring about a sustained change in his or her behavior. New and stronger traffic safety laws, along with targeted enforcement of the laws, technology, driver education programs, and public information campaigns, have been contributing to traffic safety goals. To reach the TZD vision, it will be essential that a wide range of safety partners actively participate in both the planning and implementation of safety programs.



Note that because of the multidisciplinary nature of the factors that contribute to crashes and the countermeasure options, the key areas discussed in this section overlap with each other. For example, ignition interlock is an in-vehicle technology that prevents drinking and driving, which often leads to increased crashes. It is discussed under Safer Drivers but could easily have been included under Safer Vehicles instead. This section discusses strategies intended to:

- Increase restraint use by drivers and passengers.
- Reduce speeding-related fatalities.
- Reduce impaired driving fatalities.
- Reduce driver distraction-related fatalities.
- Increase safety of young drivers. Increase safety of older drivers.

Increase Seat Belt Use by Drivers and Passengers

Data for 2012 show that only 86 percent of vehicle occupants are using their seat belts (47). Data for 2011 show that though 34 percent of total fatalities were people who were not restrained, when excluding motorcycle, pedestrian, and bicyclist fatalities (in other words, road users for which restraints are not a factor), 52 percent of the fatalities were unrestrained. Increasing restraint use has needed and will continue to need legislative, enforcement, education, and technological solutions (39).

Primary seat belt laws for front seat occupants have been enacted in 33 states and several United States territories. These laws allow law enforcement officers to stop and ticket a vehicle occupant without that person having committed any other offense. In sixteen of these states, there are primary rear passenger seat belt laws. Seat belt use is higher in states and territories with primary laws than those without, and primary laws requiring seat belt use for all passengers would be expected to increase belt usage if enacted (18).

In addition to seat belt laws themselves, legislation may need to be enacted in specific jurisdictions to allow use of specific enforcement methods and to fund both the acquisition of equipment and enforcement procedures. As with other traffic safety legislation, an important aspect is communicating with the public and with legislatures about the benefits, costs, and other factors related to these enforcement methods in order to gain support.

Seat belt use among commercial motor vehicle drivers tends to lag behind that of passenger vehicle drivers, and is generally higher in states with primary enforcement seat belt laws (16). As one way to promote seat belt use, some organizations that operate vehicle fleets are using high-visibility seat belt covers, which help with observing compliance with company policies as well as with enforcement of seat belt laws.

High-visibility enforcement programs, such as the national “Click It or Ticket” campaign, draw drivers’ and occupants’ attention to seat belt use, and effectively increase usage. As is common with enforcement of other traffic safety laws, once the enforcement is less visible, the campaign ends, and the threat of being cited seems to be over, the positive effects can fade and seat belt use can drop. However, it is not possible to sustain this level of high-visibility enforcement —there is not enough funding nor law enforcement officers. In addition, people can become desensitized to the enforcement and stop paying attention.



High-visibility campaigns can focus on nighttime seat belt use or on child restraint use. In 2012, 61 percent of people who died in nighttime crashes were not buckled up (44). One challenge with enforcing seat belt laws at night is officers' ability in low light conditions to determine whether occupants are wearing seat belts. Night-vision goggles and infrared spotlights have proven successful at identifying unbelted drivers. Enhanced photo-imaging technologies may also help detection.

Properly installed child safety seats reduce the risk of fatal injury by 71 percent for infants and 54 percent for toddlers (39). Associated with high-visibility child safety seat campaigns is the need to educate consumers about the need to properly install these seats, and to encourage child safety seat manufacturers to modify car seat designs and installation manuals as needed.

Vehicle manufacturers are developing in-vehicle technologies that promote seat belt use. For example, there are systems that detect the presence of an occupant and whether that individual is wearing a seat belt; new technologies are being developed and installed that provide more aggressive and persistent warning sounds and lights to alert occupants to buckle up. These include systems that produce visual and audio signals that change with vehicle driving time and speed, a built-in gear shift delay, and automatic entertainment lock-out options. Current research is focusing on evaluating and identifying a user-friendly seat-belt reminder for rear seat occupants. Though these systems are currently available on some vehicles, without a federal regulation to require these systems, they will not become prevalent throughout the vehicle fleet unless manufacturers commit to their installation and consumers purchase vehicles with these technologies voluntarily.

Reduce Speeding-Related Fatalities

Speeding is an excellent example of a behavior contributing to crashes that requires multidisciplinary and coordinated solutions to reduce the potential for future crashes related to this behavior. Speeding contributes to both the occurrence of crashes and to their severity. Strategies must involve roadway design and treatments, vehicle design, and efforts to change driver attitudes and behavior. In addition to speed limit signs, visual cues on appropriate travel speeds can be provided by the design of the roadway—for example, the width of lanes, the proximity of roadside objects to the road, on-street parking, sharpness of curves, and lengths of straight sections are all cues that help drivers select a speed. In-vehicle technologies can also provide drivers with information on their speeds or control speeds, and these are discussed more in the Vehicles section.



Nearly 10,000 people died in 2011 in crashes involving speeding (see Table 1). Of the speeding drivers involved in fatal crashes, 42 percent had a blood alcohol content (BAC) at or above the legal limit of .08 grams per deciliter (g/dL), so strategies to reduce impaired driving fatalities could also help reduce fatalities that involve speeding (42).

Locations where speeding is common are suitable for targeted speed enforcement, where officers focus on that particular issue in combination with public awareness campaigns. Increased fines are a potential strategy, as well. Because automated enforcement technologies provide sustained enforcement of a specific traffic law (speeding, red light running, toll violations) without the need for dedicated officers or compromising officer safety at the roadside, they can be an alternative option for jurisdictions looking for effective and efficient ways to address a significant concern.

The challenges related to implementing automated enforcement on a nationwide scale are numerous. Some states need enabling legislation to be able to use automated enforcement while others have laws that specifically prohibit automated enforcement. Public resistance can also be a deterrent since automated enforcement can be viewed as a revenue generator or as an invasion of privacy. Still, automated enforcement does cause drivers to be more compliant with speed limits and traffic signals.

An area-wide speeding enforcement program or an aggressive driving enforcement program that specifically targets speeding in conjunction with other violations would use a public information campaign supported by a wave of enforcement activities, possibly coordinating with multiple neighboring jurisdictions, to bring attention to the safety problem to reduce these behaviors. The visibility of the program in the media and the visibility of the enforcement activities, along with communication of data on the results of the program (number of citations, for example), demonstrate to the public that the program is active and successful. In other words, there is a good chance that drivers will be cited if they speed or drive aggressively. When the program is periodically repeated, the message and safe behaviors are reinforced.

Reduce Impaired Driving

About one-third of all crash fatalities involve a driver with a BAC over the legal limit of 0.08 g/dL. In fact, in 2012, over 10,300 people died in crashes in which a driver had a BAC of 0.08 or higher (44). Less is known about the extent of drugged driving, but there is an increasing focus on understanding and combatting this form of impaired driving. At the center of high-impact strategies for combatting impaired driving are legislation, enforcement, and technology.



Well-publicized sobriety checkpoints deter impaired driving by increasing drivers' awareness of the risk of arrest and potential consequences of drunk and drugged driving. Though arrests are made, the main goal is the deterrent effect achieved with publicity of the checkpoints. The National Highway Traffic Safety Administration (NHTSA) estimated that this strategy would reduce impaired driving fatalities by at least 15 percent (49). Several US territories and 38 states conduct sobriety checkpoints (19). Enacting legislation that allows checkpoints in the remaining jurisdictions and increasing use of checkpoints would be expected to reduce impaired driving.

It is critical to coordinate with prosecutors and judges to gain their support of sobriety checkpoints and other impaired driving strategies, as well as their commitment to pursue convictions and impose penalties. This will help deter repeated violations and raise awareness among drivers of the possible serious penalties associated with impaired driving.

Driving while intoxicated (DWI) or driving under the influence (DUI) courts target repeat offenders and impaired drivers with a high BAC for intensive monitoring after conviction, providing both accountability and long-term treatment. Depending on the specific state's law, offenders who participate in or complete a program addressing long-term behavior change may be eligible for a suspended sentence, or a restricted or probationary driving permit, possibly in conjunction with the use of an ignition interlock.

Ignition interlock devices prevent vehicles from starting if alcohol over a specified concentration is detected on the drivers' breath. There is an ignition interlock program in every state, in which a potential penalty for a drunk driving conviction is installation of an ignition interlock for a period of time. Eighteen states either require all people convicted of drunk driving to use an ignition interlock even if it is their first offense, or offer an incentive (such as a shorter sentence) if offenders choose to use an interlock device. Other states require interlocks for repeat offenders or for drunk drivers with a high BAC, or leave the use of interlocks up to the judges' discretion. Expanding the use of interlocks for all convicted drunk drivers, both first-time and repeat offenders, would continue to decrease the number of alcohol impaired driving fatalities and serious injuries. The availability of interlocks on all motor vehicles (in other words, even for drivers who do not have a drunk driving conviction) would be expected to prevent even first offenses and related crashes. There would have to be a federal mandate or willingness on the part of consumers to purchase and use such devices, but widespread use would allow drivers to prevent themselves from operating their vehicle when impaired.

Passive alcohol detection systems are being developed to detect alcohol use without a person having to be actively tested (specifically by blowing into a breath alcohol testing device). These devices would test the air, the driver's skin, or other means, and then prevent the vehicle from starting if the alcohol concentration is over a specified level. Eliminating the need for a sober driver to actively interact with the device would be expected to increase consumer acceptance and promote widespread use of these systems. NHTSA and a coalition of automakers are working on the Driver Alcohol Detection System for Safety (DADSS) program to develop these technologies.



Drug-impaired driving is growing concern. Three states have drug-impaired driving laws, and 18 states have per se laws that ban a driver from having any prohibited substance in his or her body while driving (19). In the most recent NHTSA National Roadside Survey of Alcohol and Drug Use by Drivers, 11 percent of daytime drivers and 16 percent of nighttime drivers tested positive for drugs, ranging from prescription, over-the-counter, or illegal drugs. This does not mean that these drivers were impaired, however. Since drugs are absorbed by and act on the body differently than alcohol, additional research is needed to determine which drugs impair driving, and the dosage levels that are associated with impaired driving and higher crash risk (46).

Additional work is needed to research the extent of drug-impaired driving and the impact various drugs have on driving abilities, and to further develop and implement strategies for addressing this growing concern. Similar to alcohol, further development of detection technologies is needed. Training and deployment of additional officers as Drug Recognition Experts will allow for more efficient determination of whether a driver is impaired due to drug use, and what type of drug was used. Legislation is also needed to permit enforcement with specific detection technologies. Providing additional information to drivers, such as through improved labels on medication that indicate the effect on safe driving, will help drivers reduce their risks as well. More knowledge on the impacts of prescription and over-the-counter drugs would allow organizations with commercial drivers to determine whether policies restricting driving while using specific medicines are appropriate.

Reduce Driver Distraction

As mentioned in Table 1, in 2012, 3,328 people died in crashes involving a distracted driver, though since it can be difficult to determine whether distraction is a factor in a crash, the actual number of related fatalities may be higher. Using a cell phone while driving is a common distraction, and other distractions include talking with other passengers, eating, programming a navigation device. Fatalities involving all distractions, both inside and outside the vehicle, are included in the statistic above.

A multidisciplinary approach is being used to combat distracted driving, and these efforts need to be expanded. Stronger partnerships among legislators, law enforcement, educators, telecommunications companies, and others are needed to successfully address cell phone and texting distractions. Two types of countermeasures demonstrating the range of strategies for addressing distracted driving are:

- Technology-based solutions, which have the potential to minimize or immobilize the use of devices inside the vehicle, particularly those that are portable rather than integrated into the vehicle.
- Infrastructure-based strategies, such as center line and edge line rumble strips, which can combat distracted driving by bringing the driver's attention back to the roadway.



As with other traffic safety laws, public support is needed to get distracted driving laws enacted or strengthened. Once the laws are in effect, public support is still needed for enforcement and adjudication of the laws. High-visibility enforcement campaigns are one method for both enforcing and creating public awareness for these laws, and a NHTSA project demonstrated the effectiveness of these campaigns (45). Additional enforcement methods and technologies are needed to support efforts to reduce distracted driving.

Cell phone use while driving receives a significant amount of attention nationwide, and this growing issue faces many challenges, including:

- Many drivers do not understand the risks of using cell phones while driving.
- Laws prohibiting cell phone use while operating a vehicle may not exist or may be relatively weak.
- Identification of distracted driving by officers and enforcement of laws can be difficult. There are often no witnesses to implicate a distracted driver in a crash.

Federal regulations prohibit hand-held cell phone use and texting by interstate truck and bus drivers, as well as drivers transporting hazardous materials, and individual states regulate driving of passenger vehicles within their borders. Laws regarding cell phone use and texting while driving vary by state (19):

- 41 states and several territories ban texting for all drivers, and six additional states ban texting by novice drivers.
- 37 states ban cell phone use by novice drivers, and 11 states ban hand-held cell phone use by all drivers.
- Almost all texting bans are primary enforcement laws.
- Some states have bans on cell phone use in work or school zones, or restrictions specific to school bus drivers.

Technologies can help prevent the use of cell phones and other electronic devices while driving. Vehicle manufacturers and associations that represent the manufacturers have experience developing devices, services, and standards to support the safe use of in-vehicle technologies. However, since many of these in-vehicle devices and services are developed by the telecommunications and computer industries, coordination among these industries and the related standards and regulation organizations is needed. These efforts will continue to support development and manufacturing of technologies that minimize distractions or prevent use of specific devices or functions. Communication with consumers about related safety advantages will be needed in order to promote widespread purchase and use.

Clearly, a change in road users' perceptions of the risks involved with distracted driving as well as their support of related legislation and enforcement activities is needed to make a significant change in distracted driving.





Increase Safety of Younger Drivers

Despite a downward trend in highway fatalities involving teen drivers, motor vehicle crashes remain the leading cause of death for American teenagers. In 2011, 4,347 drivers aged 15 to 20 were involved in fatal crashes, and 1,987 teen drivers were killed in crashes. These novice drivers merit special attention because they have less experience on the roadway and may often overrate their driving abilities. Driver fatalities for this group declined 48 percent between 2002 and 2011. As with all drivers, common risky behaviors associated with younger driver-involved fatalities and serious injuries involve not wearing seat belts, speeding, and impaired driving. In 2011, 32 percent of young drivers killed in crashes had a BAC of .01 g/ dL or higher, with 26 percent having a BAC of at least .08 g/dL. (43). A sustainable reduction in fatalities of younger drivers will require a multidisciplinary approach used for other road users, including strengthening laws and educational programs and using technology to prevent risky behaviors. Specific needs include:

- Strengthening graduated driver license (GDL) laws: Since their introduction in the mid-1990s, GDL laws have been instrumental in reducing the number of crashes, injuries, and fatalities among teen drivers. All states have GDL laws, and most GDL laws include a learner stage, an intermediate stage with limited unsupervised driving, and then a standard license. Details of the GDL laws vary by state with respect to bans on cell phone use, nighttime driving, and number of passengers. Stronger laws combined with encouraging additional parental supervision during the GDL process will help reduce younger driver risks.
- Standardizing driver education: Standardizing the driver education programs used across the country, and their administration, will help ensure a consistent level of training for younger drivers.
- Using technology to prevent risky behaviors: Researchers are also exploring several options to decrease younger driver fatalities by preventing risky behaviors. For example, the Ford MyKey system recognizes when a teen's key is used; the system then responds by limiting maximum speed, reducing audio system volume, and even providing a more persistent fasten seat belt audio warning. Research is also underway on a teen-oriented reminder system. In addition, the Safer Vehicle section discusses advanced systems that monitor driver attention and respond to abrupt behavior, which often indicates that the driver may be slow to respond to a potentially hazardous situation. These systems can also help a novice driver avoid crashes.
- Targeting education, enforcement, and other programs to specific safety issues in which teens are overrepresented: Programs to increase public awareness of safe driving and enforcement of traffic laws that are aimed at younger drivers, for example in the vicinity of trucks, will help reduce the risks in this area.





Increase Safety of Older Drivers

In 2011, 17 percent of highway fatalities involved drivers that were 65 or older. Road users older than 65 years account for 16 percent of all licensed drivers—a number that will increase dramatically as the nation’s population ages (40). Efforts to ensure older drivers are able to continue driving safely focus on functional capabilities related to motor skill coordination and response time, rather than chronological age. These efforts are proving successful as the trend in the number of people dying in crashes involving an older driver has been decreasing. Many national and state-level road design and traffic control device manuals have been updated to recommend design and engineering measures that help reduce risk to older drivers.

Nationwide research is underway to address different states’ processes for renewing licenses for older drivers; these focus on mandating periodic refresher courses and testing in order for older individuals to retain unrestricted licenses. License renewal processes that require all drivers, regardless of age, to demonstrate minimal levels of visual, mental, and physical capability, would help ensure all licensed drivers are competent to drive.

Medical Advisory Boards (MABs) are used in many states to develop policies related to older driver licensing and to review capabilities of individual drivers. A review of a state’s MAB is would help with the development of clear guidelines for how the board is to operate and would increase the general involvement and activity levels of the boards.



Key Strategies for Improving Driver and Passenger Safety

Key Strategy	Implementation Timeframe
Enact and enforce primary seat belt laws.	Short
Implement high-visibility restraint enforcement, including nighttime and child restraint use	Short
Implement advanced seat belt reminder systems, including those for rear-seat occupants.	Long
Enact targeted enforcement for speeding-related offenses.	Short
Enact legislation and implement automated traffic enforcement—including pervasive automated speed enforcement and applications for school and work zones	Short
Implement rigorous aggressive driving and speeding-related enforcement programs.	Short
Enact legislation and implement high-visibility sobriety checkpoints.	Short
Implement appropriate penalties and DWI/DUI courts.	Short
Improve alcohol and drug detection technology.	Mid
Implement ignition interlock systems.	Mid
Enact legislation and develop detection and enforcement methods to handle drug impairment, including prescription drugs.	Mid
Enact and enforce legislation to address distracted driving—including texting bans	Short
Implement technologies to prohibit or limit cell phones and electronic devices while vehicle is in motion.	Short to Mid
Strengthen GDL legislation and enforce graduated driver licensing laws	Short
Improve driver education by standardizing materials and laws across the nation.	Mid
Implement teenage driver oriented technologies that adjust stereo volume, increase seat belt warning signals and react to signs of distraction	Mid
Implement public education campaigns and enforcement of safe driving practices in proximity of commercial vehicles—with an emphasis on targeting teen drivers	Short
Improve older driver licensing policies and screening of older drivers.	Mid
Implement Medical Advisory Boards that independently review older driver capabilities	Short





Improving driver behavior is accomplished through education, enforcement, and technology strategies that encourage proper driving behavior or prevent risky behaviors. In addition to coordinated programs that prevent specific behaviors, there is a need to change the reasons why people make unsafe decisions regarding the way they drive, as well as the legislation, enforcement activities, and other countermeasures they will support. As with other highway safety efforts, programs to change safety culture will not be effective on their own, and even a sustained change in safety culture will not mean that other strategies are no longer needed. The programs to improve driver behavior discussed above, along with strategies for other road users discussed in the next section, are the strategies that most directly reach road users and influence the change in traffic safety culture.





SECTION 3.2: KEY AREAS

Safer Vulnerable Users

There are road users who, because they lack the physical protection of a vehicle, are more susceptible to severe injury or death when involved in a traffic crash. These vulnerable users include pedestrians, bicyclists (or pedalcyclists, including all wheeled and pedal-powered vehicles), and motorcyclists. Other individuals whose work takes place on the roadway—construction and maintenance workers, emergency medical and incident responders, and law enforcement personnel—also lack protection and face serious risk of being struck by a vehicle while on the job.

Successfully protecting vulnerable road users relies on a combination of improving infrastructure and planning, enacting and enforcing legislation, and targeting education programs to specific road user audiences. These initiatives may require that road users behave in a certain way or use protective equipment, which can generate controversies related to personal freedoms, privacy, and the ability to enforce laws.



As with drivers, the characteristics and capabilities of older road users need to be considered when addressing the needs of vulnerable road users. In 2011, road users older than 65 represented 17 percent of traffic fatalities, 19 percent of pedestrian fatalities, 13 percent of bicyclist fatalities, and 6.5 percent of motorcyclist fatalities (40). As the number of older road users increases, transportation networks should be planned and constructed to address the specific needs of the aging population, including when they are not traveling in passenger vehicles. It is important for educators, planners, and designers to appreciate and protect these vulnerable road users who are more susceptible to serious traffic-related injuries because of the effects of the aging process—which can include gradual decline of visual, cognitive, and psychomotor abilities necessary to drive and walk safely.

Pedestrians and Bicyclists

Following several years of decreasing fatalities and injuries, in both 2011 and 2012 pedestrian and bicyclist deaths increased (36, 44). As discussed in the Safer Driver section, strategies to reduce roadway fatalities for vulnerable users depend on improving the behavior of all users, including motor vehicle drivers.

Traffic safety laws that dictate how pedestrians, bicyclists, and drivers use and share the roads establish expected behaviors, such as proper yielding, and define how road users should interact with each other. Like traffic laws for motor vehicles, pedestrian and bicycles laws have the associated challenge of educating the public and legislators about the need for the laws and for enforcement activities.

In addition to informing pedestrians and bicyclists how to use roads safely, it is necessary to educate drivers on traffic laws and proper behaviors around pedestrian and bicycle traffic. One specific issue is speeding. Speeding presents significant challenges to unprotected road users as higher speeds increase the distance needed for a vehicle to stop and escalate the severity of crashes. Strategies for reducing fatalities related to speeding, such as automated enforcement, would also improve pedestrian and bicyclist safety, especially in urban and suburban areas where there tend to be more pedestrians and cyclists.

Awareness campaigns can target specific issues that have been contributing to crashes. For example, pedestrians and cyclists need to make themselves as visible as possible, especially at nighttime or in low-light conditions. Information on the benefits of reflective clothing and on using lights can encourage more non-motorized users to increase their visibility. Another example is distraction—as cellphone and smart phone ownership continues to climb, so will the number of incidents involving distracted pedestrians who do not look where they are walking, even if it leads them into a traffic lane.



Another issue pedestrians need to be aware of is impaired walking. Alcohol—for either driver or pedestrian—played a role in 48 percent of traffic crashes that resulted in pedestrian fatalities. In these crashes, 35 percent of the pedestrians and 13 percent of the drivers involved had BAC levels of .08 g/dL or higher, and in six percent of the crashes, both pedestrians and drivers had a BAC of .08 or higher (36). Along the same lines, in 23 percent of fatal bicycle crashes, the bicyclist had a BAC of .08 or higher (37). Education and awareness are central to reducing these types of fatalities. For example, while individuals who realize they have consumed too much alcohol to drive often make a responsible decision to leave their cars behind, they may not realize that there are risks related to walking or riding near vehicular traffic while impaired.

Research demonstrates that wearing bicycle helmets can prevent head injuries and save lives during a crash. Parents increasingly insist that children wear helmets when they ride bicycles; however, but the adults accompanying the children too often are not helmeted. In 2011, the average age of bicyclists killed in traffic crashes was 43 (37). Nearly half of the states have helmet laws for younger bicyclists, and only the US Virgin Islands requires helmets for all bicyclists (19). Many localities have bicycle helmet laws. The variation in laws can be confusing. While bicycle helmet laws face many of the same challenges related to enacting laws, such as enforcement and achieving public support, bike helmets remain a high-impact countermeasure for reducing bicyclist fatalities.

With walking and bicycling increasing in popularity for commuting and recreation, more urban and suburban areas are reconfiguring roadways to accommodate bicycle lanes and sidewalks to encourage pedestrian activity. However, many of the nation's roadways and neighborhood streets were built when infrastructure focused primarily on automobile traffic. Elements of the roadway environment, including travel lanes for all motorized vehicles, traffic signs and signals, and bus stops and other transit access points, must be designed to balance the safety and mobility of all travel modes expected to use the roads. This balance is challenging because of the different characteristics and needs of each type of road user. Road designers must evaluate the expected effect of infrastructure treatments on all types of road users—even treatments intended to address the contributing factors for crashes involving vulnerable users—to make the most appropriate decision for individual situations. Intersections by nature have a number of conflict points, and many strategies that reduce risk for pedestrians and bicyclists can do the same for motorized road users as well. Changes to signal timing, reduced speed limits, preventing mid-block crossings, constructing alternative paths such as overpasses, and intersection lighting are examples of strategies that, depending on needs at specific intersections, can reduce crash potential for all road users.

Various engineering manuals and guidance documents provide highway agencies with information and tools needed to balance different user characteristics and consider the exposure and risks for all user types. For example, the AASHTO Guide for the Planning, Design, and Operation of Pedestrian Facilities provides a tool to aid pedestrian safety in roadway design among state and city engineers. A focus on vulnerable users has led to developing concepts such as Complete Streets, which involve adopting a policy to design and operate all transportation facilities to accommodate safe access for all road users.



Further development and promotion of these resources and concepts would provide agencies with the tools and information necessary to balance different user characteristics and reduce risks for all users. Then, dissemination of the resources and training for the staff of transportation agencies and their partners would be necessary to ensure awareness and use of the materials and concepts

Motorcyclists

Motorcycles are an increasingly popular and economic transportation choice—the number of registered motorcycles increased from 4.9 million in 2001 to 8.4 million in 2011. Based on registered vehicles, motorcyclists have a fatality rate six times that of passenger car occupants. Per mile traveled, motorcyclists are almost 30 times more likely than passenger car occupants to die in a traffic crash and five times more likely to be injured (38). Motorcyclists represent a unique population of the motoring public—they are the only type of road users who can travel at high speeds and on all road types, without the benefit of a vehicle body surrounding them, leaving riders more susceptible to injury in a crash.



Enforcement and education campaigns that target motorcyclists can raise awareness of risk-taking behaviors and reduce their occurrence. Speeding and impaired riding are two common safety issues addressed in these types of campaigns. These 2011 statistics demonstrate the need for these types of programs (38):

- 35 percent of motorcycle riders involved in fatal crashes were speeding, compared to 22 percent for passenger car drivers.
- 29 percent of motorcyclists had a BAC of at least .08 g/dL, slightly higher than the percentage of passenger vehicle drivers.

Stronger and more consistent motorcycle rider training and licensing programs are needed to increase rider understanding of how to operate their bikes, the rules of the road, and specific safety issues. In 2011, 22 percent of motorcyclists involved in fatal crashes did not have a valid motorcycle license (a driver license with a motorcycle endorsement or a motorcycle-only license) (38). Nearly all states currently offer basic rider education, which primarily focuses on defensive driving, situational awareness, and emergency response. Important issues such as impaired driving, distracted driving, protective equipment, visibility to motor vehicle drivers (high-visibility clothing), training, and licensing are all topics that should also be standard in motorcycle training.



NHTSA estimates that helmets saved over 1600 motorcyclists' lives in 2011, and that 700 or more lives could have been saved if all motorcyclists had worn helmets. Also in 2011, 65 percent of motorcyclists killed in states without universal helmet laws were not wearing helmets; nine percent of motorcyclists who died in states with universal helmet laws were not wearing helmets. However, motorcycle helmet use has been increasing; NHTSA's National Occupant Protection Use Survey showed that 66 percent of riders used helmets that met USDOT requirements for the level of protection provided, which is up from 54 percent in 2010 (38). The data demonstrate that wearing helmets would significantly reduce the number of bicycle and motorcycle deaths and injuries; however, there is a strong resistance to state requirements for helmet use for all rider age groups as well as strong efforts to repeal additional state all-rider helmet laws. Educating riders on the importance of wearing helmets can reduce motorcycle fatalities, though not as drastically as enacting laws requiring helmets for all riders.

Highway Workers

Those who work in the roadway environment are exposed to greater risk of being killed or seriously injured in traffic crashes just by being out on the road longer than most people. In 2012, 609 people, including road users and construction, maintenance, and other highway workers, were killed in traffic crashes (32). Because police, incident response, and road construction and maintenance activities vary and are intermittent, road users are typically less well accustomed to traveling through these types of situations. A multidisciplinary approach aimed at multiple audiences is necessary to reduce fatalities among both workers and road users. Strategies include educating drivers on safe driving practices in roadway work zones and around other incidents, as well as educating those working in or near the roadway on safety practices, including proper gear such as retroreflective clothing. Increased fines for traffic violations and enhancing enforcement efforts, especially for speed limits, are key enforcement strategies. Transportation agencies have a key role in designing work zones to reduce the risk of crashes as much as possible, and in ensuring staff and contractors are adequately trained on appropriate set up and operation of work zones.

Strategies to significantly reduce roadway fatalities for all users depend on educating road users on appropriate ways to use the roads and the risks involved with certain behaviors, enacting legislation that prohibits those behaviors that commonly lead to crashes or requires less risky behaviors, and providing a roadway environment that offers optimal levels of protection. Similar to many strategies that reduce crashes, long-term efforts to improve our traffic safety culture will also support vulnerable road user strategies by changing the way people make decisions about how they use the roads and interact with other road users.



Key Strategies for Improving Driver and Passenger Safety

Key Strategy	Implementation Timeframe
Enact and enforce traffic laws applicable to motor vehicle operators and vulnerable users that improve pedestrian and bicyclist safety	Mid
Enact and enforce traffic laws applicable to motor vehicle operators and vulnerable users that improve pedestrian and bicyclist safety	Short
Enact and enforce bicycle helmet laws that apply to cyclists of all ages	Mid
Implement pedestrian awareness programs targeting pedestrian visibility and impaired walking	Short
Implement infrastructure/roadway improvements to support speed management to reduce risk of pedestrian fatalities	Mid
Implement infrastructure/roadway improvements to reduce factors contributing to crashes with pedestrians	Mid
Improve traffic control devices to reduce risk of pedestrian fatalities	Mid
Implement infrastructure/roadway improvements to reduce factors contributing to crashes with bicyclists	Mid
Enact and enforce motorcycle helmet legislation for all ages and riders	Short
Implement targeted enforcement and public education programs to reduce the risk of motorcyclist fatalities (specifically speeding and impaired riding).	Short
Implement motorcycle rider education on impaired driving, distracted driving, protective equipment, training and licensing (including conspicuity).	Short
Educate drivers on safer driving practices in work zones.	Short
Improve speed management and enforcement in work zones to reduce the risk of work zone fatalities	Short
Improve work zone design and operations to reduce the risk of work zone fatalities	Short





Image courtesy, Volvo

SECTION 3.3: KEY AREAS

Safer Vehicles

While vehicles are rarely the sole cause of fatal crashes, they do provide opportunities for protecting occupants. Vehicle technologies discussed in this section address both passenger vehicles and commercial motor vehicles through strategies to prevent crashes and lessen the severity of crashes that do occur. The strategies highlighted are intended to:

- Alert drivers to risks.
- Assist drivers who are at risk of a crash.
- Protect vehicle occupants during crashes.
- Enable communication with other vehicles and the roadway.
- Ensure vehicles continue to perform as designed.

Many technologies and safety features mentioned in this section are currently available on some commercial and passenger vehicles, to varying degrees. Manufacturers and others are continually researching, developing, and deploying changes to vehicle designs and technologies aimed at preventing crashes or reducing the severity of injuries in crashes that do occur. Vehicle-based initiatives to reduce fatalities and serious injuries involve developing and employing vehicle safety design features, as well as policies that promote safe driving.



Some of the safety measures highlighted in this section are appropriate for all vehicle types, while some are more applicable specifically for smaller and lighter vehicles such as passenger cars and light trucks (including pickup trucks, sport utility vehicles, and vans). Because heavy vehicles have different characteristics from smaller vehicles, different safety technologies and features may be appropriate. Although crash rates per mile traveled are lower for commercial vehicles, crashes involving heavier vehicles typically cause more severe injuries as a consequence of the dynamics of heavy vehicles.

One challenge to deployment of vehicle technologies is that development, testing, and approval takes a significant amount of time. Manufacturers typically require the systems perform accurately nearly 100 percent of the time. This is necessary to ensure predictable and high quality performance of the technologies. In addition to the technical issues with developing a new system, other factors include safety regulations, industry standards, consumer demand, and economic pressures that vehicle manufacturers must work through.

Another challenge to full implementation of any new vehicle-based safety countermeasure is the time needed to ensure these features and systems are installed in every vehicle on the road. The vast number of private and commercial vehicles in use in the United States is one of the main challenges to achieving significant reductions in fatalities and serious injuries due to vehicle safety improvements in a short period of time. It is estimated that it takes 30 years for a new feature to penetrate the entire vehicle population, though penetration of the truck population is shorter, and for some technologies it is possible that benefits can be seen after only a portion of the population has been equipped.

Communicating the benefits of vehicle safety features to consumers will increase the rate at which the features become common throughout the vehicle population. Consumers will need information on the safety benefits in order to determine whether to purchase a particular technology or a higher cost vehicle with the feature installed. Similarly, if a feature requires some action by the driver on each trip, consumers will need to understand of how the extra step is outweighed by the reduction in risk achieved by using the particular feature.

Commercial driving is regulated and supervised, and drivers tend to travel more miles and be on longer trips than passenger vehicles—this makes individual commercial vehicles and vehicle fleets ideal for testing new safety features, since it is easier to install retrofit devices on company fleets and monitor driving. New vehicle technologies and systems have been introduced to and implemented throughout the commercial vehicle population with the help of a united push by manufacturers, companies with commercial vehicle fleets, federal regulators, and researchers. While it would still take time for consumers to purchase vehicles with the new safety features, aggressively promoting use of these features would help get new countermeasures into all vehicles sooner.



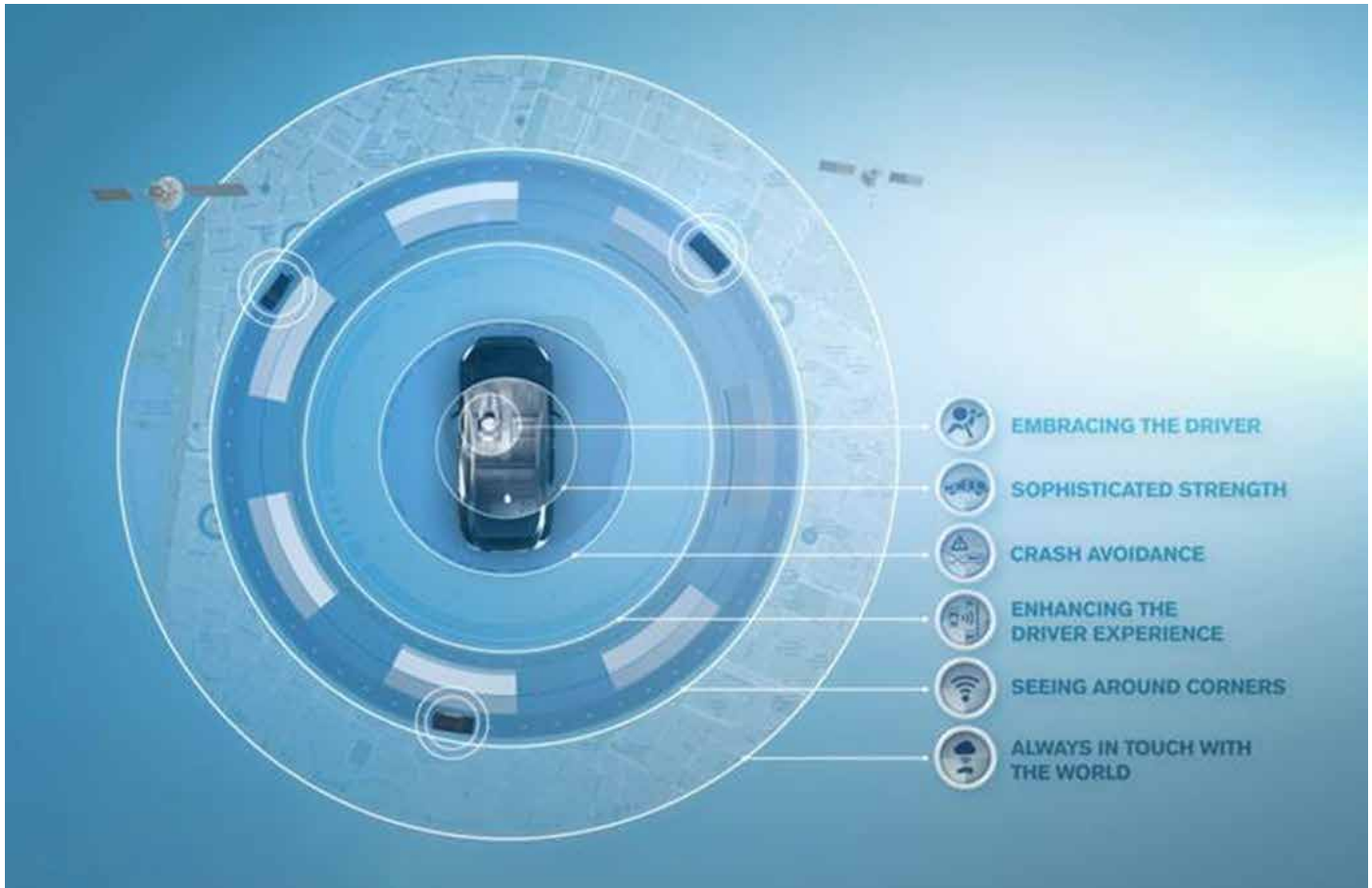


Image courtesy, Volvo

Alert Drivers to Risks

In-vehicle technologies can reduce the risk of crashes by alerting drivers to risks they are taking (such as speeding), prevent specific behaviors (such as impaired driving or speeding), or monitor driver actions in order to provide feedback at a later time. Systems can also alert drivers to problems with the vehicle, such as brakes that may not be functioning properly.

As mentioned in the Safer Drivers section, speeding is a contributing factor in crashes with a wide range of solutions, and in-vehicle technologies can supplement the enforcement strategies discussed in the Safer Drivers section. The increasing sophistication of technical interventions will play an important role in reducing fatalities and serious injuries related to speeding.

Technologies can be used to monitor a driver's speed and provide a visual or audible warning to the driver when a specific speed is exceeded, or record and transmit reports when a specific speed is exceeded. These technologies compare vehicle speed to a predetermined limit, though, rather than the actual speed limit or to an appropriate speed based on adverse weather or other conditions. Real-time information could allow the system to provide a warning to the driver, which could help the driver adjust speed accordingly. A report of the information could be used to improve future driving behavior, particularly if the report is provided to management in the case of commercial drivers, or to parents in the case of teen drivers.



Technologies to limit vehicle speeds are currently in use in some large trucks and passenger cars. Speed governors provide an economic benefit because they increase vehicle fuel efficiency—an important factor for trucking companies. More widespread use of speed governors in passenger vehicles, trucks, and buses would be expected to reduce speeding-related fatalities, since lower speeds allow drivers more time to react and prevent crashes or reduce the severity of crashes when they do occur.

Intelligent Speed Adaptation systems use satellite and digital map technologies to identify a vehicle's location and the speed limit for that location. Depending on the complexity of the specific system, the driver will be warned when the speed limit is being exceeded, the system will increase resistance on the accelerator so that it is more difficult to maintain the higher speed, or the system will automatically limit the speed. It is estimated that a system that prevents speeding would reduce fatal crashes by 37 percent (5).

There has been limited deployment of all of these technologies to date. Speed governors are used more frequently (or are even mandated for heavy vehicles or buses) in other countries. As successful as speed monitoring and feedback systems can be, it remains uncertain whether enough drivers would voluntarily purchase and use these systems to make a significant difference in speeding related fatalities and serious injuries. Two concerns are privacy issues and the possibility of device tampering that would reduce the effectiveness of the device.

To combat driver fatigue, alertness monitoring devices can detect driver inattention, based on eyelid closure, face orientation, and pupil movement. When needed, drivers receive a visual, audible, or tactile alert, or in some cases, the system assumes control of the vehicle and brings it to a stop. Though this is a promising countermeasure, additional testing and development of these systems is necessary, and there is no reliable, affordable system currently available.

Trucking companies often monitor various data from their vehicles, drivers, and operations. Onboard monitoring technology and systems can continuously monitor acceleration and braking force, in addition to speed. These systems can also provide real-time warnings as well as post-trip reviews for the operator and the safety manager. The information can be used to provide feedback to drivers on specific behaviors that should be improved, and to track and recognize improvements in drivers' performance.

Brake performance monitoring systems can detect significant air brake problems, provide an alert to drivers in real-time, and inform technicians servicing the vehicle. Because it is difficult to detect brake problems while driving, alerts from brake monitoring systems allow drivers to know their brakes need attention prior to brake failure. Enforcement personnel can also use the information during inspections.



Assist Drivers Who Are at Risk of a Crash

When a crash is imminent, safety technologies can intervene to alert drivers to the risk. These use radar, laser, lidar, or other technology to detect vehicles, pedestrians, or other objects in close proximity to the vehicle. Drivers will then receive an audible or visible warning so they may take corrective action. Some systems can exert control over the vehicle to help drivers maintain or regain control in critical situations.



Image courtesy, U.S. Department of Transportation

There are many warning systems under development and becoming more available on vehicles. A few examples of systems already available on vehicles today are forward collision warning systems, lane departure warning systems, and side object detection systems:

- Forward collision warning systems analyze radar signals to determine the distance and relative speed between the vehicle or object ahead and produce audio and/or visual alerts to indicate one vehicle is too close to another or to an object. As the distance between the two decreases, the warnings become more persistent.
- Lane departure warning systems provide audio, visual, and/or tactile alerts to drivers when they cross lane markings or are drifting off the roadway. Like a rumble strip installed in the pavement, these systems can help prevent lane departures due to driver inattention, drowsiness, or other impairment.
- Side object detection systems use radar, laser, lidar, computer vision, or ultrasonic scanning technology to warn drivers of objects beside them in their blind spots. This is especially helpful with lane changes to the right. Crashes between passenger vehicles involving a lane change to the right are generally not as severe as those involving heavy vehicles, however since almost three-quarters of truck side crashes are the result of a lane change/merge as the truck moves to the right, side object detection systems may be particularly beneficial on trucks.

In addition to these warnings, some advanced systems can intervene to help control the vehicle when a crash is about to occur:

- Lane keeping assistance systems use a forward-looking system to estimate the vehicle position in the lane, and the alignment of the road. The system will brake or steer the vehicle if needed. Video-based systems will have difficulties in inclement weather or when there are degraded or no lane markings. Other systems use GPS, radar sensors, or other technologies and can use other longitudinal information when lane markings either are not present or are not visible due to weather or light conditions.



- Electronic stability control (ESC) monitors a vehicle's individual wheels and brakes when the vehicle appears to be losing control. This can help prevent lane departure, rollover crashes, and large truck jackknife crashes. ESC monitors or systems have been mandated for all new vehicles, and once ESC is on all light vehicles, it is expected to reduce fatalities by 5,300 to 9,600 per year (35).
- Emergency brake assist instruments measure speed and apply additional brake pressure if it appears the driver is attempting an emergency stop. This can reduce braking time and stopping distance, which in turn can help reduce the severity of an impact in a crash, or perhaps even prevent a crash, especially when used with anti-lock braking systems.



Protect Vehicle Occupants During Crashes

Vehicles have many safety features that protect occupants when crashes cannot be avoided. Improved crashworthiness of structural elements and development and improvement of safety features such as seat belts and airbags have drastically changed crash outcomes. The automotive industry, researchers, and regulators are continuously working to increase the protection that passenger and commercial vehicles provide during crashes. At the same time, vehicle designs are always changing, and this adds to both the challenges and opportunities for protecting drivers and passengers. Likewise, testing procedures evolve with the safety features of vehicles, the technologies that can enhance testing, and the need to test new vehicle types and a wider range of occupant characteristics (such as size and seating position).

Improved strength of vehicles to mitigate side impact and rollover crashes would lessen the severity of these types of crashes. In a front impact crash, the front of the vehicle and engine compartment absorb much of the energy of the crash. The sides and top of the vehicle, however, do not offer as much protection. NHTSA has mandated that all US passenger vehicles provide a minimum level of protection in side crashes. Updates to vehicle crash test procedures in recent years have increased the information available on how occupants are protected during side impact crashes, which aids in the continued development of structural and other safety features.



While commercial driving is regulated, trucks and buses do not have some of the features to protect occupants, such as airbags, found in passenger vehicles. Seat belts are not required on motor coaches and school buses. School buses have been designed to protect occupants not wearing seat belts, but this is not the case for other buses. While there would be costs to retrofit buses already in service, this would help reduce motor coach fatalities and injuries more quickly. Other occupant protection and crashworthiness standards would improve motor coach safety performance, specifically window glazing to minimize ejection, fire prevention and suppression systems, roof strength and crush resistance, collision warning systems, and rollover stability.

While in-vehicle safety features have come a long way, presently there are additional technologies to improve driver and occupant safety in the research, design, and development phases. For example, new occupant restraints move beyond the passive safety features of seat belts and airbags to systems that reduce the probability of severe head or chest injury. These restraint technologies respond to specific factors of potential crashes—crash severity, type of crash, and the occupants’ build, size, and position in the vehicle. Another example is external airbags—collision warning systems mentioned above could be used to trigger deployment of airbags that would be expected to especially benefit pedestrians or other vulnerable road users, or even smaller vehicles involved in a collision with larger vehicles.

As the nature of the mix and characteristics vehicle changes—as has occurred with the increased numbers of sport utility vehicles and truck traffic on the nation’s roadways—it is important to ensure that infrastructure safety features accommodate the features of vehicles in use. The compatibility of vehicle designs with roadside hardware is a consideration for both the automotive industry and highway engineers. As vehicles change, so must the objects that may be struck during a crash, such as guardrails, barriers, sign posts, lighting supports, and work zone traffic control devices.

Enable Communication with Other Vehicles and the Roadway

Vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) technologies are being developed to facilitate communication, control, and visibility among vehicles and the roadway. Connected vehicle technologies allow vehicles to exchange data wirelessly with other vehicles, the roadway, and drivers’ wireless devices in order to assess the risk of crashing, determine whether to warn the driver or even to take corrective action, and then take the appropriate action. For example, V2V systems will be able to warn drivers when a vehicle is driving on the wrong side of the road or about to do so. At intersections, these systems will help warn drivers when a collision with



Image courtesy, U.S. Department of Transportation



another vehicle is likely, provide information about oncoming traffic to drivers making left turns, alert drivers if there is a risk of collision with a pedestrian in a crossing, and warn drivers about potential stop sign or traffic signal violations V2V systems will need to be in place throughout the vehicle population, so there are similar challenges to reaching wide scale implementation as there are with crash avoidance technologies discussed earlier in the Safer Vehicles section.

An example of a V2I system is a road condition warning system that will help drivers on curves by monitoring speeds and providing information on appropriate speeds. Devices will need to be installed in the roadway environment to support these systems, so as with other strategies discussed in this section, a significant challenge is deploying devices in vehicles and on roads due to the sheer size of the transportation system—and the associated funding needs. Connected vehicle technologies will help improve traffic operations and environmental impacts of vehicular travel, therefore there is a wide range of partners with an interest in further developing and implementing connected vehicle technologies.

Ensure Vehicles Continue to Perform as Designed

The discussion of vehicle safety features and technologies above has been focused on new vehicles. The issue of vehicle population turnover, and the time and activities needed for a new feature to become prevalent in vehicles, will continue to challenge the future of vehicle safety. Once new vehicles are on the road, it is necessary that they continue to provide the level of protection as designed and manufactured. It is also important that consumers have all the information regarding a vehicle's history so they are able to make informed decisions about potential purchases of used vehicles. Vehicle titling, registration, maintenance, damage, repair, and inspection



programs are critical to reducing fatalities and serious injuries related to upkeep and maintenance of the existing vehicle population. There are a variety of issues related to vehicle inspections that are indirectly though critically related to reducing fatalities and serious injuries, including:

- Ensuring state passenger and commercial vehicle inspection programs are supported by inspector training on the vehicles and the safety systems installed, which is critical to the success of inspection programs.
- Compiling all registration, titling, brand, damage, and repair information on a vehicle's history in one record.
- Informing consumers on the means to access vehicle title information, so they can determine whether a used vehicle they are purchasing has been previously damaged and/or repaired.
- Ensuring safety regulatory requirements on trucks and buses are kept current, simple and enforceable so they properly reflect current safety needs and can be effectively enforced.



Key Strategies for Improving Vehicle Safety

Key Strategy	Implementation Timeframe
Expand the use of in-vehicle speed feedback and control technologies	Long
Implement technologies to monitor driver behaviors and vehicle safety features	Long
Further develop, test, and implement collision warning systems (forward, side, lane departure).	Long
Implement vehicle technologies that assist with controlling vehicles if a crash is imminent, including electronic stability control	Long
Improve structural strength of vehicles in right-angle crashes and overturning crashes to reduce risk of fatalities	Long
Develop and implement vehicle-to-vehicle and vehicle-to-infrastructure communications and include those technologies in infrastructure planning, engineering, design, management, and budgeting decisions	Long
Implement One Vehicle–One Record	Mid
Provide universal access to vehicle history reports for vehicle damage of used vehicles	Mid

Safety partners must continue to work together to develop, promote, and incorporate new vehicle features to reduce the risk of crashes, injuries, and fatalities. Other related needs include creating a consumer demand for additional safety features, which will promote future development and wide-scale acceptance of safety technologies. It will also be essential to educate drivers about the advantages of vehicles with specific safety features and how to use them.





SECTION 3.4: KEY AREAS

Safer Infrastructure

Any changes to the roadway environment must consider the other two elements—vehicles and road users—and how they will interact with the roadway once it has been changed. One challenge, however, is the size of the public roadway network—four million miles, maintained by numerous highway agencies at all levels of government—and implementing effective countermeasures in the most appropriate locations. Therefore, in addition to countermeasures in the roadway environment, strategies include methodologies that support their widespread use. Many of the general challenges of implementing vehicle strategies are also issues with infrastructure-based countermeasures, particularly the issues related to understanding how the countermeasures will perform. It is necessary to understand how a particular feature or countermeasure works, the reliability of its performance, the range in road characteristics that factor into which strategies will be effective in a given location, and as mentioned above, identifying the extent of the existing system with those characteristics.

Infrastructure improvements discussed in this section include the following:

- Upgrade infrastructure to mitigate crashes and reduce injury severity.
- Adopt advanced cross-cutting technologies. Improve design practices to maximize safety benefits.
- Ensure agency policies and procedures incorporate safety considerations throughout the highway project development process.



Install Countermeasures to Mitigate Crashes and Reduce Injury Severity

In 2012, there were over nearly 19,000 fatalities involving a vehicle departing from its travel lane and crossing an edgeline or centerline (44); roadway departures are over 50 percent of all fatal crashes (14). In addition, for several years an average of 21 percent of fatalities and roughly 50 percent of the serious injuries occurred at intersections (15). In recent years, infrastructure improvements involve significant efforts to change the roadway and roadside design, signs and traffic signals, lighting, and other equipment, to incorporate countermeasures that reduce serious roadway departure and intersection crashes. Particular focus has been on evaluation and more widespread use of lower cost countermeasures. These efforts have been crucial to, among other things, preventing specific types of crashes, and accommodating the growing population of various types of road users and specific vehicle types.

These short-term, cost-effective improvements can maximize safety benefits in a time of limited transportation funding, but they are often site-specific improvements that are integrated into an agency's ongoing road maintenance and reconstruction projects. An important safety strategy is to include these improvements in the initial planning stages of projects at the state, regional, and broader local area level. Countermeasures are often more cost-effective when applied utilizing an "at-risk" corridor approach, with these corridors identified by crash data, or system wide, including on local roads not maintained by state departments of transportation. Effective shorter-term lower cost countermeasures for impacting the factors that contribute to roadway departure and intersection fatalities include:

- Install signing and pavement markings with retroreflective properties to improve guidance along the roadway, especially in and around curves.
- Use shoulder and centerline rumble strips and stripes to warn drivers they are leaving their travel lane.
- Design roadside to include appropriate hardware (such as cable median barrier, crash cushions, and guardrail end treatments) or manage trees to minimize the severity of crashes that occur.
- Improve driver awareness of intersections by installing or improving signs, pavement markings, and lighting.
- Changing traffic signal timing to provide left-turn only phases, improve clearance intervals (yellow plus all-red signals), and coordinate signal timing to improve traffic flow.

Roadway-based countermeasures are intended to prevent crashes from occurring and to reduce the severity of crashes that do occur. While there are often similar factors contributing to crashes of the same type, it is not possible to predict where and when crashes will occur well enough to prevent all of them. Therefore, some countermeasures are more frequently installed in a systemic manner to minimize risk across the roadway network. The countermeasures listed above are suitable for systemic application.



Strategies that target a particular user type can also be installed where a specific safety problem has been experienced or in a systematic manner in locations where the potential for serious crashes involving these users exists. Countermeasures aimed at reducing risk for older drivers, such as signs with larger lettering or protected left-turn phases at signalized intersections, could be installed in specific locations where there has been a concentration of older drivers or of crashes involving older drivers, or even throughout an entire area. Many infrastructure-based countermeasures that help older drivers provide benefits to all drivers as well.

While systematically implementing low-cost countermeasures is key to providing a transportation system that protects road users as much as possible, higher cost projects that require a longer-term approach are also necessary to provide for a comprehensive program. For example, larger scale projects such as replacing a traditional intersection with a roundabout or interchange, or constructing truck-only lanes to separate heavy commercial vehicles from smaller vehicles, may be the most appropriate longer-term solutions; however, agencies are increasingly challenged to find necessary funding for larger projects.

Larger, high cost projects may be needed to address crash contributing factors in specific locations. Projects involving reconstructing an intersection or section of roadway to reduce serious crashes require more planning, construction activities, and time, as well as more funding, than the lower cost countermeasures previously mentioned, but may be the most effective method for reducing risks of fatalities and serious injuries. This type of project would eliminate or reduce the risk for specific types of serious crashes, though less severe crashes might become more common. For example, an intersection design that reduces risk of crashes by reducing conflicting movements is the restricted crossing U-turn, also called by other names such as superstreet or J-turn intersection. With this design drivers wishing to turn left or continue straight through an intersection turn right, make a U-turn, and return to the intersection to proceed through or turn right, respectively. Another example is replacing conventional intersections with roundabouts, which can reduce serious head-on and angle crashes and improve traffic flow; however, less severe, lower speed sideswipe crashes may become more frequent at those intersections.

Adopt Advanced Cross-Cutting Technologies

Advanced in-vehicle computers and monitoring, communications, and sensing technologies allow vehicles to communicate with each other and with the roadway infrastructure. There is significant potential for these technologies to help prevent crashes, mitigate the impacts of crashes that do occur, and improve emergency response. Factors contributing to run-off-road, head-on, intersection, and other crash types can be addressed with systems designed to warn road users of situations with higher potential for a crash. Also, the data derived from these technologies can assist in understanding more about crash factors and crash causation. The data can also aid enforcement in targeting their resources at the most effective locations, with tools such as GIS-based mapping.



An important strategy is to encourage transportation agencies to begin planning for incorporating technologies that support vehicle-to-vehicle (V2V) and vehicle to infrastructure (V2I) communication into individual projects and general project development processes. Many of these technologies are still in the development or testing phase, and far from being prevalent throughout the vehicle population. However, advanced research and planning is crucial to prepare for the time when these technologies are available and the infrastructure-based systems are needed.

One example is devices installed at high-speed intersections that sense the presence of a vehicle approaching the intersection or waiting on a side street, and alert at least one of the drivers to the presence of the other vehicle. This strategy is relatively new but could be suitable at many intersections nationwide where it is not appropriate or cost effective to install stop signs on all intersection approaches or traffic signals.

Building on a successful program to research and develop strategies for addressing our nation's transportation needs, one initiative of the second Strategic Highway Research Program (SHRP2) is collecting data from passenger vehicle related drivers to how they operate the vehicles. By recording data on normal driving conditions, events related to crashes and near-crash incidents, it is expected that analysis of the data collected will help safety professionals better understand the cause of crashes—especially as the detailed data will describe the relationships between crash cause and driver behavior, environment, and roadside features. Researchers anticipate these data and even the data collection technologies will be invaluable to understanding speeding-related, roadway departure, and intersection-related, and other crash types.

Improve Design Practices to Maximize Safety Benefits

Much of the recent research in infrastructure safety explores how transportation agencies make and implement safety decisions. Efforts to collect data and improve accuracy are producing tools that help agencies analyze data, estimate the effectiveness of possible safety countermeasures, and quantify their expected benefit in reducing crashes. While these advances in the science of infrastructure safety are not complete, information and tools that promote a systematic approach to safety are available. This strategy specifically considers safety as a design criterion used to evaluate roadway performance and project development processes. This approach is termed “performance-based design,” and with it, safety becomes one of the crucial metrics considered throughout the project development process—rather than implementing a safety modification and then evaluating its effectiveness at the end of development.



Ensure Agency Policies and Procedures Incorporate Safety Throughout the Highway Project Development Process

Transportation agencies can use their policies and procedures to promote the adoption of new methods to incorporate safety throughout the highway project development process and make more efficient use of limited funds. In doing so, highway agencies nationwide will proactively endorse and encourage a cultural shift toward performance-based design. This shift is already beginning in response to requirements for data-driven safety approaches used to develop and implement state strategic highway safety plans (SHSP), as well as the availability of more data, data analysis procedures, and more information on the effectiveness of specific roadway design elements and safety countermeasures.

Safety research initiatives have produced two key publications that support a data-driven, comprehensive approach to highway infrastructure safety—the *Highway Safety Manual* (HSM) and the *Human Factors Guide for Road Systems* (HFG).

The HSM provides tools for evaluating roadway designs and various infrastructure-based safety countermeasures. The HSM’s predictive models help identify potential improvements and evaluate alternative roadway designs. Crash modification factors (CMFs) provide information on the effectiveness of individual treatments or countermeasures. Agencies can use CMFs to analyze crash frequency and severity and estimate effectiveness of proposed safety improvements.

The HFG enables roadway agency planners and designers to integrate the needs and limitations of all road users into their consideration when developing potential safety treatments.

Strategies for transportation agencies should include incorporating newer concepts and methods, such as those in the HSM, HFG, or older road user guidelines, into their existing processes, guidelines, and tools. As more practitioners become familiar with the tools and materials, and new policies and design guidelines are developed to encourage or require their use on appropriate projects, safety performance-based design will become standard throughout the industry.

Crash data or expected changes in traffic volume and type, demographics, and other transportation system characteristics might indicate the ways that agencies should modify current policies and guidelines so that safety issues are considered throughout the project development process. For example, a transportation agency would need to consider and accommodate an expected increase in older drivers. Similarly, an expected increase in commercial vehicle traffic may indicate a need for system-wide efforts to consider large trucks and buses in roadway design and operations decisions. Agency policies or procedures may need to be modified or developed to promote systematic application of specific countermeasures, mentioned earlier in this section.

Analysis methods, design policies and planning for specific technologies, as well as vehicles and or users will not directly prevent specific crashes; however, these practices will lead to decisions



that create a roadway environment with the least possible risk.

Key Strategy	Implementation Timeframe
Improve signing, markings, and lighting to increase driver awareness of intersections	Short
Install shoulder and centerline rumble strips/stripes to reduce risk of lane departure crashes	Mid
Install median barrier systems, crash cushions, and guardrail end treatments to minimize the risk of lane-departure fatalities.	Mid
Improve signal timing by adding protective left-turn phases, improving clearance intervals, and coordinating signals	Short
Install retroreflective signing and pavement markings to reduce risk of lane departure fatalities, especially in and around curves	Short
Implement roadway enhancements for older drivers.	Mid
Redesign intersections, including constructing restricted crossing U-turn intersections, roundabouts or removing skews	Mid
Install technologies that warn drivers of potential conflicts and/or assist them in choosing appropriate gaps in traffic at intersections	Mid
Incorporate science-based methodologies into project development	Mid
Consider commercial vehicle safety in planning, design, operations, and management of the transportation system	Short

Key Strategies for Improving Infrastructure Safety

As shown in the Figure 2 at the beginning of Section 3, the roadway environment is rarely the sole factor causing a crash. However, in conjunction with the vehicle and road user, the roadway environment contributes to about one third of all crashes. Infrastructure strategies that address specific roadway locations can be used by highway agencies to make decisions about the roadway network. This is a part of a comprehensive approach that involves enforcement, road user education, and other strategies to bring about more significant and sustained reductions in fatalities and serious injuries.





SECTION 3.5: KEY AREAS

Enhanced Emergency Medical Services

Emergency Medical Service (EMS) is the partner in the comprehensive safety management system that provides the last opportunity to stabilize or even save the life of a person injured in a crash and is therefore integral to reaching the TZD vision. Success in this mission, however, depends on the severity of the injury, EMS response and transport times, and the resources of the nearest trauma center.

This section focuses on the essential role of EMS in reducing injury outcomes on the nation's roadways and the technologies and systems necessary to advance collaboration with all safety partners—and to save lives. Strategies to improve the technologies and practices used throughout the process of responding to highway crashes and the management of EMS agencies and providers follow these goals:

- Improve incident detection, 911 access, and enhanced 911 system capabilities.
- Improve on-scene medical care and transport to hospitals.
- Improve access to higher-level trauma centers.
- Collaborate with safety partners to improve understanding of EMS and identify opportunities to reduce crashes and save lives.



Each state and territory regulates and supports local EMS agencies, of which there are approximately 15,000 nationwide. Similar to other highway safety partners, including public agencies, there is variation across the country in how local EMS agencies and trauma systems are managed, and how state-level EMS offices are organized within the state government structure. Coordination among neighboring agencies is more time-critical for local EMS agencies than for other safety stakeholders due to the need to deploy responders and resources to crashes that might not be located within their jurisdiction. Additionally, EMS offices' responsibilities may vary—for example, many, but not all, also designate and develop trauma centers. This variance in oversight contributes to the challenges of nationwide implementation of strategies, such as a universally-approved practice to manage triage, highway mass casualties, or patient care, and standardized transportation practices associated with trauma systems.

Improve Incident Detection, 911 Access, and Enhanced 911 System Capabilities

Key strategies that improve detection, location, and transfer of information about crashes are focused on data and communications technologies. While technological advances can make emergency medical response more challenging (such as determining the location of a wireless caller), many of the same technologies can improve the ability to respond quickly and ensure the appropriate resources are available.

Nationwide 911 services identify a caller's location when the call is dialed over a conventional land-based phone. Enhanced 911 (E911) technologies that can determine a cellular caller's location are becoming more common across the country, and can identify the locations of cellular phones used to make 911 calls and to which Public Safety Answering Point (PSAP), or emergency call center, to route the call. Full implementation of E911 across the country relies on providing additional PSAPs and the equipment and technologies in each center, as well as adequate wireless coverage nationwide. Future expected development



of the 911 system, referred to as “Next Generation 911” will allow people to transmit text messages—including images, video, and other data files—about the crash location and scene, which will provide responders with vital information as they prepare to respond or are on the way to the crash scene.

Advanced Automatic Collision Notification (AACN) technologies wirelessly transmit data that describe the location and crash severity to emergency call centers. When a crash occurs, these in-vehicle systems use data from sensors to estimate the probability of a severe injury, and this information, along with vehicle location, are transmitted to the service provider (such as OnStar). An attempt at voice contact with the vehicle occupant is made and emergency responders are notified if needed or if the occupant is not able to respond. Additional information on injury severity can be obtained once voice contact is made with vehicle occupants. NHTSA and the Centers for Disease Control and Prevention (CDC) are collaborating to improve AACN, since these systems do not currently use a standard data dictionary or transmission criteria for the telematics data from vehicles, and there are also no consistent algorithms for estimating injury severity.

Reliable communications systems are needed in order to provide consistent and accessible information to emergency medical personnel, emergency departments, and trauma centers across agencies and jurisdictions.

During on-the-scene emergency response, responders primarily communicate through land mobile radio (LMR) systems operated and licensed by state and local jurisdictions. Limitations on communications among responders can hamper response times and rescue efforts. There are federal grant programs to improve interoperability of states’ EMS response systems and regional communications systems, and to improve community emergency preparedness planning, though far more financial resources are needed than are available. Though the EMS community still has to rely on LMR and cell devices, there have been advances that do provide limited ability to transmit text and images.

Improve On-Scene Medical Care and Transport to Hospitals

Upon arriving at the crash scene, emergency medical technician (EMTs) conduct field triage to assess not only the extent and severity of injury but also to which medical facility patients should be transported.

The responders—emergency medical technicians and paramedics—are usually trained in state or educational facilities to develop skills related to medical interventions, devices, and medicines. The training uses the *National Emergency*



Medical Services Education Standards created by NHTSA. The curriculum was updated in 2010 to discuss consistent care delivery in a prehospital setting; however, states are currently in varying stages of adopting these new standards.

In 2011, a CDC Panel of Experts on Field Triage published the most recent 5-year update to the *Guidelines for Field Triage of Injured Patients*. These guidelines help prehospital care providers recognize those with injuries most likely to benefit from specialized trauma center resources. An important improvement to the 2011 field triage procedures was to define procedures so that EMTs can better evaluate the level of facility to best serve those injured—as not all injuries need a Level 1 trauma center, which provide the highest level of emergency care. While state health departments are encouraged to adopt the trauma triage protocols, the departments are not all organized in the same way and some states lack authority to impose national protocols on local systems within their states. In order to support the role of EMS in reducing fatalities from traffic crashes, it is important that these protocols become standard across the nation.

While the EMS role is to help save lives, EMS activities can, at times, lead to fatalities. For example, the EMS fatality rate is 12.7/100,000 workers—comparable to police and firefighters and more than twice that of all occupations and—and three-fourths EMS responder fatalities are transportation-related (occur during ground or air transport, or involve being struck by a motor vehicle) (29). Additionally, research suggests that ambulances themselves can be overrepresented in crashes—their crash rates are seven to 10 times greater than heavy trucks (23). And ambulances—along with law enforcement vehicles—account for increased crashes with other vehicles or pedestrians. Data from NHTSA’s Fatality Analysis Reporting System (FARS) indicate that two of three fatalities associated with ambulance collisions are either occupants of other vehicles or pedestrians (34).

Initiatives to provide for protecting ambulance occupants from injury should include improving the vehicle safety engineering and design standards for ambulances. The only compartment of an ambulance subject to Federal Motor Vehicle Safety Standards (FMVSS) pertaining to occupant safety is the cab where the driver and a front seat passenger ride. Therefore, patient care compartment design has evolved over time without the direction of national standards that require designs that protect responders and patients in the event of a crash, though there are efforts underway to develop international standards for the design, performance, and testing of ambulances, including the patient care compartment. Another strategy would be to regulate ambulances similar to large trucks, for which various collision-avoidance and other safety systems have been mandated.

In addition to reducing risk related to ambulance travel, there is a need to develop and implement contemporary educational programs to improve safe EMS vehicle operation and on-scene operating standards. There is also a need for an evidenced-based model for what mode of operation (lights and/or sirens) emergency vehicles should use when traveling to a crash scene or transporting patients to a helicopter landing zone or hospital.



Installing the vehicle-to-infrastructure (V2I) communication technology discussed earlier in the Safer Infrastructure section would help ambulance drivers be aware of and better able to respond to real-time traffic conditions, especially when approaching and traveling through intersections or other areas that may necessitate a slower speed. The V2I technology can also increase responder awareness of approaching adverse weather conditions, which could help responders select the best direct routes and improve response time.

Some areas are served by helicopters that transport seriously injured patients to the nearest appropriate trauma center. One related concern is the number and frequency of helicopter crashes associated with EMS response and patient transportation. The decisions to use helicopter transport vary by local medical directors' preferences, EMS agency helicopter policies, prohibitions at local receiving facilities, and the degree to which state protocols or other rules affect EMS helicopter use. Standardized criteria for using air medical helicopters would support decisions to use this mode and safer transport of patients and personnel.



Improve Access to Higher Level Trauma Centers

Once a crash occurs, the clock starts ticking. The chance to save lives depends on the time it takes for the EMS team(s) to reach the location, evaluate the scene, assess the extent and seriousness of injury(s), stabilize the victims, and transport the injured to the appropriate medical or trauma center(s). According to the 2010 United States census, 19 percent of the U.S. population lived in rural areas (56), yet rural road crashes account for over half of all traffic fatalities. CDC research concluded that a severely injured victim who received care at a Level I trauma center within one hour had a 25 percent reduction in risk of death (28). However, maps from the CDC show that only 24 percent of the land and 83 percent of the population of the United States is within a one hour drive or flight of a Level I or Level II trauma center—leaving 45 million Americans more than one hour away (6). The impact of this can be seen in 2011 data from FARS: of the drivers who died while being transported to the hospital, 75 percent were rural drivers compared to 25 percent for urban drivers (41).



An Institute of Medicine of the National Academies report, *The Future of Emergency Care in the U.S. Health System*, calls for regionalizing emergency care. Such an approach would deploy and integrate EMS personnel, equipment, agencies, and the hospitals to which they transport patients. This would benefit trauma victims by supporting more effective destination decision making, transportation, and use of resources. The goal is to make Level I and II trauma systems accessible within one hour by ground and air from any point within in the US.

Collaborate with Safety Partners to Improve Understanding of EMS and Identify Opportunities to Reduce Crashes and Save Lives

Crash scenes can get crowded with the number and variety of emergency responders. The disciplines involved in a single serious crash can include law enforcement, fire suppression, one or more EMS agencies, rescue or vehicle extrication (if not provided by EMS, police, or fire), roadway maintenance, and towing. While EMS is the focus of this section, it is imperative that all responding agencies have the necessary multidisciplinary training and equipment to cooperate, communicate, and ensure that victims are evaluated, stabilized, and transported quickly.

While there is currently no nationwide initiative or directive to create this necessary cooperation, the Federal Interagency Committee on EMS (FICEMS) ensures coordination among the federal agencies involved in emergency medical response. In addition to NHTSA, FICEMS also includes representatives from the Department of Defense, Homeland Security, Health and Human Services, and the Federal Communication Commission. This coordination effort should be enhanced with additional partnerships, to include the Federal Highway Administration, public EMS officials, and other external partners. This expanded partnership would support implementation of a national highway safety strategy as well as similar activities within each state.

As a partner in managing highway safety, it is also important that the EMS community is involved in traffic incident management planning and training. Since MAP-21 continues requirement for each state to have an SHSP, there are opportunities within each state to further collaborate to align goals, focus resources, and integrate the multidisciplinary programs and strategies aimed at reducing deaths on the nation's roadways.



Key Strategies for Enhancing Emergency Medical Services

Key Strategy	Implementation Timeframe
Fully implement enhanced 911 centers	Short
Participate in Next Generation 911 planning and implementation	Short
Implement pairing of Advanced Automated Collision Notification (AACN) data with algorithms to predict probability of severe injury	Mid
Develop AACN-based predictors to alert responders to the need for vehicle extraction	Mid
Improve and sustain excellent communications technologies for emergency medical responders	Mid
Implement the <i>National EMS Education Agenda for the Future</i> , including National EMS Education Standards	Short
Implement field triage scheme: the <i>Guidelines for Field Triage of Injured Patient</i>	Short
Develop, implement, and enforce safety engineering and design standards for ambulances, including removing Federal Motor Vehicle Safety Standards crashworthiness exemption	Mid
Improve ambulance access to intelligent transportation systems	Mid
Implement air medical transport (helicopter) use criteria	Short
Provide telemedicine applications for EMS	Mid
Improve emergency medical response in rural locations and especially for mass casualty incidents	Long
Implement comprehensive and state-regulated trauma systems to improve access to crash victims	Mid
Include EMS agencies in traffic incident management planning and training	Mid

The EMS response is the last chance to reduce death and disability from roadway crashes after prevention efforts have not been successful. The capacity and capabilities of responders to provide emergency care vary widely depending on where the crash occurs. This variance can make a significant difference in the outcome of each crash victim. The strategies discussed in this section support providing a high quality response to crashes. Widespread development of technologies and programs to support implementation of these strategies will be a key factor in achieving the TZD vision.





SECTION 3.6: KEY AREAS

Improved Safety Management

The previous sections highlight key individual high-impact highway safety strategy areas for reducing roadway injuries and fatalities. This section focuses on the challenges common to all key highway safety areas—from the broader issues related to how safety stakeholder partners collaborate to develop and implement appropriate safety initiatives; to the finer points of collecting, using, linking, and maintaining accurate traffic safety crash data and systems; to providing for a knowledgeable safety workforce.

Safety Partnerships and Planning

This TZD National Strategy builds on and complements other initiatives that help highway safety stakeholders reach a common understanding and appreciation of the goals, resources, and challenges each partner can offer to support other partners as they identify and address the factors that lead to crashes. In addition to helping build relationships, collaborating on safety activities can educate partners about one another's issues and raise awareness of the multiple perspectives involved in identifying and implementing effective safety programs.



For example, coordination between emergency medical service professionals and highway agencies helps improve coordination between the transportation, emergency medical response, and public health communities. As a result, more medical facilities are reviewing data collection and databases, and implementing or enhancing procedures that monitor a crash victim beginning at the crash scene through hospitalization and recovery period, including any long-term health problems. In addition to having data on crash outcomes linked to crash information, one benefit associated with collecting these data is that researchers will be better able to track the costs of injuries associated with specific crash types and treatments. This complete picture of crashes would be of interest not just to the medical community as it looks for ways to improve care, but also to vehicle designers, engineers designing the roadway and roadside environment, designers and manufacturers of roadside hardware such as guardrail and signs, and so on.

Including the enforcement and judicial communities in discussions about highway safety issues will help raise awareness within the criminal justice community—judges, prosecutors, and law enforcement—about behaviors that often contribute to fatal and severe injury crashes, such as driving impaired or distracted, or not using seat belts and motorcycle helmets. A result of this could be increased enforcement of traffic safety laws and stronger penalties for violations, and this can lead to improved road user awareness of both the risks involved with specific behaviors and the threat of citation and penalty.

State SHSPs are a tool for creating and strengthening partnerships. State transportation agencies already work with their numerous safety partners as they implement and enhance their SHSPs. Data from several sources are used to identify the most effective programs to address specific safety priorities. Through processes to develop, evaluate, and update the SHSPs, it is possible to identify new partners, encourage their involvement, and explore opportunities to better interact with existing partners. The strategic highway safety planning process is applicable beyond the state level—local transportation agencies are developing strategic safety plans, as well. Other stakeholders, including associations and other non-public organizations, have increased their commitment and strengthened partnerships through developing plans to focus their safety activities. Continued efforts to engage new stakeholders and exchange knowledge with partners, along with supporting partners' efforts will continue to strengthen relationships and safety programs and sustain the success of SHSPs.

As the Safer Infrastructure section illustrated, integrating safety through performance-based design into a transportation agency's long-range transportation planning process also advances safety to regional-level project discussions—discussions more typically driven by the need to reduce congestion or address other needs. Elevating the safety discussion to this level should also result in more awareness and prioritization of safety when making decisions that impact the transportation network within a jurisdiction.





Data, Data Systems, and Analysis Tools

All highway safety stakeholders from every discipline can relate to data challenges. The role of law enforcement officers and organizations in safety data is crucial, since these stakeholders are responsible for collecting the crash data which are the foundation for safety evaluations and development of programs and initiatives. Without knowing how, why, and where crashes occur and what happens to the road users and vehicles during the crashes, it is difficult for any one stakeholder to identify:

- What specific safety issues to prioritize.
- The most appropriate treatments or programs.
- The level of success expected from the various existing programs, technologies or countermeasures that have been tried.
- What additional concerns are developing.

Data-related challenges include funding, staff, and tools necessary to collect all the traffic safety data needed, adequately analyze the data, and determine the most appropriate treatments and evaluate treatment effectiveness. Collection of all the information necessary to adequately understand a particular aspect of safety can be daunting due to the sheer number of crashes, size of the vehicle population or roadway network, or number of patients involved in crashes.



While public agencies are typically responsible for collecting and managing data, additional safety partners should be involved in analyzing data and developing and implementing highway safety improvements based on the data results related to their specific concerns (pedestrians, bicyclists, motorcyclists, older drivers, teen drivers, etc.). The ability to integrate, share, and analyze data from different stakeholders will necessitate that consistent data are collected across jurisdictions, and will require establishing reliable linkages among the partners. Stakeholders need to be able to access data applicable to their own particular roles so they are better able to address the wide range of factors contributing to crashes or injury outcomes, as well as manage and deploy resources. Tools such as GIS-based mapping tools can help provide access to data to a wider range of stakeholders such as local highway agencies, and can also help organizations more efficiently manage their resources in order to have the most impact.

The success of using traffic safety data for all of these activities depends on efficiently collecting complete, accurate, and timely data, coupled with easy integration with different data sources and accessibility to the data for reporting and analysis. Electronic collecting and reporting crash, injury, and other related information helps reduce the time it takes for the data to be available for analysis and decision making. Connecting the crash data to roadway information, injury outcome data, and other information related to the occurrence and outcomes of crashes is necessary to develop a clear picture of what is happening when crashes occur. Stakeholders must identify where specific safety strategies would effectively reduce the number and severity of crashes; decide how to implement the strategies; and establish whether the strategies have produced—or would be expected to produce—reductions in crashes or the factors contributing to crashes.

Strong relationships with partners contribute to the success of the Federal Motor Safety Carrier Safety Administration (FMCSA)’s increased focus on the accurate, timely, and integrity of crash and inspection data related to commercial motor vehicle crashes. As a regulated industry, commercial motor vehicles and buses are subject to both crash and inspection data collection and analysis. Two important FMCSA safety resources are:

- Comprehensive Safety Analysis (CSA) program is designed to reduce large truck and bus crashes, injuries, and fatalities; provide comprehensive safety measurement system; allow broader array of interventions; encompass comprehensive review and analysis of FMCSA compliance and enforcement programs; use safety determination methodology based on performance data rather than on-site compliance review; reduce variability in crash reports in terms of what data state and local agencies collect and how it is collected; and bring consistency and integrity to data gathered and analyzed.
- FMCSA DataQs is an online resource where FMCSA, state, and industry partners can review and request corrections to data concerns, which facilitates FMCSA’s ability to monitor, evaluate, and improve inspection report data.

An example of how commercial motor vehicle data is used to reduce fatalities involving large trucks and buses is the increased efforts to prevent carriers who have been shut down due to safety violations from establishing themselves as new businesses. Rather than waiting for a new pattern of safety violations to occur, linking the “reincarnated carrier” to the existing company will allow action against the new company immediately. FMCSA is currently in the rulemaking process for a regulation to allow for this.



Partnerships are also needed among similar agencies, such as state departments of transportation or motor vehicles, who can work together to implement programs that are larger than one jurisdiction. One example relates to driver licensing. One out of every five fatal crashes involves a driver with an invalid license, no license, or unknown license status (1). These drivers may have never been properly licensed, may have had their license suspended as a penalty for a non-driving violation, or they may have an impaired driving conviction. Because the range of reasons that a person might be unlicensed is broad, there is also a range of stakeholders who are working to ensure only properly licensed drivers are driving. One strategy that would help stakeholders involved with enforcement and adjudication is to implement “One Driver, One Record” programs where all information about a driver’s record is in one system and available to enforcement and licensing agencies, regardless of which state(s) may have issued the license(s) or where previous violations have occurred.

Several tools designed to help safety partners take a more coordinated, consistent approach to data collection and analysis are described below:

- Model Minimum Uniform Crash Criteria (MMUCC) gives guidance on the types of crash data elements agencies should collect and provides suggestions for each element.
- National EMS Information System (NEMSIS) provides an established framework for collecting, storing, and sharing standardized EMS patient care data from states nationwide.
- Data-Driven Approaches to Crime and Traffic Safety (DDACTS) identifies times and locations where crashes and crimes overlap and allows law enforcement to concentrate on these areas.
- Model Inventory of Roadway Elements (MIRE) is a data dictionary similar to MMUCC but is focused on roadway and traffic data elements to support data-driven safety decision making. A subset of MIRE is the “Fundamental Roadway and Traffic Data Elements to Improve the Highway Safety Improvement Program,” which specifies the roadway and traffic data that states must collect.
- *Highway Safety Manual* has tools and methodologies that help highway engineers quantify the safety-related effects of transportation-related decisions. It provides the foundation for developing models to integrate safety explicitly in non-safety tools, such as operational and capacity tools.

Data limitations are very much the norm, but there are tools and procedures available to support informed decisions regarding countermeasures or programs to reduce crash risk even in situations where data are particularly limited. An example is the United States Road Assessment Program (usRAP), which evaluates crash risk and proposes infrastructure-based countermeasures based on crash data and roadway information obtained from video logs of roads. Further development of tools and procedures that support data-driven consideration of safety even when available data are not ideal will help to further the inclusion of safety in decisions.

As technology continues to develop, there will be further improvements in the data that safety partners use to identify problems, select countermeasures, and evaluate the effectiveness of programs and projects. However, as future technologies continue to improve transportation, new challenges appear. For example, as intelligent transportation systems continue to develop and are incorporated into infrastructure and vehicles, safety professionals will need to address how they manage real-time data collection and analysis. Stakeholders should evaluate the data, along with the knowledge and skills, available to a team, and identify gaps to be addressed and the data improvement activities to pursue when funding or other resources become available.



Regardless of a stakeholder's specific transportation-related responsibilities, its safety efforts must include a clear vision of related issues and their relationship to the stakeholder's transportation decisions. These decisions must demonstrate how safety performance is considered in conjunction with costs, efficiency, mobility, and environmental issues, among other factors. Developing a strategic data plan can help identify the data and skills available to a team, along with the gaps that need to be addressed and the data improvement activities to pursue when funding or other resources become available. In addition to data, data systems, and data analysis procedures, stakeholders must also embrace an organization-wide attitude or safety culture that helps prioritize safety data improvements and support safety investment.

Many stakeholders are making significant progress toward removing institutional barriers and understanding challenges related to obtaining traffic safety-related data for analysis. One advantage to having strong partnerships with other safety stakeholders is the opportunity to work together to identify and address data and analysis needs. Sharing data and assisting partners with reporting and analysis tasks is a way to pool resources and skills. While crash, highway, medical outcome, and other data collection and management activities are typically the responsibility of public agencies, other safety partners would be involved in analyzing data and developing and implementing programs based on the results of data analysis. The strategies discussed in this section reflect the fundamental need to allocate attention and resources to collecting, managing, and processing traffic safety-related data and support collaboration among safety stakeholders.

Develop a Skilled Highway Safety Workforce

A recognized problem for the future of the transportation industry is developing and retaining a workforce with the skill sets to keep Americans moving, and moving safely. All safety partners share the familiar challenge of competing for the limited number of talented employees, and ensuring their staff, contractors, and/or volunteers have the necessary knowledge and skills to significantly contribute to effective safety programs and goals.

Workforce development concerns affect organizations of all types and sizes, and it is imperative that agencies plan how they will address current and future workforce needs. While there are similar concerns across all organizations, organizations need to develop individual initiatives that best address their own needs as they work to attract, train, and retain employees who have up-to-date and



comprehensive skills and can move into open positions as staff retires or moves on to other opportunities, and as the state of the art advances. Methods for addressing this challenge vary, based on the size and type of the organization and the resources available to each—public versus private organizations, statewide or national stakeholders versus those with a localized focus, researchers versus advocates.

As noted in Section 2, the demographic, economic, and other factors that affect the nation's transportation needs also impact a changing workforce and the ways organizations attract, develop, educate, and retain employees. Therefore, while it is important to cultivate and retain professionals whose roles involve developing and implementing safety programs, it is also important to support and develop employees that contribute to safety programs but also support other aspects of the highway safety field. This can include the broad spectrum of transportation professionals, in fields as diverse as engineering, economics, public law and policy, law enforcement, psychology, social marketing, communication, medicine, public health, administration, education, statistics and physics, among others. Developing a skilled workforce includes attracting and retaining staff with skills such as using new methodologies to conduct research or applying developing technologies to highway safety challenges and who will continue to identify new strategies to improve safety (11).

The way stakeholders perform their work and deliver their programs and services is continually changing. Technological advances have allowed for everything from teleworking and remote training, to driver monitoring systems and vehicle-to-infrastructure communication. These advances present both opportunities for attracting and retaining personnel and additional training and development needs.

While it is important that professionals with roles in developing and implementing safety programs are developed and retained, it is also important to consider such support for staff that contribute to safety programs but also support other aspects of an organization. This includes staff with data expertise, both from the IT perspective and the statistical analysis perspective. Other skills such as performing research using new methodologies or applying developing technologies to highway safety challenges are needed to continue identifying new strategies for improving safety.

A major challenge to the industry is a lack of highway safety training available, at both the university and professional or continuing education level. The National Cooperative Highway Research Program (NCHRP) Research Results Digest 302, *Core Competencies for Highway Safety Professionals* provides a broad framework for educating new and existing safety professionals. The core competencies represent the fundamental set of knowledge, skills, and abilities needed to effectively function as a professional in the highway traffic safety community. As such, they establish the foundation considered to be necessary for effective performance by all safety professionals. This includes those specializing in engineering, analysis, public policy, road user behavior, injury prevention and control, and safety management. The NCHRP Report 667, *Model Curriculum for Highway Safety Core Competencies*, developed a model education and training curriculum based on the core competencies outlined in NCHRP Research Results Digest 302; conducted a pilot test of the curriculum; and established guidelines for curriculum deployment covering multiple educational and training settings.



As a result of these initiatives, safety partners have begun building on the earlier initiatives to identify their own core competencies and develop their own training programs. Many of these resources are available online and multidisciplinary and multi-departmental peer exchanges also support safety initiatives.

Even when training opportunities that meet a specific individual's needs are available, it is often difficult to take advantage of the opportunities. There are practical limits to how much training or professional development activities a university student or professional can participate in, due to other educational requirements and work duties—not to mention funding. So while availability of development opportunities is a challenge, a significant related need is the ability of people to participate. Alternative models for developing highway safety professionals should be explored to determine how best to provide courses or other development opportunities while accommodating scheduling, workload, cost, and other limitations.

While it is important that professionals with roles in developing and implementing safety programs are developed and retained, it is also important to consider such support for staff that contribute to safety programs but also support other aspects of an organization. This includes staff with data expertise, both from the IT perspective and the statistical analysis perspective. Other skills such as performing research using new methodologies or applying developing technologies to highway safety challenges are needed to continue identifying new strategies for improving safety.

Key Strategies for Improving Safety Management

Key Strategy	Implementation Timeframe
Strengthen and expand strategic highway safety planning and implementation activities	Short
Develop and improve coordination between the transportation and public health communities and injury surveillance practices to better develop, implement, and evaluate state, regional, and local safety plans	Short
Develop, implement, and evaluate public education campaigns to improve public understanding of highway safety	Short
Educate judges, prosecutors, and law enforcement on the effect of impaired, aggressive, and distracted driving and the role of occupant restraints and motorcycle helmets to reduce fatalities and serious injuries	Short
Incorporate explicit role of safety in the long-range transportation planning process.	Mid
Improve crash data collection	Mid
Improve accuracy and completeness of crash location information for all public roads	Mid
Broaden data collection practices to capture different road users (pedestrians, bicyclists, motorcyclists, older drivers, teen drivers, etc.)	Mid



Implement “One Driver, One Record”	Mid
Maintain and link data systems from different stakeholders and improve access to linked data	Mid
Adopt and implement data dictionaries, guidelines, and standards for national use	Mid
Improve data collection for crashes involving emergency vehicles and regulated commercial vehicle crash and inspection data	Mid
Strengthen efforts to prevent unsafe motor carriers from reincarnating as new businesses to circumvent safety regulations	Mid
Develop data analysis methods and tools for use at state, regional, and local levels across all stakeholders, including cost-benefit analysis for behavioral programs	Short
Implement analysis tools that support data-driven decision making	Short
Plan for succession with highway safety knowledge	Short
Develop and promote core competencies for all positions within stakeholder organizations and ensure staff is knowledgeable regarding the current state-of-the-practice	Mid

Common to all the key areas are challenges related to managing programs that improve highway safety. From a relatively high level of developing or creating partnerships with stakeholders that can help develop and implement safety strategies to the comparatively finer points of collecting data on a particular aspect of a safety problem, we are all faced with similar challenges. Regardless of which “E” or discipline a stakeholder might represent, organizations working in the highway safety field need to make a commitment to support safety programs by improving partnerships and joint programs, information and the ability to understand details of safety risks and potential ways to reduce risks, and a skilled and dedicated workforce.

KEY AREAS

Conclusion

At the center of the transportation system are road users, and it is a combination of the road users and the other elements of the system that protect people while they travel. Continued development of existing and new strategies in each of the key areas discussed in this section will support joint and individual efforts to reduce fatalities and serious injuries. There are significant resources needed to collect data, perform research and evaluation, and stimulate deployment of countermeasures and programs. Stakeholders cannot focus only on the shorter term, lower cost activities because they will be easier to accomplish—there are longer and more costly strategies that will be critical to achieving the TZD vision, and we need to accelerate planning, researching, and funding for these strategies in the near future.





The underlying theme in all these key areas is traffic safety culture. Many of the strategies discussed in this section contribute to changing our safety culture, or will not be more fully implemented until an evolution in safety culture leads to public acceptance and support of the strategies that directly affect how they travel as well gaining the support of transportation agencies in the widespread use of these strategies, methods, and policies.





SECTION 4 SAFETY CULTURE

Creating a positive traffic safety culture (TSC) is integral to helping our nation move toward a vision of a highway system with no fatalities. While much research has been performed on cultural transformation, and there has been research on transforming traffic safety culture, more work is needed to be able to apply this knowledge to traffic safety (21). This section discusses this key area with more of a research focus than used in Section 3, since this is an emerging field with fewer proven strategies. Similar to the other key areas discussed in this National Strategy, the approach to transforming traffic safety culture involves assessing current status, determining appropriate strategies, aggressively implementing the strategies, evaluating progress to determine further steps.

Before defining TSC, consider why this concept is attracting so much attention. First, even as the U.S. has experienced a general decline in highway fatalities, several behaviors continue to contribute to a significant portion of fatal crashes, as discussed in Section 2. This suggests that U.S. culture accepts an inherent level of risk. As long as this cultural risk acceptance exists, there is no way to reach the vision of zero traffic fatalities. To embrace TSC, it is vital to create and instill the social imperative necessary to reject risky behaviors, engage protective behaviors, and embrace traffic safety policies.

Second, the social factors embedded within the culture that define us influence many common behavioral crash factors. For example, social factors within the prevailing culture influence the decision to drive while impaired, including beliefs that such behavior involves only minimal risk and the perception that such risky behavior is common—everyone does it. The same logic applies to protective behaviors (e.g., wearing a seat belt) that the safety community uses within our culture to motivate road users to reduce risks. In both cases, it is necessary to understand the social basis of individual behavioral decisions in order to create conditions that foster safe behavioral choices.



Third, the notion of culture not only relates to road user behavior choices, but also to decisions affecting whether individuals accept and comply with the traffic safety policies. In turn, a positive culture for traffic safety would also raise the political priority and increase resources allocated for traffic safety strategies.

Traffic Safety Culture Model

TSC represents a new model that supports traffic safety priorities such as the Toward Zero Deaths (TZD) National Strategy. It is, however, unlike traditional approaches to roadway safety that create the foundation for behavior (education), penalize specific behaviors (enforcement), reduce injury outcome from behaviors (engineering, EMS). Rather, the TSC model focuses on how social factors in a culture influence how people prioritize traffic safety and accept traffic safety strategies. That is, the TSC model assumes that behaviors related to traffic safety performance are the products of a deliberative process that is influenced by our culture. Therefore, it is difficult to achieve sustainable improvements in traffic safety until we understand these processes and create a culture in which everyone values traffic safety and works to enhance it.

In order to use this new model effectively, it is necessary to begin with a standard definition and apply it consistently. Indeed, it is common in any engineering process to operate with standard definitions for key concepts and relationships among these concepts. For example, in highway design, horizontal curves are designed to provide adequate sight distance for drivers traveling at or below a specific speed, so they are able to stop their vehicles should there be an unexpected object in the roadway. With TSC, the model(s) needed not only includes the key concepts to define the culture, but also represents the relationship of the concept(s) with behaviors and crash outcomes. For this purpose, the model portrayed in Figure 4 defines TSC as the values, beliefs, frames, norms, and attitudes shared by a group of people that influence their individual decisions regarding driving behaviors and safety interventions (13). In this model, the origin of culture can be traced to the effect of the physical environment on the social and economic development of an area. In turn, social and economic development within a population can motivate individuals to change their environment (e.g., provide more roadway access).

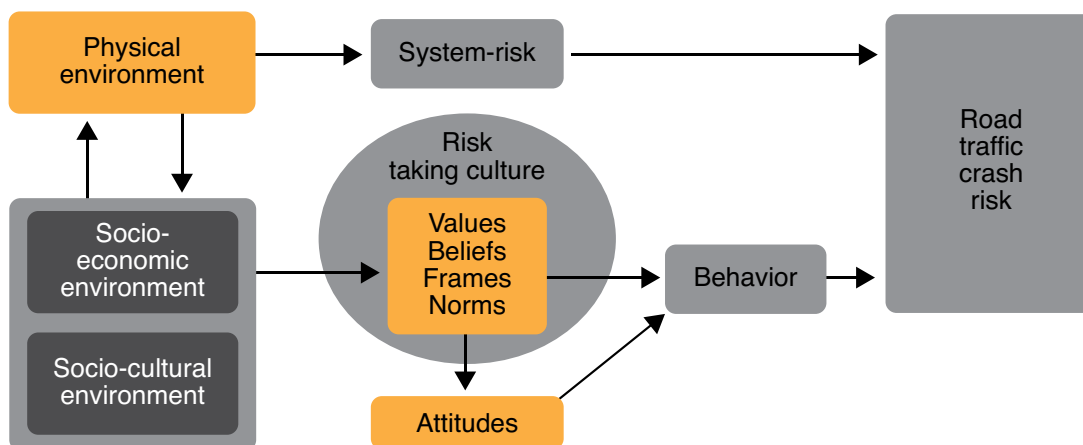


Figure 4. Descriptive and predictive model of key concepts that define traffic safety culture and their relationship with behavior and crash risk.



Safety professionals can use the descriptive nature of this definition to develop standard measurement tools with which to monitor trends in the cultural transformation. Most importantly, the predictive nature of the underlying model(s) allows safety professionals to design TSC strategies that can transform behavioral choices to improve traffic safety.

- Values. Principles to which we aspire and use to define what is important to us (e.g., protecting family, preserving life, freedom of choice, self-esteem). “I drive safely because being a good driver is important to my self-esteem.”
- Beliefs. How individuals perceive the way things work and interrelate, including the perceived probability and consequences of our actions (e.g., self-determination versus fatalism, expectation of positive or negative outcome). “I speed on this road because I know that without regular police enforcement it is unlikely I will get caught.”
- Frames. Tendency to perceive and interpret a situation or information from a certain reference point, expectation, or belief system. “Automatic speed enforcement is just a way for our government to make money off of us”.
- Norms. Perceptions of common behaviors (and expectations) amongst peer groups. “I text and drive because all my friends do.”
- Attitude. Emotional reaction and perception of use associated with a behavior or object. “I hate seat belts—they do not work.”

The TSC model operates by transforming a critical number of these cultural elements of behavioral choice to avert risky behaviors and promote safe behaviors. Rather than produce short-term changes in behavior, it is expected that the TSC transformation model will provide the fundamental and enduring motivation needed to sustain improvements in traffic safety.

However, transformation is not possible without designing and implementing strategies that (1) recognize there are multiple levels of society (cultural subtypes); and (2) operate within those cultures as community-based programs. As Figure 5 illustrates, only by operating and integrating TSC programs across multiple levels of our society can we achieve effective and sustainable improvements in road user behavior (2).

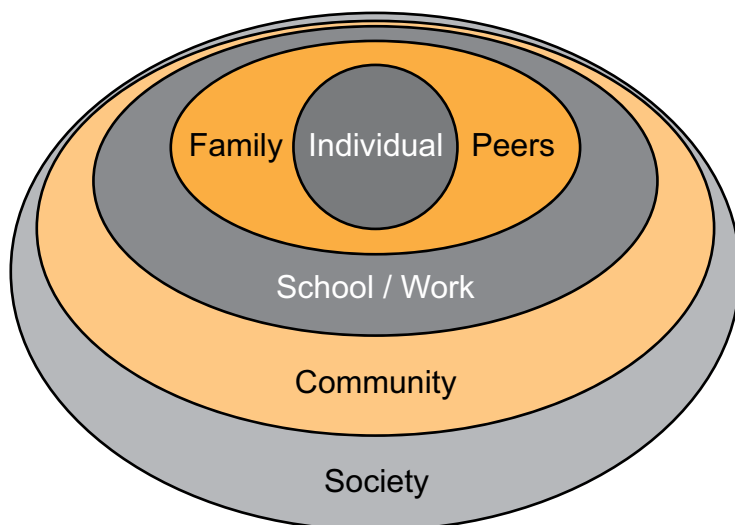


Figure 5. Example of the multiple socio-ecological levels of society that can exert cultural influence on individual behavioral choices affecting health risk. (7)



TSC Transformation Strategies

Because TSC is an emerging field, no existing off-the-shelf TSC programs are ready to be applied to a particular traffic safety consideration. Instead, the descriptive concepts and predictive model used for other fields suggest a number of strategies to transform TSC. These strategies focus on transforming a particular behavioral choice sustained by a culture. From a selected strategy, it will then be necessary to develop a specific research program to analyze the unique nature of the behavioral risk factor and cultural influence event for a particular level of society.

Values

The goal of a TSC strategy based on values is to promote behavioral choices by explicitly linking target behaviors and values. For example, the slogan used by the City of Boise relied on the nearly universal value to protect family, “Buckle up for those who love you,” to encourage seat belt compliance. In this case, the implicit link is that buckling up could save your life so you will be there to take care of your family.

Beliefs

The goal of the belief-based TSC strategy is to provide direct experience that challenges and revises components of a belief system that foster unsafe behaviors. For example, some people drive while intoxicated either because they underestimate their level of intoxication or they overestimate their own capacity to compensate for their intoxication (i.e., I’m only buzzed, I’ll drive slow and take surface streets home). Safety professionals have used this impairment to challenge drivers’ beliefs that they can compensate. One example of this is the “Buzzed Driving is Drunk Driving” campaign in the U.S. Australia also has an effective public safety video that shows drivers saying, “I’m okay to drive” when they really are not. Another example is the Dutch Alcohol-free on the Road Program that targets higher risk alcohol-related crashes among young drivers. The program goal is to increase awareness about the risks of alcohol and reduce the incidence of drunk driving by having young drivers navigate a closed course while sober and then while intoxicated. The driving test itself assessed several critical driving skills such as operating in narrow lanes, weaving around objects, reacting to traffic signals, and controlled braking on wet roads. As expected, these tests demonstrated significant alcohol impairment effects to the participating drivers. Using a quasi-experiment design comparing a sample of program participants to a matched control group, the results demonstrated that young males who participated in the program were six times less likely to be arrested and convicted of drunk driving (4). Using experiences to challenge the accuracy of beliefs will help change those beliefs.



Frames

The goal of a frames-based TSC strategy is to shift an observer's reference point or expectation so that the observer interprets the situation differently (i.e., with a more acceptable decision). For example, the public often perceives automated speed enforcement as negative. The same technology can be designed with different reference points. A Swedish Speed Lottery pilot program identified and fined speeders by taking a photo of their license plates—like current automated enforcement systems. However, the design of this system instilled a new (positive) expectation because the system also identified non-speeders who could be subsequently rewarded through a lottery system using a portion of the accumulated fines. Although the Speed Lottery was a demonstration project, preliminary data suggest that drivers viewed the system positively—speeding was reduced by 22 percent (12).

Norms

The goal of this TSC strategy is to correct a misperceived norm so that individuals adopt and form existing positive norms that support a positive traffic safety culture within their social (peer) group. As an example, a social marketing campaign developed by researchers at Montana State University used the Positive Community Norm approach to target established perceptions of drinking and driving among young Montana adults. An initial survey revealed that 92 percent of respondents perceived that most of their peers were drinking and driving (the perceived norm); however, only 20 percent of respondents actually drove after drinking (the actual norm). This misalignment between the perceived and actual norms became the focus of a social media campaign. As a result of this campaign, there was a 5 percent reduction in normative misperceptions, an increase in using designated drivers, and a 2 percent decrease in drinking and driving. These changes are significant considering that over the same period, a control sample of young adults in Montana counties that did not receive the same media campaign increased normative misperceptions by 2 percent, reduced use of designated drivers by 10 percent, and drinking and driving increased by 12 percent (50).

Attitudes

The goal of an attitudes-based TSC strategy is to change the emotion or perceived effectiveness of a behavior. Most commonly, methods use fear tactics to reduce the attractiveness of a behavior; however, using fear is not always effective to improve traffic safety (25). Additionally, the people who most likely engage in unsafe driving behavior are themselves less likely to respond to threats or punishment (10).

In contrast, humor-based messages of behavioral threats have proven effective over repeated exposure and may represent a more acceptable culture for traffic safety strategies (24). As an example, Australia developed the Pinkie Campaign, a humorous portrayal of social judgment from women and their peers to change attitudes of young men (aged 17 to 25 years) toward speeding (33). An evaluation of this campaign suggested that it resulted in 18 percent fewer self-reported speeding incidents among young male drivers, a nine percent reduction in speeding tickets, and a reversal in the growing trend of increasing fatalities that saved 56 drivers over the initial two years this campaign was active (3).





Social Environment

Finally, as Figure 4 illustrated, it is possible to transform TSC by affecting the economic and social environment from which our culture emerges. In this regard, social capital refers to a community's social networks, interpersonal connections, and public resources as well as the resulting perceptions of cohesion, trust, and willingness to engage with the community activities (20). Research demonstrates that states with higher levels of social capital (defined by the amount of community engagement and reported trust of others) have lower rates of traffic crash fatalities (30). Based on this protective effect, it may be possible to create pro-social attitudes and behaviors by increasing social capital through community investment in general education and promoting home ownership to foster social commitment to a location and community (31). Additionally, a community with higher levels of social capital engender expectations of its members to behave in ways that benefit the community rather than just the individual.

Creating a Traffic Safety Culture

Most TSC strategies target specific risky (e.g., drunk driving) or protective (e.g., seat belt use) behaviors, so it is first necessary to establish a culture that recognizes and values the TZD vision. To achieve this, first it is necessary to raise awareness of traffic safety as a critical public health problem. Cultural transformation is possible only when the importance of traffic safety is recognized and this concern is communicated throughout all levels of society. The transformation process begins once traffic safety becomes part of the collective conversation.



Second, it is necessary that all transportation-related organizations embrace a positive traffic safety culture. Although many definitions of the term “safety culture” exist, the term has generally been used to describe the enduring valuation and prioritization of safety for all members in an organization (58). “Safety culture” as a term has had a long history in organizations in which safe operations are critical, such as in nuclear power plants, commercial aviation, and healthcare (8). In order to enable the transformation process, a positive traffic safety culture must be established in all transportation-related organizations as a part of policy and practice for all disciplines.

Third, to sustain the transformation process, it is necessary to change the relationship (frame) between the driving population and highway safety agencies. Rather than having agencies dictate appropriate behaviors, the intent is to create the motivation within the driving population to partner with highway safety agencies to achieve mutual goals. One method to achieve this type of partnership is by using incentives that reward healthy choices. For example, there is a theory that providing monetary rewards to individuals who reach a specified age without a traffic-related injury would motivate safer behaviors and increase participation with the government to create programs that support less risky decisions by road users and reduce injury (57).

Fourth, changing the safety culture of highway safety agencies can enable transformation from national, regional, and state social-ecology levels (Figure 5). Also, it will be necessary to implement programs that will start the transformation process at levels related to the individual including the family, school, and work environment. The close nature of these levels is not only likely to provide a more immediate and direct influence on the individual, it will also accelerate the transformation process across the social ecology. For example, TSC programs developed for family and school settings will propagate the TSC transformation as participating parents and children interact and communicate within their communities.

Monitor Success

As noted above, and as is the case with any of the programs or countermeasures discussed in this National Strategy, a crucial component to establishing a positive safety culture is to develop an ongoing measurement and feedback system (48). Indeed, evaluation is an important component of a comprehensive process to develop and manage any traffic safety program (51).

Evaluations can focus on the results of a program. In terms of the TZD National Strategy, the desired outcome is evaluated in the number of crash fatalities. The criterion for success is measuring zero fatalities, but the implicit interim goal is to reduce fatalities as the nation moves toward zero deaths. Interim performance targets provide several criteria with which to evaluate success. In addition, a running multi-year average provides a baseline for determining the effectiveness of the safety program relative to natural variation in annual crash fatalities. Given that TSC programs usually focus on the cultural elements of specific behavioral risk factor, it may also be informative to include a detailed analysis that identifies specific crash types related to those risk factors.



It is also important to evaluate the process that supports the targeted outcomes. These processes represent the effective components of the implemented program. Referring again to the general TSC model (Figure 4), part of the process to improve traffic safety is a corresponding change in targeted driving behavior. Therefore, one form of process evaluation would involve systematically measuring and analyzing changes in the behaviors targeted by the TSC strategies. Several methods can be applied to measure behavioral risk factors, including analyzing crash data (59), police reports (53), driver surveys (52), and roadside observation of behaviors such as speed or seat belt use (17). This allows safety professionals to identify and replicate programs that work, and to revise programs that do not. An example is the Traffic Safety Culture Index survey conducted by the AAA Foundation for Traffic Safety for the past several years.

In terms of the process underlying a TSC strategy, the most important assessment component will be measuring the TSC itself. Most common TSC measures are self-reported questions in a survey. As Table 2 shows, there are standard question formats for some TSC components (9). For other components, research may be needed to develop appropriate measures for a particular TSC program. Regardless of the specific measurement, pilot testing is necessary to increase reliability and validity of TSC components measured.

It is also important to measure the number of exposures to the TSC strategy, which usually involves some objective measure (e.g., number of aired commercials within the target community) as well as a subjective measure of population awareness (e.g., survey of self-reported exposure to commercials).

Finally, evaluating the transformation process requires comparing the baseline measurement obtained before implementing the TSC program. Indeed, the recommendation is to include several post-implementation measurements in order to characterize the durability of observed effects.

Expectation:

How likely is it you would crash if you drove 10 mph above the speed limit during your commute to work every day for a year?

Unlikely ☐ ☐ ☐ ☐ ☐ ☐ ☐ Likely

Valuation:

How severe would a crash be if you were driving 10 mph above the speed limit during your commute to work?

Not Very Severe ☐ ☐ ☐ ☐ ☐ ☐ ☐ Very Severe

Table 2. Example of Question Formats to Measure Behavior Beliefs about Speeding. (9)



The First Steps

Unlike the long-standing traditional methods of improving traffic safety, the TSC model is not yet sufficiently advanced to provide specific and standardized methods. Nonetheless, the discussion in this document suggests a number of important strategies that should be implemented to enable the transformation process:

1. Conduct a standardized assessment of the current (baseline) TSC within individual state-level or other jurisdictions, or within a specific community associated with a safety advocacy or other partner organization, that includes multiple social-ecology levels. This assessment would provide a baseline against which to measure progress and identify crucial areas to focus the transformation process.
2. Develop and operationalize an action framework to implement a national transformation program across all levels of the social ecology (26). This would provide the comprehensive, systematic, and rationale roadmap necessary to manage the transformation process.
3. Adopt the TSC vision within all state and local agencies with a role in highway safety, supported by implementing programs to adopt a positive organizational safety culture. According to the U.S. Department of Labor (Occupational Health and Safety Administration), some key components of a positive safety culture include (1) transformational leadership and commitment by senior management and (2) continually measuring and analyzing performance metrics (48). This would be necessary to ensure policy support and resource availability would enable the transformation process.
4. Implement educational and social media campaigns across the social ecology to create shared awareness, motivation, and commitment toward traffic safety as a significant and valued public health issue. This shared investment in traffic safety among society is necessary to provide the cultural capacity for transformation.
5. Implement incentive schemes within the general population that reward immediate and sustained cooperation toward achieving personal and collective traffic safety goals. Using tangible rewards to recognize individuals for safer behaviors would instill a natural motivation to encourage, support, and participate in planning for safety-oriented policy and programs.
6. Develop education programs in elementary schools to instill the fundamental values, beliefs, and attitudes that can support developing a positive safety culture as children grow and mature. Building this foundation will increase the positive traffic safety culture as children travel with their family and eventually become independent road users themselves.
7. Introduce training modules within novice driver education and licensing programs to provide education, practice (modeling), and evaluation of positive TSC indicators. This would provide the opportunity to develop a positive TSC in conjunction with driving knowledge and skills.
8. Ideally, children participating in steps 6 and 7 would also transfer a positive TSC to their families. In addition, education programs and social media campaigns should be designed to value and instill a positive TSC within the family. Communication and interactions within and between families would transfer the transformation process into the community and across the social ecology (refer to Figure 5).



A positive traffic safety culture that motivates protective behavior and inhibits risky behavior would also encourage acceptance of other forms of intervention that share the vision of improving traffic safety performance. Culture-based programs generated from this new model must be combined with traditional approaches to traffic safety. Using these strategies effectively will require understanding and applying behavioral models from the social sciences. Furthermore, it will be a long-term process that involves all levels of society to pursue and sustain the transformation process. To be successful, the process will require that individuals and organizations challenge their core assumptions and traditional models of thinking about traffic safety. Additionally, transportation safety professionals must also challenge their own core assumptions, consider the many levels of the social-ecological system, understand that efforts to change TSC will be long-term, and customize and update strategies. In summary, to transform traffic safety culture it will be necessary to:

- Challenge core assumptions. Assumptions create each person's perceptual frames and then beliefs, attitudes, and norms about traffic safety. Transforming our national safety culture requires that individuals critically reflect, engage, and collaborate to fundamentally revise our common values and priorities to support the TZD vision.
- Think ecologically. Recognize that a traffic safety culture operates at many levels within the social-ecological system (refer to Figure 5). Any strategies or countermeasures, funding, and policy decisions must reflect systemic thinking and be designed to operate across various ecological levels. Individual drivers are only one part of a very complex system that also includes families, organizations, communities, subcultures, and social norms.
- Focus long term. Culture and transformation are long-term dynamics. It is insufficient to speak of and apply traffic safety culture as a short-term process. Results-oriented agencies may too often choose immediate (reactive) results and campaigns over the sustained development of a new model. The TZD effort requires proactive, long-term focus to cultivate and sustain transformation.
- Envision cultural health. It is crucial that the public perceive a traffic safety culture as part of a larger conversation whereby safe driving is one part of a culture of healthy behavior and livable communities. This process begins with envisioning healthy community cultures.
- Be dynamic. It is important to recognize that traffic safety culture changes dynamically in response to the environment and social norms. As such, individuals and organizations must continuously revise and update their assumptions and strategies based upon new information and data.
- Customize strategies. Like any ecological system, the traffic safety culture is comprised of a myriad of specific subcultures and subsystems. To meet local needs, it is crucial to research the prominence of different reference groups and generate customized strategies.
- Talk and listen. The transformation process occurs through critical reflection by guiding emerging traffic safety solutions from within a community rather than by dictating an intervention from outside. Engaged conversation of concerned citizens is the key to any successful social movement.
- Engage transformational leaders. Moving the new model forward through transformational learning strategies requires engaging leaders who understand the national traffic safety perspective and can move the new model forward through transformational learning strategies. These leaders must be bold, visionary, and must understand the process of fostering critical reflection and dialogue among local citizens.





SECTION 5 LET'S GET TO WORK

Achieving the vision of a highway system free of fatalities will take time, dedication, resources, and energy, and the TZD National Strategy is a tool to unify the efforts of many highway safety stakeholders working toward this vision. This document lists many strategies that are reducing and will continue to reduce highway fatalities, but borrowing the phrase that whole is greater than the sum of its parts, the main idea is that it is the synergy of safety partners working together and identifying ways to build upon current activities and expand efforts in new areas that will have the significant impact on traffic fatalities and serious injuries.

Join the National Dialogue

To support widespread, aggressive, and proactive efforts to reduce fatalities and serious injuries, we must build a substantial national dialogue on highway safety that expands our interactions beyond our individual traditional circles of partners. This sustained interaction would foster an on-going conversation to identify policy, resource, and partnering needs and potential solutions—as well as to maintain momentum and interaction among stakeholders.

Nationwide, we need to aggressively promote use of the strategies that we know are effective, and also continue to seek out new strategies. We have enough knowledge on many of the strategies that, given adequate resources, we could implement on a widespread basis. There are many countermeasures and programs currently in use which we do not fully understand, and evaluation of these must continue. At the same time, as we are constantly learning more about the familiar factors involved in crashes—the road environment, the road users, and the vehicles—we need to continue looking for new ways to prevent crashes and reduce the severity of crashes that do occur.



Whether new or already in use around the country, many of the strategies that will have a significant impact on the national numbers will take years to fully implement. This National Strategy uses a 25-year timeframe to encourage safety stakeholders to consider these countermeasures and programs with longer implementation periods, high funding needs, and other significant challenges—at the same time we are working on expanded use of proven and lower-cost countermeasures. Even though the lower cost, shorter term, or much used countermeasures and programs may be the most feasible strategies and will achieve results, it is important to also focus on the programs and initiatives that are longer term and will require higher levels of resources.

One long-term key initiative is changing traffic safety culture so that personal, professional, and organizational decisions are safety-driven. As discussed in Section 4, this is an issue to address from the individual to national levels as well as across a wide range of specific safety issues, and therefore will naturally need significant collaboration among many stakeholders to be able to both determine appropriate activities and to implement all the programs and reach all the audiences needed. Adoption and implementation of TZD by many partners, demonstrating unified commitment, will be a major step in the process of transforming to a traffic safety culture.

Get Started

The next step for highway safety stakeholders is to consider how they fit into efforts to achieve the zero deaths vision and how they can best inject new energy and commitment into both their own efforts and the nationwide initiative. Adopting the TZD vision and the National Strategy is a commitment to reduce fatalities and contribute to the national effort of transforming our traffic safety culture. Adopting an aggressive highway safety vision is a crucial first step, and the next steps are determining how that vision changes a stakeholder's activities and culture, and following up plans that work toward that vision with actions, programs that will aggressively contribute to the reduction in fatalities.

Collaborate with nontraditional partners. While all organizations involved in highway safety will not be able to participate in all programs in each key area discussed in Section 3, they should consider identifying nontraditional efforts—programs not generally in their area of interest or expertise—in which they can participate. This can help encourage other partners from unanticipated sources to join the nationwide TZD effort and contribute their knowledge gained from other initiatives.

Look for new ideas. For entities that have not yet developed a strategic approach to their safety efforts, this National Strategy could be used as a starting point. Other organizations with established safety strategies may find new ideas in the National Strategy worth considering.

Share best practices and lessons learned. Individual organizations will likely have their own customized approach to TZD implementation, based on their roles and experience in transportation, traffic safety, and strategic planning. However, sharing knowledge and experiences with other stakeholders will help spread ideas and strengthen other organizations' programs.

Track progress. As part of an implementation plan, agencies will need to set intermediate goals to evaluate progress and identify additional needs. Progress can be measured in lives saved but also with the efforts undertaken that contribute to reaching the vision of zero fatalities.



Spread the Message

One of the main concepts of the TZD National Strategy is collaboration, so it is important for organizations adopting the TZD vision to reach out to more stakeholders and enlist them in activities that support the aggressive and proactive approach to reducing fatalities. It might be discussions on using individual countermeasures that serve as the catalyst for strengthening partnerships, or it might be inclusion in strategic safety planning teams, or it might be discussions on organizational safety culture. However it is started, it is the combined efforts of stakeholders that are key to implementation of the TZD National Strategy and to achieving the vision.

The challenge for many individual organizations will not be in implementing individual countermeasures or programs but in engaging and empowering stakeholders. It will be critical to expand current momentum by implementing proven communication strategies and by examining nontraditional methods that may also be effective. A National Cooperative Highway Research Program project developed a strategic communications plan for the TZD National Strategy, along with branding materials. These resources can be downloaded from the TZD website and used by all stakeholders to aid their communications regarding their TZD vision and to demonstrate their commitment to the vision. The communications plan identifies target audiences and strategies for reaching these stakeholders. It is essential that conversations about the National Strategy and the TZD vision are consistent, so key messages were developed to assist stakeholders in their communications with partners, potential partners, staff, management, members, constituents, and the general public.

We have already seen some results of effective outreach and communication. Through the efforts of state department of transportation and state highway safety offices, law enforcement, advocates, and individual partners, more than half of all states have incorporated an aggressive zero-based goal or vision in their strategic highway safety plans. One of the key benefits of the TZD National Strategy is that it provides a mechanism by which these successful strategies and lessons learned can be shared.

Key Messages

1. Our nation's highway safety vision is Toward Zero Deaths, where even one traffic fatality is unacceptable.
2. The National Strategy on Highway Safety is the roadmap to reaching the TZD vision.
3. Creating a culture of safety is my personal and professional responsibility.
4. Traffic fatalities are a public health crisis.
5. I can help prevent traffic fatalities and serious injuries by how I drive, ride, bike, or walk today.

Everyone already has a goal of zero deaths for themselves and their families. Together, with efforts like TZD, we can make a national commitment to implement strategies, raise awareness, and change the behaviors that contribute to reducing traffic fatalities.



Accept the Challenge

Because the factors leading to crashes are many, the potential ways to counteract those factors are numerous as well. Many countermeasures and programs are discussed in previous sections of this document, and still more are listed in the appendix. For many of these strategies and any others that stakeholders use, the technical barriers are not significant. Instead it is often the constraints of funding, staff, organizational culture, and other issues, that limit how extensively or how effectively any one strategy can be applied. This document focuses on the need to work collectively to overcome these institutional, political, funding and other barriers. So rather than serve as a technical guide for selecting, using, and evaluating specific countermeasures, the TZD National Strategy is emphasizes use of not the science of highway safety, but the art of highway safety to overcome these challenges.

A highway system free of fatalities is a challenge that will require time and diligence. But we have more than 34,000 reasons every year to accept this challenge and work together Toward Zero Deaths.



ACKNOWLEDGEMENTS

Development of the Toward Zero Deaths National Strategy was led by a group of organizations that represent professionals with a role in highway safety. The associations on the TZD Steering Committee are:

- American Association of Motor Vehicle Administrators
- American Association of State Highway and Transportation Officials
- Commercial Vehicle Safety Alliance
- Governors Highway Safety Association
- International Association of Chiefs of Police
- National Association of County Engineers
- National Association of State Emergency Medical Service Officials
- National Local Technical Assistance Program Association

Members and staff of these organizations provided input to and review of the National Strategy. Technical support was provided by the Federal Highway Administration, Federal Motor Carrier Safety Administration, and National Highway Traffic Safety Administration.

The TZD Steering Committee would like to acknowledge significant contributions from additional individuals and organizations:

- Many dedicated safety stakeholders contributed to the development of the National Strategy through workshops, webinars, conference sessions, reviews of the document, and other means, and have also helped develop the nationwide momentum for an aggressive approach to reducing highway fatalities, a TZD vision, and a national strategy that unifies stakeholders.
- Nicholas Ward of the Western Transportation Institute of the Montana State University developed Section 4 on traffic safety culture.
- Penna Powers Brian Haynes developed the strategic communications plan discussed in Section 5, which includes design of this document and the TZD website.



APPENDIX

DETAILED LIST OF STRATEGIES

This list of strategies includes the key strategies presented Section 3, as well as additional strategies effective in reducing risk of fatalities and serious injuries. When appropriate, strategies presented in Section 3 are expanded to provide more detail. As with the key areas, there is overlap between these lists. This list was developed with input from National Cooperative Highway Research Program project 17-51(4), which developed input to the TZD National Strategy, and information from many highway safety stakeholders.

SAFER DRIVERS

Occupant Protection

- Enact and enforce primary seatbelt laws
- Implement high-visibility restraint enforcement, including nighttime and child restraint use
- Implement advanced seat belt reminder systems, including those for rear-seat occupants
- Strengthen state child safety seat legislation to support federally approved child restraint use
- Implement parent education programs on topics related to child restraints and child occupant safety practices
- Implement programs to provide approved child safety seats to parents and caregivers needing financial assistance
- Implement driver restraint monitoring systems
- Increase fines for violating seatbelt and child restraint legislation
- Speeding and Aggressive Driving
- Enact targeted enforcement for speeding-related offenses
- Enact legislation and implement automated traffic enforcement—including pervasive automated speed enforcement and applications for school and work zones
- Implement rigorous aggressive driving and speeding-related enforcement programs
- Implement real-time speed-feedback warning systems: on roadside
- Set appropriate speed limits and deploy other speed management techniques

Impaired Driving

- Enact legislation and implement high-visibility sobriety checkpoints.
- Implement appropriate penalties and DWI/DUI courts.
- Enact legislation and implement standard ignition interlock programs for offenders
- Improve alcohol and drug detection technology
- Implement ignition interlock systems
- Implement Screening and Brief Intervention (SBI) for repeat DUI offenders
- Coordinate with private sector establishments serving alcohol
- Implement policies that prevent excessive consumption of alcohol, a.k.a. binge drinking
- Implement policies (incompliance checks, responsible beverage server training, etc.) that prevent access to alcohol by persons under the age of 21
- Increase fines and penalties associated with impaired driving





- Implement Ignition Interlock reciprocity
- Train and deploy Drug Recognition Experts
- Enact legislation and develop detection and enforcement methods to handle drug impairment, including prescription drugs
- Develop .08 equivalent for marijuana impairment

Distracted Driving

- Enact and enforce legislation to address distracted driving—including texting bans
- Implement technologies to prohibit or limit cell phones and electronic equipment while vehicle is in motion
- Implement and enforce employer policies to eliminate distracted driving

Teen Drivers

- Strengthen GDL legislation and enforce graduated driver licensing laws
- Improve driver education by standardizing materials and laws requiring driver education across the nation
- Implement teenage driver oriented technologies that adjust stereo volume, increase seat belt warning signals and react to signs of distraction
- Implement public education campaigns and enforcement of safe driving practices in proximity of commercial vehicles—with an emphasis on targeting teen drivers
- Implement parent education programs
- Implement driver-monitoring systems for teen drivers

Older Drivers

- Improve older driver licensing policies and screening of older drivers, including potentially tailoring licensing to specific needs such as daylight driving only
- Educate older drivers about driver rehabilitation
- Implement safe driving courses for older drivers
- Implement Medical Advisory Boards (MABs) that independently review older driver capabilities
- Implement vehicle enhancements for older drivers
- Increase involvement of family-practice and internal medicine physicians who are in regular contact with older drivers in the decision about driving and licensing

Unlicensed Drivers and Drivers with Suspended or Revoked Licenses

- Implement One Driver, One Record
- Enact legislation to remove license actions for non-driving violations

Work Zones

- Educate drivers on safer driving practices in work zones



Commercial Vehicles

- Implement commercial driver programs to reduce risk of fatalities involving commercial vehicles
- Implement driver monitoring systems
- Create adequate truck and bus parking facilities, and develop a nationwide system to provide truck parking availability to assist truck and bus drivers in locating available facilities
- Implement public education campaigns and enforcement of safe driving practices in proximity of commercial vehicles

VULNERABLE USERS

Pedestrians

- Enact and enforce traffic laws applicable to motor vehicle operators and vulnerable users that improve pedestrian safety
- Implement pedestrian awareness programs targeting pedestrian visibility and impaired walking
- Implement education programs for school-age pedestrians aimed at eliminating pedestrian fatalities
- Coordinate with private sector establishments serving alcohol to eliminate impaired walking
- Consider pedestrians with disabilities in the design of pedestrian facilities
- Implement infrastructure/roadway improvements to support speed management to reduce risk of pedestrian fatalities
- Implement infrastructure/roadway improvements to reduce factors contributing to crashes with pedestrians
- Improve traffic control devices to reduce risk of pedestrian fatalities
- Develop and use new design guides and guidelines to reduce risk of pedestrian fatalities
- Promote vehicle designs and technologies that lower risk for pedestrian fatalities in motor vehicle crashes
- Implement walking courses for older pedestrians

Bicyclists

- Enact and enforce traffic laws applicable to motor vehicle operators and vulnerable users that improve bicycle safety
- Raise driver awareness of proper behaviors around bicyclists
- Enact and enforce bicycle helmet laws that apply to cyclists of all ages
- Implement infrastructure/roadway improvements to reduce factors contributing to crashes with bicyclists
- Improve roadway and intersection design to reduce risk of bicyclist fatalities
- Improve traffic control devices to reduce risk of bicyclist fatalities
- Develop and use new design guidelines to reduce risk of bicyclist fatalities
- Educate and enforce traffic laws applicable to bicyclists.
- Enact and enforce laws, and deploy educational efforts to curtail distracted bicyclist riders and motor vehicle operators





- Implement driver education to raise awareness of and behaviors around bicyclist traffic
- Implement targeted education programs for school-age bicyclists to reduce risk of bicyclist fatalities
- Implement infrastructure/roadway improvements to support speed management to reduce risk of bicyclist fatalities
- Implement infrastructure/roadway improvements to reduce conflicts with bicyclists

Motorcyclists

- Enact and enforce motorcycle helmet legislation for all ages and riders
- Implement targeted enforcement and public education programs to reduce the risk of motorcyclist fatalities (specifically speeding and impaired riding)
- Implement motorcycle rider education on impaired driving, distracted driving, protective equipment, training and licensing (including conspicuity)
- Implement infrastructure/roadway improvements to reduce conflicts with motorcyclists
- Improve roadway and intersection design to reduce risk of motorcyclist fatalities
- Improve traffic control devices to reduce risk of motorcyclist fatalities
- Develop and use new design guidelines to reduce risk of motorcyclist fatalities
- Enact and implement graduated testing and licensing for motorcyclists
-

Work Zones

- Educate workers on safety practices in work zones
- Improve work zone design and operations to reduce the risk of work zone fatalities
- Improve speed management and enforcement in work zones to reduce the risk of work zone fatalities

VEHICLES

Speeding and Aggressive Driving

- Implement real-time speed-feedback warning systems: in vehicle

Advanced Vehicle Technologies

- Expand the use of in-vehicle speed feedback and control technologies
- Further develop, test, and implement collision warning systems (forward, side, lane departure)
- Implement electronic stability control for light trucks
- Implement lane departure warning systems
- Implement driver monitoring systems
- Implement alcohol interlock systems
- Implement automatic braking systems
- Implement speed governor systems
- Develop and implement vehicle-to-vehicle communications technologies
- Develop and implement vehicle-to-infrastructure communications technologies
- Develop and implement vehicle technologies for motorcyclists and motorcycles



- Develop and implement vehicle technologies for commercial vehicle drivers and commercial vehicles
- Develop and implement vehicle technologies for younger drivers
- Implement Intelligent Transportation Systems to reduce the risk of fatalities

Crashworthiness

- Improve structural strength of vehicles in right-angle crashes and overturning crashes to reduce the risk of fatalities

Commercial Vehicles

- Implement commercial vehicle inspections and enforcement to reduce risk of fatalities involving commercial vehicles
- Implement vehicle technologies for commercial vehicle drivers and commercial vehicles to reduce risk of fatalities involving commercial vehicles
- Implement a comprehensive bus inspection program to reduce the risk of fatalities involving motorcoaches and other passenger-carrying vehicles

Upkeep and Maintenance of the Existing Vehicle Population

- Implement One Vehicle—One Record
- Provide universal access to clean title checks for vehicle damage of used vehicles
- Improve timeliness of identification of vehicle safety recall and enforce vehicle safety recalls
- Implement vehicle inspections to reduce fatality risk related to vehicle upkeep and maintenance
- Enforce legislation related to upkeep and maintenance of headlamps, windshields, tire thread, etc.

INFRASTRUCTURE

Lane Departures

- Install shoulder and centerline rumble strips and stripes to reduce the risk of lane departure fatalities
- Install median barrier systems, crash cushions, and guardrail end-treatments to reduce the severity of lane departure fatalities
- Install retroreflective signing and pavement markings to reduce the risk of lane departures
- Install high friction surfacing, in particular at curves
- Create physical separation of oncoming traffic on high crash potential two-lane roads (2+1 designs)
- Implement landscaping policies that prevent planting of new trees in the clear zone in urban or rural areas, or in the median of divided highways where cable barriers have been installed (or will be installed).



Intersections

- Improve signing, markings, and lighting to increase driver awareness of intersections
- Improve signal timing by adding protective left-turn phases, improving clearance intervals, and coordinating signals
- Redesign intersections to reduce conflicts and to reduce exposure to crashes, including constructing restricted crossing U-turn intersections, roundabouts or removing skews
- Install technologies that warn drivers of potential conflicts and/or assist them in choosing appropriate gaps in traffic at intersections
- Implement innovative intersection and interchange designs to reduce the risk of fatalities
- Consider implementation of roundabouts where appropriate

Safety Performance-Based Design

- Incorporate science-based safety methodologies into project development
- Update existing design guidelines and tools to enhance safety performance based design
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Advanced Vehicle Technologies

- Consider vehicle-to-vehicle and vehicle-to-infrastructure communications as part of infrastructure planning, design and management

Older Drivers

- Implement roadway enhancements for older drivers
- Update design policies and practices for roadways and vehicles to reflect the needs of older drivers

Commercial Vehicles

- Consider exclusive truck lanes
- Consider commercial vehicle safety in the planning, design, and operation of the transportation system

Ambulances

- Consider traffic signal pre-emption



EMERGENCY MEDICAL SERVICES

9-1-1 Access and Capabilities

- Plan for Phase II-compliant-enhanced 9-1-1 centers
- Participate in “Next Generation 9-1-1” planning and implementation
- Improve interoperability between 9-1-1 centers and traffic management centers

Improve Incident Detection

- Develop and implement universal telematics definitions and transmission (e.g., .xml) standards
- Implement pairing of advanced automated collision notification (AACN) data with algorithms to predict the probability of severe injury
- Develop advanced automatic collision notification–based predictors for the need for vehicle extrication

EMS System Response and Capacity

- Improve and sustain excellent communications technologies for emergency medical responders
- Increase coordination among neighboring EMS agencies
- Implement on-board driver measurement and feedback systems in all ambulances
- Connect emergency response vehicles
- Develop and implement evidence-based emergency vehicle operations standards
- Provide telemedicine applications for EMS to allow emergency responders to prepare emergency room personnel on incoming injuries
- Improve ambulance access to intelligent transportation systems
- Improve emergency medical response to roadways in rural areas, especially for mass casualty incidents
- Implement the National EMS Education Agenda for the Future as published by NHTSA
- Establish national vehicle extrication education and competency standards for emergency response personnel
- Regionalize emergency care

On-Scene Medical Care

- Implement the “Field Triage Scheme: The National Trauma Triage Protocol” as published by the CDC
- Implement communications technologies to provide information to emergency room personnel to allow for better preparation for incoming injuries
- Include EMS agencies in traffic incident management planning and training
- Provide and improve real time route access awareness for emergency medical response agencies
- Plan and designate landing zones for air medical helicopters in high crash frequency/severity area



Crash Victim Patients

- Develop, implement and enforce safety engineering and design standards for ambulance, including removing FMVSS crashworthiness exemption
- Implement air medical helicopter utilization criteria
- Improve ambulance access to intelligent transportation systems

Hospital and Specialty Care Infrastructure

- Implement comprehensive and state-regulated trauma systems to improve access to crash victims
- Develop and implement inter-facility telemedicine applications for crash victim care

Ambulances

- Develop and enforce safety engineering and design standards for ambulance, including removing FMVSS crashworthiness exemptions.
- Develop and adopt policies for the use of ambulance lights, sirens and selection of appropriate operating speeds

SAFETY MANAGEMENT

Safety Partnerships and Planning

- Strengthen and expand strategic highway safety planning and implementation activities
- Develop and improve coordination between the transportation and public health communities and injury surveillance practices to better develop, implement, and evaluate state, regional, and local safety plans
- Utilize road safety audits or assessments (RSAs) to evaluate risks for crashes
- Advance the practice of multidisciplinary incident management planning and training, involving EMS, fire, law enforcement, public works, transportation, towing and recovery, hazardous materials, and other personnel
- Educate judges, prosecutors and law enforcement on the impact of impaired driving, distracted driving, restraint use, and aggressive driving and speeding on motor vehicle-related fatalities, the value of motorcycle helmets in reducing motorcyclist fatalities, and risks related to work zones.
- Develop, implement and evaluate public education campaigns to improve public understanding of highway safety
- Incorporate consideration of pedestrian and bicycle facilities into long-term planning activities
- Incorporate explicit role of safety in the long-range transportation planning process



Data Collection, Data Management Systems, and Linkage

- Improve crash data collection
- Improve the accuracy and completeness of crash location information for all public roads
- Establish and maintain data clearinghouses
- Broaden data collection practices to capture different system users (pedestrians, bicyclists, motorcyclists, older drivers, teen drivers, etc.)
- Implement “One Driver, One Record” and implement system to proactively notify commercial vehicle companies when there is a status change to a truck or bus driver’s record
- Implement the National Emergency Medical Services Information System (NEMSIS) at state and local levels
- Maintain and link data systems from different stakeholders and improve access to linked data
- Adopt and implement for nationwide use data dictionaries, guidelines and standards, including Model Minimum Uniform Crash Criteria, Model Inventory of Roadway Elements, NEMSIS and the Fundamental Roadway and Traffic Data Elements to Improve the Highway Safety Improvement Program
- Collect and analyze real-time ITS data to support fatality reduction

Data Analysis

- Develop data analysis methods and tools for use at the state, regional, and local levels across different stakeholders, including cost-benefit analysis for behavioral programs
- Implement analysis tools that support data-driven decision making, including the Highway Safety Manual, the Interactive Highway Safety Design Model, road safety assessment programs, and mapping tools
- Develop and implement enhanced analysis tools for determining factors contributing to crashes
- Improve the injury severity reporting of persons involved in motor vehicle crashes
- Advance the science of crash data analysis and modeling (including crash prediction models, severity distribution prediction, and risk-based modeling)
- Implement and integrate injury surveillance practices into the evaluation and monitoring of safety plans at the national, state, and local levels
- Assess and track motor vehicle crash-related traumatic brain injury (TBI)

Workforce Development

- Identify and support peer exchange activities to support knowledge transfer of best practices and lessons learned
- Develop and promote core competencies for specific positions within organizations
- Develop university-level highway safety curriculum
- Designate highway safety professionals in transportation agencies at all levels of government
- Plan for succession of staff with highway safety knowledge
- Promote the highway safety profession to attract staff



REFERENCES

Input from many individual stakeholders, publications, and other resources was used to develop the Toward Zero Deaths National Strategy on Highway Safety. Reports and other materials used as background or cited in the National Strategy are documented in this section.

Toward Zero Deaths White Papers

A key initial step in the development of the Toward Zero Deaths national strategy on highway safety was the preparation of white papers intended to stimulate stakeholder discussions on the key areas and strategies for the national strategy. These white papers also served as background for the national strategy document, and contain many additional references that may be of interest to highway safety stakeholders. The papers were made possible with funding from the Federal Highway Administration and are available on the TZD website. The team that developed the white papers included:

- Team Lead: Hugh McGee of Vanasse, Hangen, Brustlin, Inc.
- Lessons Learned from United States and European Experiences: Ezra Hauer, consultant, and Daniel Carter of the University of North Carolina Highway Safety Research Center
- Future View: Alan Pisarski, consultant, and Forrest Council, VHB Consultant
- Safety Culture: Nicholas Ward and Jeffrey Linkenbach of the Montana State University Western Transportation Institute
- Safer Drivers: Neil Lerner, Jim Jenness, and Fran Bents of Westat, Inc.
- Safer Vehicles: Richard Retting of Sam Schwartz Engineering, Ron Knipling, consultant, and Fran Bents of Westat, Inc.
- Safer Vulnerable Users: Charlie Zegeer and William Hunter of the University of North Carolina Highway Safety Research Center and Janet Barlow, consultant
- Safer Infrastructure: Paul Jovanis and Eric Donnell of the Pennsylvania State University
- Data Systems and Analysis Tools: Barbara DeLucia of Data Nexus, Inc., and Geni Bahar of NAVIGATS
- Emergency Medical Services: members of the National Association of State EMS Officials

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