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NCHRP REPORT 500

**Guidance for Implementation of the
AASHTO Strategic Highway Safety Plan**

***Volume 9: A Guide for Reducing
Collisions Involving Older Drivers***

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The members of the technical committee selected to monitor this project and to review this report were chosen for recognized scholarly competence and with due consideration for the balance of disciplines appropriate to the project. The opinions and conclusions expressed or implied are those of the research agency that performed the research, and, while they have been accepted as appropriate by the technical committee, they are not necessarily those of the Transportation Research Board, the National Research Council, the American Association of State Highway and Transportation Officials, or the Federal Highway Administration, U.S. Department of Transportation.

Each report is reviewed and accepted for publication by the technical committee according to procedures established and monitored by the Transportation Research Board Executive Committee and the Governing Board of the National Research Council.

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FOREWORD

By Charles W. Niessner
Staff Officer
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The goal of the AASHTO Strategic Highway Safety Plan is to reduce annual highway fatalities by 5,000 to 7,000. This goal can be achieved through the widespread application of low-cost, proven countermeasures that reduce the number of crashes on the nation's highways. This ninth volume of *NCHRP Report 500: Guidance for Implementation of the AASHTO Strategic Highway Safety Plan* provides strategies that can be employed to reduce the number of collisions involving older drivers. The report will be of particular interest to safety practitioners with responsibility for implementing programs to reduce injuries and fatalities on the highway system.

In 1998, AASHTO approved its Strategic Highway Safety Plan, which was developed by the AASHTO Standing Committee for Highway Traffic Safety with the assistance of the Federal Highway Administration, the National Highway Traffic Safety Administration, and the Transportation Research Board Committee on Transportation Safety Management. The plan includes strategies in 22 key emphasis areas that affect highway safety. The plan's goal is to reduce the annual number of highway deaths by 5,000 to 7,000. Each of the 22 emphasis areas includes strategies and an outline of what is needed to implement each strategy.

NCHRP Project 17-18(3) is developing a series of guides to assist state and local agencies in reducing injuries and fatalities in targeted areas. The guides correspond to the emphasis areas outlined in the AASHTO Strategic Highway Safety Plan. Each guide includes a brief introduction, a general description of the problem, the strategies/countermeasures to address the problem, and a model implementation process.

This is the ninth volume of *NCHRP Report 500: Guidance for Implementation of the AASHTO Strategic Highway Safety Plan*, a series in which relevant information is assembled into single concise volumes, each pertaining to specific types of highway crashes (e.g., run-off-road, head-on) or contributing factors (e.g., aggressive driving). An expanded version of each volume, with additional reference material and links to other information sources, is available on the AASHTO Web site at <http://transportation1.org/safetyplan>. Future volumes of the report will be published and linked to the Web site as they are completed.

While each volume includes countermeasures for dealing with particular crash emphasis areas, *NCHRP Report 501: Integrated Management Process to Reduce Highway Injuries and Fatalities Statewide* provides an overall framework for coordinating a safety program. The integrated management process comprises the necessary steps for advancing from crash data to integrated action plans. The process includes methodologies to aid the practitioner in problem identification, resource optimization, and performance measurements. Together, the management process and the guides provide a comprehensive set of tools for managing a coordinated highway safety program.

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Acknowledgments

This volume of *NCHRP Report 500* was developed under NCHRP Project 17-18(3), the product of which is a series of implementation guides addressing the emphasis areas of AASHTO's Strategic Highway Safety Plan. The project was managed by CH2M Hill, and the co-principal investigators were Ron Pfefer of Maron Engineering and Kevin Slack of CH2M Hill. Timothy Neuman of CH2M Hill served as the overall project director for the team. Kelly Hardy, also of CH2M Hill, served as a technical specialist on the development of the guides.

The project team was organized around the specialized technical content contained in each guide, and the team included nationally recognized experts from many organizations. The following team of experts, selected on the basis of their knowledge and expertise in this particular emphasis area, served as lead authors for the older driver guide:

- Ingrid Potts
Midwest Research Institute
- Jane Stutts
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Development of the volumes of *NCHRP Report 500* used the resources and expertise of many professionals from around the country and overseas. Through research, workshops, and actual demonstration of the guides by agencies, the resulting documents represent best practices in each emphasis area. The project team is grateful to the following people and their agencies for supporting the project through their participation in workshops and meetings and additional reviews of the older driver guide:

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Summary

Introduction

The six major areas of the AASHTO Strategic Highway Safety Plan—Drivers, Vehicles, Special Users, Highways, Emergency Medical Services, and Management—are subdivided into 22 goals, or key emphasis areas, that impact highway safety. One of these goals addresses the reduction of crashes and fatalities involving older drivers. This implementation guide provides engineering, planning, education, and policy guidance to highway agencies that desire to better accommodate older drivers' special needs.

Older drivers represent a subset of the driving population that deserves special attention. Aging affects a variety of skills needed for safe driving. In particular, the aging population experiences deterioration in physical, perceptual, and cognitive skills:

- Reductions in strength, flexibility, and range of motion caused by arthritis or other conditions can negatively impact driving.
- Many visual functions—including static and dynamic visual acuity, contrast sensitivity, and glare sensitivity—deteriorate with age.
- Normative aging most often affects cognitive changes, such as working memory, selective attention, and processing speed.

Many highway design and traffic control elements can be improved to better meet the aging population's physical, perceptual, and cognitive needs. In addition, motor vehicle departments, highway safety offices, medical professionals, and others can collaborate to help older adults extend their safe driving years.

General Description of the Problem

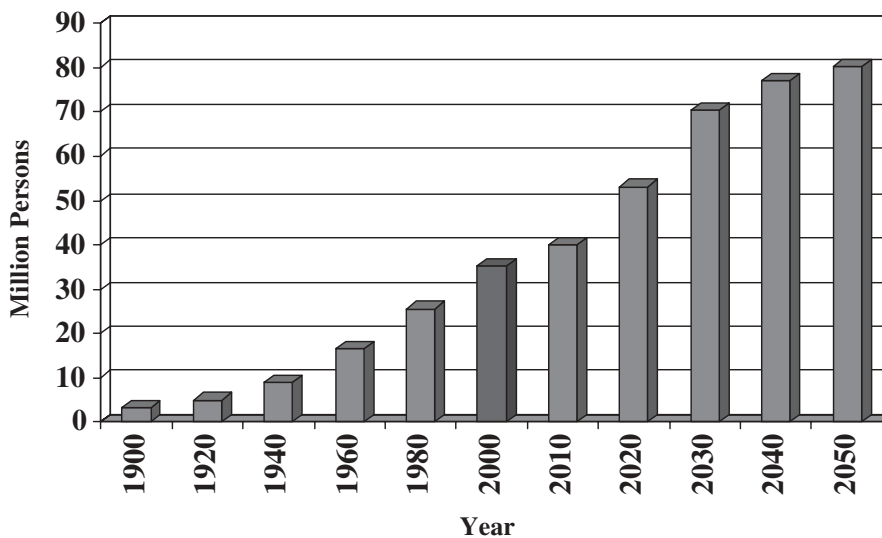
The number of older drivers in the United States will double over the next 30 years (Exhibit I-1). By 2030, one in five Americans will be age 65 or older. As people age, a decline in sensory, cognitive, or physical functioning can make them less safe drivers, as well as more vulnerable to injury once in a crash. Yet older Americans depend on automobiles for meeting their transportation needs.

The safety of older drivers can be measured several ways. On a licensed-driver basis, older adults are among the safest. The average annual number of crashes in the United States is 68 per 1,000 licensed drivers, while the corresponding rate for drivers 65 and older is only 37. The picture changes somewhat when crash rates are calculated on the basis of miles traveled. Using this measure of exposure, older adults *are* at increased crash risk.

The real safety concern for the older driver arises when one also takes into consideration their increased likelihood of being injured or killed in a crash. Compared with an overall fatality rate of 2 per 1,000 crashes, persons ages 65–74 have a fatality rate of 3.2. For those

EXHIBIT I-1

Projected Growth in U.S. Population Age 65+

(Source: Administration on Aging, "A Profile of Older Americans," 2000, www.aoa.gov/prof/statistics/profile/2002/2.asp)

75–84, the rate is 5.3, and at 85 and above it climbs to 8.6. When the safety of older drivers is measured in terms of fatalities per licensed driver and fatalities per mile traveled, there is clearly cause for concern.

Objectives of the Emphasis Area

The objectives for better accommodating the special needs of older drivers are to

- Plan for an aging population,
- Improve the roadway and driving environment to better accommodate older drivers' special needs,
- Identify older drivers at increased risk of crashing and intervene,
- Improve older adults' driving competency, and
- Reduce the risk of injury and death to older drivers and passengers involved in crashes.

Exhibit I-2 lists the objectives and strategies designed to meet these objectives. Because the AASHTO Strategic Highway Safety Plan is geared toward low-cost, short-term safety improvements, the list of strategies presented in Exhibit I-2 consists more of low-cost, short-term treatments than high-cost, long-term treatments. Many high-cost solutions should be considered at a project's planning stages and are not typically used to treat high-accident locations. Examples of high-cost solutions that should become part of an agency's design practice, rather than a "spot treatment," include

EXHIBIT I-2**Objectives and Strategies for Sustaining Proficiency in Older Drivers**

Objectives	Strategies
3.1 A Plan for an aging population	3.1 A1 Establish a broad-based coalition to plan to address older adults' transportation needs
3.1 B Improve the roadway and driving environment to better accommodate the special needs of older drivers	3.1 B1 Provide advance warning signs 3.1 B2 Provide advance-guide and street name signs 3.1 B3 Increase the size and letter height of roadway signs 3.1 B4 Provide all-red clearance intervals at signalized intersections 3.1 B5 Provide more protected left turn signal phases at high-volume intersections 3.1 B6 Provide offset left-turn lanes at intersections 3.1 B7 Improve lighting at intersections, horizontal curves, and railroad grade crossings 3.1 B8 Improve roadway delineation 3.1 B9 Replace painted channelization with raised channelization 3.1 B10 Reduce intersection skew angle 3.1 B11 Improve traffic control at work zones
3.1 C Identify older drivers at increased risk of crashing and intervene	3.1 C1 Strengthen the role of medical advisory boards 3.1 C2 Update procedures for assessing medical fitness to drive 3.1 C3 Encourage external reporting of at-risk drivers to licensing authorities 3.1 C4 Provide remedial assistance to help functionally impaired older drivers lower their crash risk
3.1 D Improve the driving competency of older adults in the general driving population	3.1 D1 Establish resource centers within communities to promote safe mobility choices 3.1 D2 Provide educational and training opportunities to the general older driver population
3.1 E Reduce the risk of injury and death to older drivers and passengers involved in crashes	3.1 E1 Increase seatbelt use by older drivers and passengers

- Limiting the use of left-hand exits,
- Providing parallel-type acceleration lanes for easier merging maneuvers, and
- Providing longer acceleration lanes to give older drivers a greater opportunity to merge.

For more information on recommended policies to better accommodate older drivers' special needs, refer to the FHWA *Older Driver Highway Design Handbook*, which can be accessed online at <http://ntl.bts.gov/DOCS/older/intro/index.html>.

Introduction

The six major areas of the AASHTO Strategic Highway Safety Plan—Drivers, Vehicles, Special Users, Highways, Emergency Medical Services, and Management—are subdivided into 22 goals, or key emphasis areas, that impact highway safety. One of these addresses the reduction of crashes and fatalities involving older drivers. This implementation guide provides engineering, planning, education, and policy guidance to highway agencies that desire to better accommodate older drivers' special needs.

Older drivers represent a subset of the driving population that deserves special attention. Aging affects a variety of skills needed for safe driving. In particular, the aging population experiences deterioration in physical, perceptual, and cognitive skills:

- Reductions in strength, flexibility, and range of motion caused by arthritis or other conditions can negatively impact driving.
- Many visual functions deteriorate with age—including static and dynamic visual acuity, contrast sensitivity, and glare sensitivity.
- Normative aging most often causes cognitive changes, such as working memory, selective attention, and processing speed.

Many highway design and traffic control elements can be improved to better meet the aging population's physical, perceptual, and cognitive needs. In addition, motor vehicle departments, highway safety offices, medical professionals, and others can join to help older adults extend their safe driving years. Both the Federal Highway Administration and the National Highway Traffic Safety Administration have developed key resource documents for this emphasis area. The U.S. Department of Transportation also recently released a planning guide entitled *Safe Mobility for a Maturing Society: Challenges and Opportunities*, which establishes the goal of creating a national transportation system that provides safe mobility to all persons at all stages of their lives.

The following guide outlines a variety of strategies that can assist state and local transportation agencies with addressing older drivers' special needs while improving safety for all road users.

SECTION III

Type of Problem Being Addressed

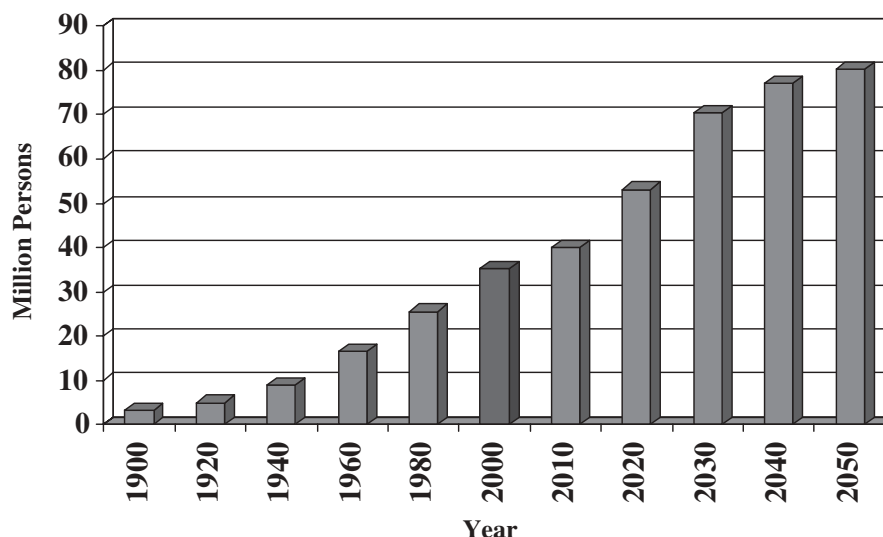
General Description of the Problem

The United States is aging—its older population will double over the next 30 years (Exhibit III-1). By 2030, one in five Americans will be 65 or older. As people age, a decline in sensory, cognitive, or physical function can make them less safe drivers, as well as more vulnerable to injury once in a crash. Yet older Americans depend on automobiles to meet their transportation needs. According to national transportation survey data, 90 percent of trips taken by older adults are by personal vehicle. Of that 90 percent, 70 percent involve the older adult driving the vehicle.

EXHIBIT III-1

Projected Growth in U.S. Population Age 65+

(Source: Administration on Aging, "A Profile of Older Americans," 2000, www.aoa.gov/prof/statistics/profile/2002/2.asp)



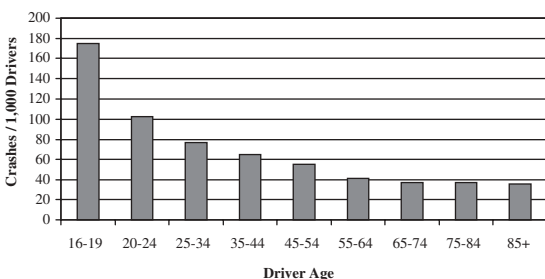
How safe are older drivers? The answer depends upon how "safety" is measured. On a licensed-driver basis, older adults are among the safest on the road (Exhibit III-2). The average annual number of crashes in the United States is 68 per 1,000 licensed drivers, while the corresponding rate for drivers aged 65 and older is only 37. The picture changes somewhat when crash rates are calculated on the basis of miles traveled. Using this measure of exposure, older adults *are* at increased crash risk (Exhibit III-3). The increase in risk is evident for 65–74 year olds, but becomes even more pronounced with increased age. Drivers age 85 and older have about the same high crash rate per mile driven as 20–24 year olds.

The real safety concern for older drivers arises when one takes into consideration their increased likelihood of being injured or killed in a crash. Compared with an overall fatality rate of 2 per 1,000 crashes, persons ages 65–74 have a fatality rate of 3.2. For those 75–84, the rate is 5.3, and at 85 and

EXHIBIT III-2

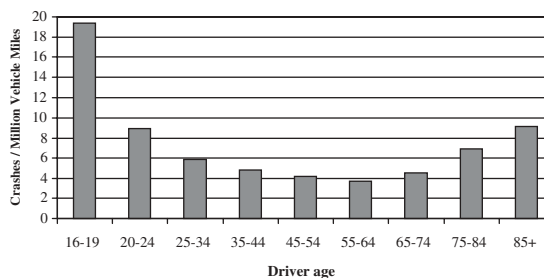
Annual Crashes per 1,000 Licensed Vehicle Drivers by Age of Driver

(Source: Cerrelli, 1998)

**EXHIBIT III-3**

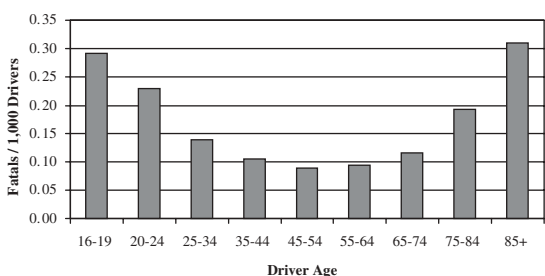
Crashes per Million Miles Traveled by Age of Driver

(Source: Cerrelli, 1998)

**EXHIBIT III-4**

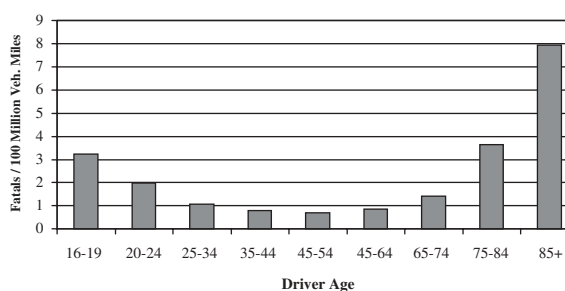
Fatalities per 1,000 Licensed Drivers by Age of Driver

(Source: Cerrelli, 1998)

**EXHIBIT III-5**

Fatalities per 100 Million Vehicle Miles Traveled by Age of Driver

(Source: Cerrelli, 1998)



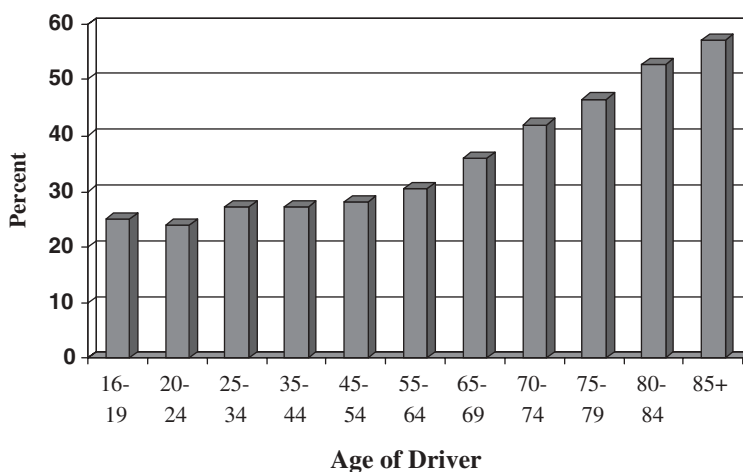
above it climbs to 8.6. If instead of measuring safety in terms of crashes per licensed driver and crashes per mile traveled, one measures it in terms of fatalities per licensed driver and fatalities per mile traveled, there is clearly cause for concern (Exhibits III-4 and III-5). Both begin to increase by age 55, and the increase is especially dramatic for persons age 85 and older.

Taken together, the data suggest that the safety problem confronting older adults is as much an issue of crash survivability as it is crash avoidance. This safety problem is not likely to improve in the future without the highway safety community's broad and concerted efforts.

Specific Attributes of the Problem

Studies have shown that compared with younger drivers, older drivers are more likely to be involved in crashes at intersections, especially when attempting a left-turn maneuver. Drivers 85 and older are more than 10 times as likely as 40–49 year olds to be in fatal multiple-vehicle crashes at intersections. Based on analysis of North Carolina crash data, older drivers are also over-represented in crashes involving right turns, U-turns, backing, starting in the roadway, and parking or leaving a parked position (Reinfurt et al., 2000). The fact that older drivers' crashes are more likely to involve angle collisions and side impacts than other age groups are likely contributors to older drivers' higher injury rates, despite the generally low speeds involved (Exhibit III-6).

EXHIBIT III-6
Of People who Died in Collisions, Percentage who Died in Angle Collisions
(Source: NHTSA, 1997)



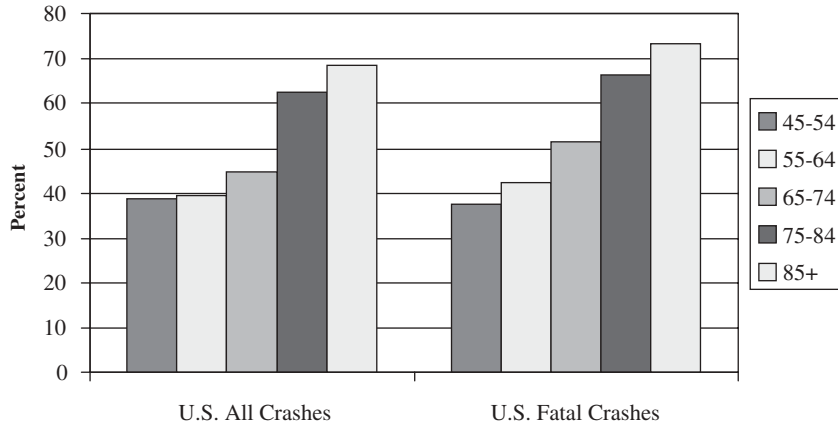
About 55 percent of people age 85 and older who died in collisions died in angle collisions. This percentage is significantly lower for younger people. Only about 25 percent of people age 16–19 who died in collisions died in angle collisions.

While much attention has been given to older drivers' higher frequency of intersection crashes, less attention has been given to their considerably lower frequency of single vehicle, run-off-roadway (ROR) crashes. Driving exposure may play an important role in both situations, since older drivers are more likely to crash at intersections and a greater proportion of their driving takes place in cities and on local streets. At the same time, older drivers may be less likely to run off the roadway, as they drive less on rural, two-lane roadways where these types of crashes typically occur.

The likelihood of being at fault in a crash has also been shown to increase with age: nearly 70 percent of drivers 75 and older involved in fatal two-vehicle crashes were at fault, compared with less than 40 percent for drivers 45–64 (Exhibit III-7). Specific crash types where older drivers are increasingly likely to be found at fault include angle collisions (usually involving two vehicles passing through an intersection on perpendicular paths), left and right turns across traffic collisions, and slowing or stopping collisions (Stewart et al., 1999). The fact that all of these collision types typically occur at intersections suggests that intersections pose problems for older drivers and that these problems do not stem merely from older drivers' being more exposed to intersection situations.

As noted above, declining functional abilities may be responsible for older drivers' increased risk of crashing. As people age, there is a decline in many of the abilities considered necessary to safely operate a motor vehicle. Older people, as a group, have reduced visual acuity, narrower visual fields, poorer nighttime vision, greater sensitivity to glare, slower reaction times, more attention deficits, reduced muscle strength, reduced flexibility and

EXHIBIT III-7
 Percent of Time Drivers Are at Fault when They Are Involved in a Two-Vehicle Crash (by Driver Age)
 (Source: Stewart et al., 1999)



range of motion, and other declines in visual, cognitive, and psychomotor function that can adversely affect driving. Older people are also more likely to suffer from chronic medical conditions and to rely on medications, both of which can result in temporary or long-term functional losses. Exhibit III-8 identifies some of the key driving-related functional abilities that have been shown to decline with age.

EXHIBIT III-8
 Key Functional Abilities Affected by Aging and Their Relationship to Driving
 (Adapted from Staplin et al., 1999)

Functional Domain	Specific Area of Functional Loss	How the Function Relates to Driving
Vision	Reduced visual acuity	Visual acuity is used to resolve fine detail; it is used to see roadway targets that have high brightness or color contrast with the surrounding background area and that have sharply defined edges, such as letters on road signs.
	Reduced visual contrast sensitivity	Contrast sensitivity allows an individual to see targets that do not differ greatly in brightness or color from the surrounding background area or that may have “fuzzy” or ill-defined edges. Examples are when the edge of the road has a worn/faded or missing edgestrip or the color of the shoulder is similar to that of the paved surface.
	Increased susceptibility to glare/slower glare recovery	An older person’s vision suffers more than that of a younger person when glare enters the eye (because of, e.g., vitreous changes in the eye associated with aging and pathology such as cataracts). The stray light masks or interferes with focal vision and lengthens the time, after exposure to the disabling effects of glare, before roadway targets can be seen as well as before the glare was introduced. At

EXHIBIT III-8 (Continued)

Key Functional Abilities Affected by Aging and Their Relationship to Driving
(Adapted from Staplin et al., 1999)

Functional Domain	Specific Area of Functional Loss	How the Function Relates to Driving
Vision (continued)		night, headlights viewed in oncoming traffic or headlights viewed in rearview mirrors produce this effect, and during the day, sun glare can cause similar problems.
	Reduced sensitivity to changes in angular size and motion	Motion detection influences judgments about an object's distance and how fast it is moving, for example, a car approaching as a driver waits to turn left at an intersection. Correct judgments of gaps in traffic for turning and merging depend strongly upon how quickly and accurately the brain can interpret changes in the size of the image that is formed on the retina at the back of the eye when his/her gaze is focused on a distant object.
	Poorer visual pattern perception and visualization of missing information	Drivers need this perceptual skill to extrapolate from only partial information, provided by a few visual elements, and to "construct" a whole image of a scene. This skill permits a driver to recognize a potential hazard when only part of it is in direct view, such as a pedestrian or another vehicle about to enter one's path from behind some obstruction.
	Less efficient visual search	Visual search abilities contribute to how fast a person can find and identify safety threats and other critical information on an ongoing basis while driving, as when a driver scans the always-changing roadway scene ahead to look for a sign, landmark, or other directional information.
Reduced area of visual attention	Visual attention relates to a portion of the visual field where a person not only is capable of seeing an object, but also can process information about it and respond quickly enough to avoid a crash if it is a traffic hazard. The risk of colliding with vehicles, pedestrians, and cyclists entering from the side of the road or at an intersection increases significantly as this area of visual attention, sometimes referred to as the "useful" or "functional" field of view, shrinks.	
Cognition	Impaired selective attention ability	A person must use selective attention continuously while driving to filter out less important events and information and to "hone in" on just those few things that are most safety critical. Though not conscious of it, drivers must constantly filter out millions of times as much sensory information as they actually use to make decisions and control their vehicles. Thus, intact selective attention abilities are essential to anticipate and respond appropriately to hazards.
	Less efficient divided attention and slower attention switching	Attentional abilities come into play when a driver must monitor and respond effectively to multiple sources of information at the same time. For example, a driver entering a freeway must track the curvature of the ramp and steer appropriately, keep a safe distance behind the car ahead, and check for gaps in traffic on the highway, while simultaneously accelerating just enough to permit a smooth entry into the traffic stream. Distractions inside and outside the vehicle may compound the problem.

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EXHIBIT III-8 (Continued)

Key Functional Abilities Affected by Aging and Their Relationship to Driving
(Adapted from Staplin et al., 1999)

Functional Domain	Specific Area of Functional Loss	How the Function Relates to Driving
Cognition <i>(continued)</i>	Less efficient working memory processes	This relates to the frequent need to think about and recall recently learned information while driving, without any lapses in safely controlling one's vehicle—for example, being able to remember and apply a simple set of navigational instructions memorized before a journey while driving in heavy traffic. A decline in this functional ability may occur gradually through normal aging processes and become sharply accelerated with the onset and progression of dementia.
Psychomotor and Physical Function	Loss of limb strength, flexibility, sensitivity, and/or range of motion Reduced ability to rotate the head and neck	Declining functionality in the limbs affects the ability to quickly shift the right foot from accelerator to brake when the situation demands, to apply correct pressure for appropriate speed control, and to safely maneuver the car through turns and around obstacles. Driving commonly requires that a driver be able to (re)direct his/her gaze in many different directions to check for potential conflicts; most obvious are the familiar "left-right-left" check before crossing an intersection and looking over one's shoulder before merging with traffic or changing lanes.

SECTION IV

Index of Strategies by Implementation Timeframe and Relative Cost

Exhibit IV-1 provides a classification of strategies according to the expected timeframe and relative cost for this emphasis area. In several cases, the implementation time will depend upon such factors as the agency’s procedures, the need for additional right-of-way, the number of stakeholders involved, policies and legislative issues, and the presence of any controversial situations. The range of costs may also vary somewhat for some of these strategies, due to many of the same factors. The estimated level of cost is for the commonly expected application of the strategy, especially one that does not involve additional right-of-way or major construction, unless it is an inherent part of the strategy.

Placement in the table below is meant to reflect costs relative to the other strategies listed for this emphasis area only. However, it is recognized that what may be a low-cost item for one agency may be a high-cost one for another. In particular, transportation departments typically operate at greater funding levels than motor vehicle departments or highway safety offices. The table below also attempts to take these differences into account. In addition, for some of the non-engineering strategies, costs may be shared among several agencies and organizations in both the public and private sectors.

EXHIBIT IV-1
Classification of Strategies

Timeframe for Implementation	Relative Cost to Implement and Operate			
	Low	Moderate	Moderate to High	High
Short (less than a year)	3.1 B1 Provide advance warning signs			
	3.1 B2 Provide advance guide signs and street name signs			
	3.1 B3 Increase size and letter height of roadway signs			
	3.1 B4 Provide all-red clearance intervals at signalized intersections			
	3.1 B5 Provide more protected left signal phases at busy intersections			

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EXHIBIT IV-1 (Continued)
Classification of Strategies

Timeframe for Implementation	Relative Cost to Implement and Operate			
	Low	Moderate	Moderate to High	High
Short (less than a year) <i>(continued)</i>	3.1 B8 Improve roadway delineation			
	3.1 E1 Increase seatbelt use of older drivers and passengers			
Medium (1–2 years)	3.1 B11 Improve traffic control at work zones	3.1 B9 Replace painted channelization with raised channelization	3.1 B6 Provide offset left-turn lanes at intersections	
	3.1 A1 Establish a broad-based coalition to plan for addressing the transportation needs of older adults	3.1 C2 Update procedures for assessing medical fitness to drive	3.1 B7 Improve lighting at intersections, horizontal curves, and railroad grade crossings	
	3.1 C1 Strengthen the role of medical advisory boards	3.1 D2 Provide educational and training opportunities to the general older driver population	3.1 B10 Reduce intersection skew angle	
	3.1 C3 Encourage external reporting of at-risk drivers to licensing authorities	3.1 D1 Establish resource centers within communities to promote safe mobility choices		
	3.1 C4 Provide remedial assistance to help functionally impaired older drivers lower their crash risk			
Long (more than 2 years)				

Description of Strategies

Objectives

The objectives for accommodating older drivers on the roadway and sustaining their proficiency are to

- Plan for an aging population,
- Improve the roadway and driving environment to better accommodate older drivers' special needs,
- Identify older drivers at increased risk of crashing and intervene,
- Improve the older adults' competency in the general driving population, and
- Reduce the risk of injury and death to older drivers and passengers involved in crashes.

Exhibit V-1 presents these objectives and related strategies for sustaining older drivers' proficiency. The following section explains the types of strategies available—either proven (P), tried (T) or experimental (E). In the case of older drivers, most identified strategies fall into the “tried” category, due to the lack of properly designed evaluations.

EXHIBIT V-1

Objectives and Strategies for Sustaining Proficiency in Older Drivers

Objectives	Strategies
3.1.A Plan for an aging population	3.1.A1 Establish a broad-based coalition to plan for addressing older adults' transportation needs (T)
3.1.B Improve the roadway and driving environment to better accommodate older drivers' special needs	3.1 B1 Provide advance warning signs (T)
	3.1 B2 Provide advance guide signs and street name signs (T)
	3.1 B3 Increase size and letter height of roadway signs (T)
	3.1 B4 Provide all-red clearance intervals at signalized intersections (T)
	3.1 B5 Provide more protected left-turn signal phases at high-volume intersections (T)
	3.1 B6 Provide offset left-turn lanes at intersections (T)
	3.1 B7 Improve lighting at intersections, horizontal curves, and railroad grade crossings (T)
	3.1 B8 Improve roadway delineation (T)
	3.1 B9 Replace painted channelization with raised channelization (P)
	3.1 B10 Reduce intersection skew angle (T)
	3.1 B11 Improve traffic control at work zones (T)

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EXHIBIT V-1 (Continued)

Objectives and Strategies for Sustaining Proficiency in Older Drivers

Objectives	Strategies
3.1.C Identify older drivers at increased risk of crashing and intervene	3.1 C1 Strengthen the role of medical advisory boards (T) 3.1 C2 Update procedures for assessing medical fitness to drive (P) 3.1 C3 Encourage external reporting of impaired drivers to licensing authorities (T) 3.1 C4 Provide remedial assistance to help functionally impaired older drivers (T)
3.1.D Improve the driving competency of older adults in the general driving population	3.1 D1 Establish resource centers within communities to promote safe mobility choices (T) 3.1 D2 Provide educational and training opportunities to the general older driver population (T)
3.1.E Reduce the risk of injury and death to older drivers and passengers involved in crashes	3.1 E1 Increase seatbelt use by older drivers and passengers (P)

Explanation of Strategy Types

The strategies in this guide were identified from a number of sources, including a literature review, contact with state and local agencies throughout the United States, and federal programs. Some of the strategies are widely used, while others are used at a state or even a local level. Some have been subjected to well-designed evaluations to prove their effectiveness. However, it was found that many strategies have not been adequately evaluated, including some widely used strategies.

The implication of the widely varying experience with these strategies, as well as the range of knowledge about their effectiveness, is that the reader should be cautious before adopting a particular strategy for implementation. To assist, the strategies have been classified into three types, each identified by letter throughout the guide:

- Proven (P):** *Those strategies that have been used in one or more locations and subjected to properly designed evaluations that show it to be effective.* These strategies may be employed with a good degree of confidence, but any application can lead to results that vary significantly from those found in previous evaluations. The attributes of the provided strategies will help the user to judge the most appropriate for his or her particular situation.
- Tried (T):** *Those strategies that have been implemented in a number of locations and that may even be accepted as standards or standard approaches, but that lack found valid evaluations.* These strategies, while in frequent or even general use, should be applied with caution, carefully considering the attributes cited in the guide and relating them to the specific conditions for which they are being considered. Implementation can proceed with some degree of assurance that a negative impact on safety is unlikely and that a positive one is very likely. It is intended that appropriate evaluations can be conducted as the experiences implementing these strategies continue under the AASHTO Strategic

Highway Safety Plan (SHSP) initiative. In this matter, effectiveness information can be accumulated to provide the user with better estimating power and to upgrade the strategy to “proven.”

- Experimental (E): *Those strategies that have been suggested and found sufficiently promising that at least one agency has considered trying them on a small scale in at least one location.* These strategies should be considered only after the others have proven inappropriate or unfeasible. Even where they are considered, their implementation should initially occur using a very controlled and limited pilot study that includes a properly designed evaluation component. Broader implementation should be considered only after careful testing and evaluations show the strategy to be effective. It is intended that as the experiences of such pilot tests are accumulated from various state and local agencies, the aggregate experience can be used to further detail the attributes of this type of strategy so that it can be upgraded to “proven.”

Related Strategies for Creating a Truly Comprehensive Approach

The strategies listed above are considered unique to problems associated with older drivers. However, to create a truly comprehensive approach to the highway safety problems associated with older drivers, related strategies should be included as candidates in any program planning process. These are five types:

- Older Driver Organizations and Involvement—Many highway safety programs can be effectively enhanced with input from older drivers and their representative organizations.

Older drivers can also provide direct input into highway agencies as focus groups or formal organizations. Since older drivers know best the types of problems they encounter in the driving environment, they could be significant assets to a highway agency’s overall safety program. As additional guides are completed for the AASHTO Strategic Highway Safety Plan, they may address the details regarding the implementation of public involvement or focus groups.

- Consideration of Older Drivers in the Planning Process—Most of the strategies in the AASHTO plan are intended for application at locations with identified safety problems. When taking a comprehensive approach, safety problems can often be avoided *prior to* a project’s construction. Specifically, design criteria that favor older drivers (e.g., right-hand exits on freeways and longer acceleration lanes) should be considered in the planning process. Thus, many highway safety programs can be effectively enhanced with consideration of older drivers in the planning process. As additional guides are completed for the AASHTO Strategic Highway Safety Plan, they may address the consideration of safety in the planning process.
- Strategies Directed at Implementing and Improving the Safety Management System—The highway safety system is fundamental to success. There should be in place a sound organizational structure and an effective decision support system, as well as infrastructure of laws, policies, etc., to monitor, control, direct, and administer a comprehensive approach to highway safety. It is important that a comprehensive program not be limited to one

jurisdiction, such as a state DOT. Local agencies often oversee most of the road system and its related safety problems. They also know best what the problems are. As additional guides are completed for the AASHTO Strategic Highway Safety Plan, they may address the details regarding the design and implementation of strategies for safety management systems.

- Strategies to Improve Emergency Medical and Trauma System Services—Treatment of injured parties at highway crashes can have a significant impact on the severity level and length of time that an individual spends in treatment. This is especially true when it comes to timely and appropriate treatment of older or severely injured persons. Thus, a basic part of a highway safety infrastructure is a well-based and comprehensive emergency care program. While the types of strategies included here are often thought of as simply support services, they can be critical to the success of a comprehensive highway safety program. Therefore, for this emphasis area especially, an effort should be made to determine if there are improvements that can be made to this aspect of the system, especially for programs focused on location (e.g., corridors) or area-specific (e.g., rural areas) issues. As additional guides are completed for the AASHTO plan, they may address the details regarding the design and implementation of emergency medical systems strategies.
- Strategies Detailed in Other Emphasis Area Guides—Any program targeted at the safety problem covered in this emphasis area should consider the inclusion of other applicable strategies covered in the crash-intervention guides for the following:
 - signalized and unsignalized intersections
 - drivers with suspended and revoked licenses
 - run-off-the-road crashes
 - horizontal curves
 - utility poles
 - pedestrians
 - unbelted drivers and occupants
 - Special Note: The Federal Highway Administration issued the *Highway Design Handbook for Older Drivers and Pedestrians* in October of 2001 (Staplin et al., 2001, <http://tfhrc.gov/humanfac/011031/coverfront.htm>). This provides a comprehensive coverage of the needs of older drivers. It also presents a series of recommendations for improving highway design to accommodate older drivers. Most roadway and engineering strategies highlighted in this guide are also discussed in the FHWA *Highway Design Handbook for Older Drivers and Pedestrians*.

Objective 3.1 A—Plan for an Aging Population

Strategy 3.1 A1: Establish a Broad-Based Coalition to Plan for Addressing the Older Adults' Transportation Needs (T)

General Description

Older adults are the fastest growing segment of the U.S. population. Over the next 30 years, the number of persons age 65+ in the United States is projected to increase from 35 million to more than 70 million. Today, one in eight persons is age 65+, but by 2030 this number is expected to swell to one in five.

In response to this dramatic population shift, the U.S. Department of Transportation recently guided efforts to develop a comprehensive plan for safe mobility for a maturing society (U.S. DOT, 2003). The plan evolved from a series of regional forums, focus groups, conferences, and stakeholder roundtables held over a period of several years. It articulated the following vision for America's future transportation system:

A transportation system that offers safe mobility to all people and allows older persons to remain independent and to age in place. Investments in highway and pedestrian infrastructure and public transportation services support independence. Medical and social service communities, transportation managers, motor vehicle administrators, and caregivers work together to extend safe driving and to offer other convenient and affordable transportation options when driving and walking must be curtailed. Public and private organizations form new partnerships to enable all citizens to enjoy **safe mobility for life**. (U.S. DOT, 2003)

The U.S. DOT document outlines specific strategies in a broad range of areas that encompass the roadway infrastructure, walkways, vehicle design, specialized vehicle systems, driver competency, public transportation services, public education, and research. The document also calls for the development of action plans at the state and local levels for addressing the safety and mobility needs of the older population.

Like the national plan, these state and local action plans need to reflect the input of a broad consortium of governmental agencies and organizations and interests in the private sector. Although state transportation departments can lead the effort, they need to create partnerships with other departments and agencies at the state, regional, and local levels. Potential collaborators include the state office on aging, area agencies on aging, law enforcement officials, state and local planners, transportation service providers, social service agencies, the medical and public health communities, the American Association of Motor Vehicle Administrators (http://www.aamva.org/drivers/drv_AgingDrivers.asp), the American Automobile Association (AAA) Foundation for Traffic Safety (<http://www.aaafoundation.org/>), the American Association of Retired Persons (AARP) (<http://www.aarp.org/drive/>), other advocacy groups, and seniors themselves. All must share in the responsibility of developing, implementing, and evaluating a comprehensive action plan to address the safety and mobility needs of the growing elderly population.

A number of states and metropolitan planning organizations have already established task forces or consortia to address the needs of older adults. The states include Arizona, California, Florida, Iowa, Maryland, and Michigan. Several of these states have also developed long-range action plans.

- The California DOT produced a comprehensive plan using the Older Adults Traffic Safety (OATS) Task Force, operated through a university center (see Appendix 1).
- The Southeast Michigan Council of Governments (SEMCOG) produced a comprehensive action plan. "Elderly Mobility and Safety: Final Plan of Action" is available on the SEMCOG website (see Appendix 2).
- A portion of the Iowa Traffic Safety Toolbox addressing older driver safety appears as Appendix 3. It was developed by the Iowa Older Driver Task Force, which also conducted focus groups to develop input (see Appendix 4).

Each of these plans was developed by a coalition of partners dedicated to addressing the safety and mobility needs of older adults. Coalitions have proven effective in addressing other highway safety concerns as well, as evidenced by Safe Community programs across the country and ongoing efforts to reduce underage drinking. Guidance on building effective coalitions is available on the National Highway Traffic Safety Administration (NHTSA) Web site at http://www.nhtsa.dot.gov/people/injury/alcohol/Community%20Guides%20HTML/Book1_CoalitionBldg.html and <http://www.nhtsa.dot.gov/people/outreach/safesobr/12qp/coalition.html>.

EXHIBIT V-2

Strategy Attributes for Establishing a Coalition and Planning for Older Adult Transportation Needs (T)

Attribute	Description
Technical Attributes	
Target	The target audience for this strategy is state departments of transportation, metropolitan planning organizations (MPOs), and local transportation and planning offices. Although other agencies and organizations should be active participants in this strategy, transportation agencies should assume primary responsibility for formulating the coalition and plan.
Expected Effectiveness	Although the plans and activities of coalition groups have not been formally evaluated, they have generated a number of positive accomplishments. However, it is still too early to judge the impact of such plans, especially in terms of reductions in older driver fatalities. Formal evaluations are needed, but it may be unfeasible to determine the direct linkage between this type of support effort and the bottom-line safety measure. Process measures, especially measures of resulting activity (i.e., the intermediate impact on the size and type of highway-safety-oriented programs implemented) of the coalition may be more appropriate.
Keys to Success	Keys to success include commitment by the state department of transportation or some other agency to lead the effort; high level, “top down” support from key stakeholders; and the ability to bring together and work with a broad cross section of individuals from other departments, agencies, and organizations. Typically, a high-level “champion” is needed within the primary agency to ensure that the process is carried through and has the proper support. The involvement and active participation of a wide array of stakeholders, representing both the public and private sectors, is also a key to success.
Potential Difficulties	The type of broad-based consortia required for this strategy may be unfamiliar to some state transportation departments, and securing widespread involvement and participation can be a challenge.
Appropriate Measures and Data	<p>Process measures of program effectiveness include the number of groups participating in the consortium, whether key stakeholders are represented, the activity level of the group, and actual adoption of practices and procedures of the targeted agencies (e.g., policies adopted, procedures altered, programs implemented).</p> <p>Effectiveness is to be ultimately measured by comparing the crash experience of groups affected by the programs, with either control populations or those not affected.</p>

EXHIBIT V-2 (Continued)

Strategy Attributes for Establishing a Coalition and Planning for Older Adult Transportation Needs (T)

Attribute	Description
Associated Needs	The primary need is for support of the consortium from the upper management in the transportation agency that takes the lead. This would include achieving commitment from other agencies, at the level of upper management, to be a continuing part of the coalition. Although consortium delegates, or their organizations, can be expected to contribute their time to the effort, funding for travel reimbursement and provision of support staff is also desirable.
Organizational and Institutional Attributes	
Organizational, Institutional and Policy Issues	A framework is needed that supports collaborative efforts by various governmental agencies. Some of the recommendations may require collaboration between government agencies or between government agencies and the private sector. Some may also require changes in policy.
Issues Affecting Implementation Timeframe	Upper management of the lead agency must provide support to an individual or individuals to help establish and lead the consortium. This is not considered to be a short-term undertaking, and various working groups of the consortium may want to maintain ongoing working relationships. The overall timeframe for the effort will be affected by what is or is not already in place at the time, as well as the goals that the consortium sets for itself.
Costs Involved	Costs should be fairly minimal, primarily involving personnel time for meetings, time for support staff, and travel for participating task force members.
Training and Other Personnel Needs	None identified.
Legislative Needs	Legislative backing can be helpful in securing adequate support and participation from key governmental agencies.
Other Key Attributes	
None identified.	

Information on Agencies or Organizations Currently Implementing the Strategy

As noted above, a number of states and MPOs have already established task forces or consortia to address the needs of older adults. They include Arizona, California, Florida, Iowa, Maryland, and Michigan. In addition, comprehensive plans are now in place in many of these states. Information on the many activities underway in Florida can be obtained by contacting Selma Sauls, Florida Department of Highway Safety and Motor Vehicles, Division of Driver Licenses, 850-487-0867. The Maryland Research Consortium activities are documented in the final reports for the Model Driver Screening and Evaluation Program project (see <http://www.nhtsa.dot.gov/people/injury/olddrive/modeldriver/>). Appendix 1 of the Volume II report contains a table of the Maryland Consortium's goals, objectives and action steps.

Objective 3.1 B—Improve the Roadway and Driving Environment to Better Accommodate Older Drivers’ Special Needs

Strategy 3.1 B1: Provide Advance Warning Signs (T)

General Description

Advance warning signs inform drivers of existing or potentially hazardous conditions on or adjacent to the roadways. Such signs require caution on the part of the driver and may call for a reduction in speed or other maneuver. Advance warning signs should be considered for the following situations:

- *Where speed may have to be reduced*—curves, grades, bumps, dips, and approaches to STOP and YIELD signs, to signals, and to railroad grade crossings.
- *Where lateral placement may have to be modified*—narrow roadways, beginnings and ends of medians, channelizing islands, reduction in the number of lanes, no passing zones, and “two-way traffic ahead” warnings.
- *Potential conflict zones*—intersections, merging areas, pedestrian and bicycle crossings, and school zones.
- *Construction and maintenance zones.*
- *Miscellaneous*—dead end streets, restricted clearances, and areas frequented by wild animals or subject to falling rocks, icing, or flooding.

Guide signs are recommended in these situations for all drivers. However, due to the slower information processing and reaction time of older drivers, it is particularly important that advance warning signs be placed well in advance of the potential hazard to provide older drivers with extra time to respond appropriately.

EXHIBIT V-3

Strategy Attributes for Providing Advance Warning Signs (T)

Attribute	Description
Technical Attributes	
Target	The targets of this strategy are roadway features that may not be anticipated or easily recognized by older adults with visual, cognitive, and/or psychomotor impairments.
Expected Effectiveness	<p>The effectiveness of this strategy in reducing crashes has not been satisfactorily quantified. Nevertheless, there is a general consensus that advanced warning signs can help reduce confusion and perception/reaction time at existing or potentially hazardous conditions on or adjacent to the roadways.</p> <p>Further research to develop safety effectiveness measures for this strategy is desirable.</p>

EXHIBIT V-3 (Continued)
Strategy Attributes for Providing Advance Warning Signs (T)

Attribute	Description
Keys to Success	<p>A key to success in applying this strategy is to identify appropriate locations and/or situations that would benefit from advance warning signs. The location is important because advance warning signs that are placed either too far or not far enough in advance of a potentially hazardous condition will make the signing less effective. Table 2C-4 in the MUTCD (http://mutcd.fhwa.dot.gov/kno-millennium.htm) presents guidelines for advance placement of warning signs relative to the type of potentially hazardous condition and the posted or 85th percentile speed on the roadway. Advance warning signs should be applied with consistency and uniformity. Engineering judgment should, where possible, be accompanied by a human factor assessment of the need for advance warning signs.</p> <p>Another key to success is the ability and commitment of the highway agency to adequately maintain the signs. Regular cleaning of signs can improve the retroreflectivity by up to 30 percent.</p> <p>Another key to success is the size of and letter height on advance warning signs. Refer to Strategy 3.1 B3 for further information on this issue.</p>
Potential Difficulties	<p>Care should be taken not to overuse advance warning signs and to place appropriate distance between the different signs. The objective is not to overload the driver with so much information that the signs become the cause of confusion and speed reduction results. Agencies should strive to use advance warning signs only where a special problem or circumstance indicates the need and to maintain a certain consistency and uniformity to the application.</p>
Appropriate Measures and Data	<p>Key process measures are the number and type of advance warning signs placed and the number of locations for which advanced signing is provided.</p> <p>Crash frequency and severity, by type, are key safety effectiveness measures. Both total crashes and crash types (by driver age group) potentially affected by the use of advance warning signs should be analyzed separately. Driver behavior (e.g., erratic maneuvers, near misses, and conflicts) may be used as surrogate safety measures. Traffic volume data are needed to represent exposure.</p>
Associated Needs	None identified.

Organizational and Institutional Attributes

Organizational, Institutional and Policy Issues	<p>Nearly any highway agency can participate in the implementation of this strategy. State highway agencies that implement this strategy may serve as a role model for local agencies, even to the extent of developing a “best practices” manual for local agencies to use in making decisions about providing advance warning signs.</p> <p>A general policy may need to be developed to provide the foundation for a long-term and consistent commitment to the strategy.</p>
Issues Affecting Implementation Timeframe	<p>This strategy does not require a long development process. Signing improvements can typically be implemented in 3 months or less. Policy development and adoption, if required, could extend the implementation period.</p>
Costs Involved	<p>Costs for implementing this strategy are nominal. An agency’s maintenance costs may increase.</p>

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EXHIBIT V-3 (Continued)

Strategy Attributes for Providing Advance Warning Signs (T)

Attribute	Description
Training and Other Personnel Needs	Training regarding use of this strategy should be provided in highway agency training courses concerning the use of traffic control devices, including the special needs of older drivers.
Legislative Needs	None identified.
Other Key Attributes	
Compatibility of Different Strategies	This strategy can be used in conjunction with most other strategies for improving safety.
Other Key Attributes to a Particular Strategy	None identified.

Information on Agencies or Organizations Currently Implementing the Strategy

Many highway agencies, including the Atlanta and Tyler Districts of TxDOT, provide advance warning signs in advance of signalized intersections (see Exhibits V-4 and V-5).

The Atlanta District of TxDOT provides innovative advance warning signs in advance of horizontal curves where a speed reduction is required (see Exhibit V-6).

EXHIBIT V-4

Advance Warning Sign in Advance of a Signalized Intersection (Atlanta District, TxDOT)



EXHIBIT V-5

Advance Warning Sign in Advance of a Signalized Intersection (Atlanta District, TxDOT)



EXHIBIT V-6

Advance Warning Sign in Advance of a Horizontal Curve (Atlanta District, TxDOT)



Strategy 3.1 B2: Provide Advance Guide Signs and Street Name Signs (T)

General Description

Guide signs inform drivers about their location and route, direct drivers to various destinations, identify roadside services and points of interest, and furnish other helpful information. Guide signs include signs for route identification, destination, interchange, and other information. Providing guide signs well in advance of a roadway decision point gives drivers additional time to make necessary lane changes and route selection decisions. This additional time is especially important for older drivers, who generally take longer to process and react to information on a sign.

Use of a supplemental street name sign with an advance warning crossroad, side road, or T-intersection sign provides older drivers with the benefit of additional decision and maneuvering time, especially if a change of one or more lanes is required prior to reaching the intersection. Older drivers have been known to exhibit excessive vehicle-braking behavior when a signal or road sign is seen. In fact, researchers have observed older drivers who stopped suddenly at or before an intersection to read street signs. This is unsafe, confusing, and disruptive to traffic following a driver who brakes for no apparent reason.

Furthermore, older drivers participating in focus groups have stated that they need more advance notice regarding upcoming cross streets to have time to decide where to turn. Providing sufficient time to allow motorists to make appropriate turning movements when approaching cross streets can improve safety and reduce congestion. Consistent street signing across political jurisdictions is also important.

EXHIBIT V-7

Strategy Attributes for Providing Advance Guide Signs and Street Name Signs

Attribute	Description
Technical Attributes	
Target	This strategy targets roadway features that older adults may not anticipate or easily recognize because of reduced or impaired visual, cognitive, and/or psychomotor skills.
Expected Effectiveness	This strategy's effectiveness in reducing crashes has not been satisfactorily quantified. FHWA is currently funding demonstration projects to evaluate its effectiveness. Further research is desirable to quantify the safety effectiveness of these techniques.
Keys to Success	A key to success in applying this strategy is to identify appropriate locations and/or situations that would benefit from advanced guide signs and street name signs. They should be applied uniformly and consistently. Engineering judgment should, where possible, be accompanied by a human factor assessment of the need for such signs. Where advance guide signs are placed upstream of interchanges, adding lane designations to the signs may enhance their effectiveness.

EXHIBIT V-7 (Continued)

Strategy Attributes for Providing Advance Guide Signs and Street Name Signs

Attribute	Description
Potential Difficulties	Another key to success is the ability and commitment of the highway agency to adequately maintain the signs. Regular sign cleaning can improve the retroreflectivity by up to 30 percent.
Appropriate Measures and Data	Care should be taken not to overuse advance guide signs and street name signs and not to inappropriately space them, as either action may cause information overload, confusion, and speed reduction.
Associated Needs	A key process measure is the number of locations where advanced guide signs and street name signs were improved. Crash frequency and severity, by type (by age group), are key safety effectiveness measures. Driver behavior (e.g., erratic maneuvers, near misses, or conflicts) may be used as surrogate safety measures. Traffic volume data are needed to represent exposure.
Organizational and Institutional Attributes	
Organizational, Institutional and Policy Issues	None identified.
Issues Affecting Implementation Timeframe	Nearly any highway agency can implement this strategy. A general policy may need to be developed to provide the foundation for a long-term and consistent commitment to the strategy.
Costs Involved	This strategy does not require a long development process. Signing improvements can typically be implemented within 3 months. Policy development and adoption, if required, could extend the implementation period.
Training and Other Personnel Needs	Costs for implementing this strategy are nominal. An agency's maintenance costs may increase. This strategy may be implemented first at higher-priority cross streets (e.g., high-speed arterials) and then at others as funds become available.
Legislative Needs	Older drivers' special needs should be included in training courses concerning the use of traffic control devices.
Other Key Attributes	
Compatibility of Different Strategies	None identified.
Other Key Attributes to a Particular Strategy	This strategy can be used in conjunction with most other strategies for improving safety.

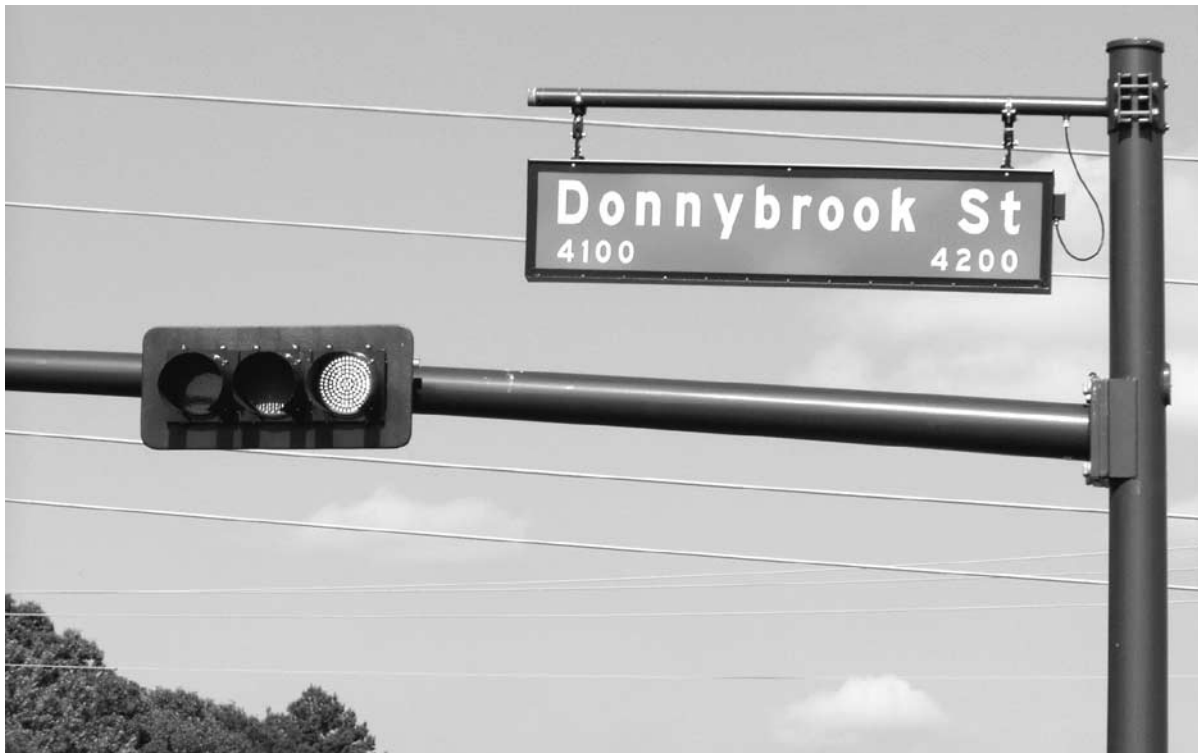
Information on Agencies or Organizations Currently Implementing the Strategy

In addition to providing advance street name signs (see Exhibit V-8), the Atlanta and Tyler Districts of TxDOT provide internally lit street name signs at many intersections (see Exhibit V-9).

EXHIBIT V-8
Advance Street Name Sign (Tyler District, TxDOT)



EXHIBIT V-9
Internally Lit Street Name Sign at Intersection (Atlanta District, TxDOT)



Strategy 3.1 B3: Increase Size and Letter Height of Roadway Signs (T)

General Description

As visual acuity declines with age, so does the ability to read roadway signs. Older drivers participating in focus groups and completing questionnaires for traffic safety researchers over the past decade have consistently stated that larger street signs with bigger lettering and standardization of sign placement overhead would make driving easier. In a laboratory simulation study, Staplin et al. (1990) found that older drivers, compared with a group of younger drivers, required larger letter sizes to discern a message on a guide sign. Increasing the letter height on roadway signs would better accommodate older drivers' reduced visual acuity.

More details regarding specific recommendations for letter height and size may be found in Appendix 5. For more information on providing larger regulatory and warning signs, see the companion guide on crashes at unsignalized intersections.

EXHIBIT V-10

Strategy Attributes for Increasing the Size and Letter Height of Roadway Signs (T)

Attribute	Description
Technical Attributes	
Target	This strategy targets roadway features that older drivers may not anticipate or easily recognize due to reduced or impaired visual, cognitive, and/or psychomotor skills.
Expected Effectiveness	This strategy's effectiveness in reducing crashes has not been satisfactorily quantified. Further research to quantify the safety effectiveness of these techniques is desirable.
Keys to Success	A key to success in applying this strategy is to select a combination of roadway signing techniques appropriate to conditions on the roadway. Engineering judgment should, where possible, be accompanied by a human factor assessment of the need to change letter heights on the signs. Another key to success is the highway agency's ability and commitment to adequately maintain the signs. Cleaning signs regularly can improve the retroreflectivity by up to 30 percent.
Potential Difficulties	Care should be taken not to overuse traffic signing, as it is likely that drivers will become accustomed to their presence and fail to respond as desired or intended. Agencies should strive to use special signing only where a specific problem or circumstance indicates the need.
Appropriate Measures and Data	A key process measure is the number of locations where larger signs and increased letter sizes were used. Crash frequency and severity, by type (by age group), are key safety effectiveness measures. Both total crashes and crash types potentially affected by the use of larger signs and lettering should be analyzed separately. Driver behavior (e.g., erratic maneuvers, near misses, or conflicts) may be used as surrogate safety measures. Traffic volume data are needed to represent exposure.
Associated Needs	None identified.

(continued on next page)

EXHIBIT V-10 (Continued)

Strategy Attributes for Increasing the Size and Letter Height of Roadway Signs (T)

Attribute	Description
<i>Organizational and Institutional Attributes</i>	
Organizational, Institutional and Policy Issues	Nearly any highway agency can implement this strategy. A general policy may need to be developed to provide the foundation for a long-term and consistent commitment to the strategy.
Issues Affecting Implementation Timeframe	This strategy does not require a long development process. Signing improvements can typically be implemented within 3 months. Policy development and adoption, if required, could extend the implementation period. One method of implementation is to incorporate larger signs as part of routine maintenance. As part of the rotation schedule, smaller signs can be replaced with larger signs. In this case, the implementation time will be whatever the cycle time is to replace all signs under an agency's regular rotation schedule.
Costs Involved	Costs for implementing this strategy are nominal. An agency's maintenance costs may increase.
Training and Other Personnel Needs	Training regarding use of this strategy should be provided in highway agency training courses concerning the use of traffic control devices, especially regarding the needs of older drivers.
Legislative Needs	None identified.
<i>Other Key Attributes</i>	
Compatibility of Different Strategies	This strategy can be used in conjunction with most other strategies for improving safety.
Other Key Attributes to a Particular Strategy	None identified.

Information on Agencies or Organizations Currently Implementing the Strategy

Phoenix, Arizona, has been using "jumbo" street name signs at intersections since 1973 because of its large older driver population. These signs are 400 mm (16 in.) high with capital lettering at 200 mm (8 in.), in contrast with the MUTCD-recommended standard sign size of 150 mm (6 in.) high and 100-mm (4-in.) lettering ("Phoenix Street Signs Big, Legible," *Rural and Urban Roads*, Vol. 11, No. 5, 1973).

TxDOT's Atlanta and Tyler Districts use "expressway size" speed limit signs on conventional highways (see Exhibit V-11). Their speed limit signs are typically 36 × 48 in., whereas the MUTCD-recommended standard size is 24 × 30 in.

The minimum STOP sign size, according to the MUTCD, is 24 × 24 in. However, the MUTCD recommends a STOP sign size of 30 × 30 in. for conventional roadways. To accommodate older drivers' declining visual acuity, the Florida DOT has decided to replace all 24 × 24 or 30 × 30 in. STOP signs with 48 × 48 in. signs. No effectiveness measures have been provided.

EXHIBIT V-11

Large (36 × 48 in.) Speed Limit Sign (Atlanta District, TxDOT)

**Strategy 3.1 B4: Provide All-Red Clearance Interval at Signalized Intersections (T)****General Description**

To accommodate older drivers' slower perception and reaction, the *Older Driver Handbook* recommends that an all-red clearance interval be consistently implemented at signalized intersections (Staplin et al., 1998). The recommendation is based on two studies that evaluated the assumptions behind the perception-reaction time used to calculate the change intervals between phases.

Tarawneh (1991) examined previous research on driver information processing to determine the best estimator of perception-reaction time for older drivers. It was determined that a signal change at an intersection is among the most extreme, in terms of both the information-processing demand and subjective feelings of stress, experienced by many older drivers. Therefore, Tarawneh called for an increase in the perception-reaction time value used to calculate the length of yellow interval from 1 to 1.5 seconds to accommodate older drivers. Knoblauch et al. (1995) compared the decision-response times and deceleration characteristics of older drivers with those of younger drivers at the onset of the yellow signal phase. The study found no significant differences in 85th percentile decision-response times between

younger and older drivers when subjects were close to the signal. However, when subjects were farther from the signal at the onset of the yellow phase, older drivers had significantly longer decision-response times than younger ones had. Knoblauch et al. concluded that no change in the yellow phase timing was required to accommodate older drivers.

Although the two studies above present conflicting conclusions, both studies recognize a higher perception-reaction time for older drivers. The *Older Driver Handbook* recommends retaining the 1-second perception-reaction time value for calculating the yellow change interval, but also providing an all-red clearance interval. The all-red clearance interval would provide sufficient time for older drivers to clear an intersection before conflicting movements begin.

Details regarding an ITE recommendation for calculating the all-red clearance interval may be found in Appendix 6.

It is important to note that signal-timing changes might affect the operational aspects of signalized intersections. The increase in clearance time may increase delay and/or affect signal progression, thereby reducing the intersection's level of service. Agencies will have to consider the potential tradeoffs before making a final decision. The TRB *Highway Capacity Manual* (HCM) can be used to determine effects on delay (<http://www.a3a10.gati.org/>).

For more information on providing all-red clearance intervals at signalized intersections, see Strategy 17.2 A2 in the companion guide on crashes at signalized intersections.

Information on Agencies or Organizations Currently Implementing the Strategy

The Wisconsin Department of Transportation implements a 4- to 5-second all-red clearance interval at signalized intersections to accommodate all drivers, including older ones.

Strategy 3.1 B5: Provide More Protected Left-Turn Signal Phases at High-Volume Intersections (P)

General Description

Accident analyses have shown that older drivers have more left-turn accidents at signalized intersections; the principal violations are failing to yield right-of-way and disregarding the signal. In addition, research has shown that the relative accident involvement ratios for older drivers were higher at signalized intersections with permitted left-turn phases than at those with protected left-turn phases.

One of the problems with permitted left-turn phases is the difficulty older drivers may have in determining acceptable gaps and maneuvering through traffic streams when there is no protective phase. Older drivers may also have difficulty understanding the rules for making permitted left turns. If the signals and markings are not understood, there at least may be delay in making a turn or, in the worst case, an accident could result if a protected operation is assumed where it does not exist.

Since older drivers have demonstrated a better understanding of the protected-only signal than of the permitted signal, its use is recommended, whenever reasonable, at high-volume intersections. Various studies have proven that installing protected left-turn phases improves left-turn safety because of the decrease in potential conflicts between left-turning and opposing through vehicles. The isolation of left-turning traffic usually reduces rear-end,

angle, and sideswipe crashes, as well as improves the flow of through traffic. A protected/ permitted left-turn phase is not expected to provide the higher degree of safety of a protected-only phase, but it is likely to be safer than a permitted-only phase.

California reported a 35-percent average reduction in total crashes when left-turn lanes were constructed and left-turn phases were implemented, as opposed to a 15-percent reduction when left-turn lanes were installed without a separate left-turn phase (Neuman, 1985). Given the wide range of conditions, a consensus on the extent of this effectiveness has not been reached.

Signal-timing changes might affect the operational aspects of signalized intersections. Providing a protected left-turn phase might reduce an individual or coordinated system's level of service. Agencies will have to consider the potential tradeoffs before making a final decision. The HCM (<http://www.a3a10.gati.org/>) can be used to determine the effect on delay and level of service.

For more information on providing more protected left-turn signal phases at high-volume intersections, see Strategy 17.2 A1 in the companion guide on crashes at signalized intersections.

Strategy 3.1 B6: Provide Offset Left-Turn Lanes at Intersections (T)

General Description

Studies examining older driver crashes and the types of maneuvers being performed just prior to the collision have consistently found that older drivers have more left-turn accidents at signalized intersections than younger drivers do. Common older driver errors include misjudging the oncoming vehicle speed, misjudging the available gap, assuming that the oncoming vehicle was going to stop or turn, and simply not seeing the other vehicle. Further, older drivers may experience greater difficulties at intersections as a result of diminished visual capabilities, such as depth and motion perception. These traits associated with older drivers can lead to collisions between vehicles turning left from the major road and through vehicles on the opposing major-road approach. To reduce the potential for crashes of this type, the left-turn lanes can be offset by moving them laterally, so that vehicles in opposing lanes no longer obstruct the opposing driver. Two treatments for offsetting turn lanes are parallel and tapered offset left-turn lanes (see Exhibit V-12).

Staplin et al. (1997) performed a laboratory study, field study, and sight distance analysis to measure driver age differences in performance under varying traffic and operating conditions as a function of varying degrees of offset or opposing left-turn lanes at suburban arterial intersections. Research findings indicated that an increase in sight distance through positively offsetting left-turn lanes can be beneficial to left-turning drivers, particularly older left-turning drivers.

While offset left-turn lanes have been used most extensively at signalized intersections, they are suitable for use at unsignalized intersections as well. Further discussion of offsets may be found in Appendix 7 and Strategy 17.1 B3 in the guide for addressing unsignalized intersection collisions.

Information on Agencies or Organizations Currently Implementing the Strategy

Exhibits V-13 and V-14 illustrate an offset left-turn lane at a signalized intersection in Wisconsin.

EXHIBIT V-12
Parallel and Offset Left-Turn Lanes (AASHTO, 2001)

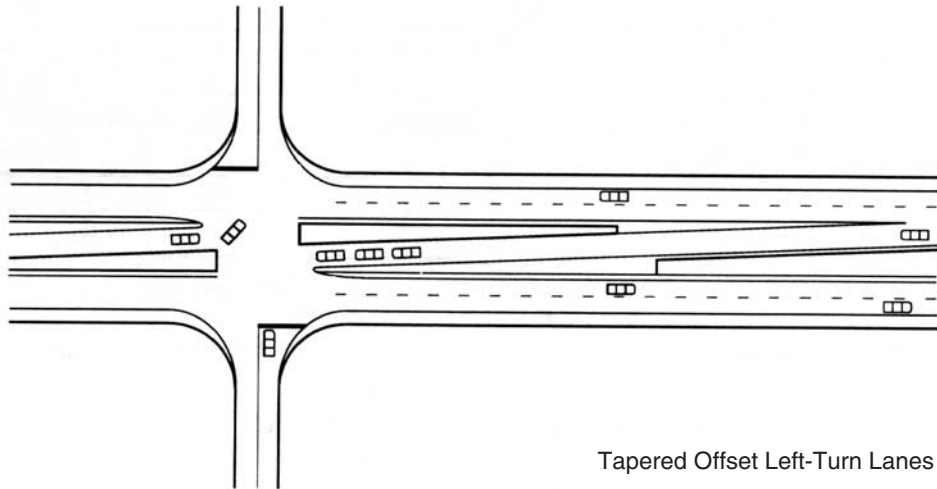
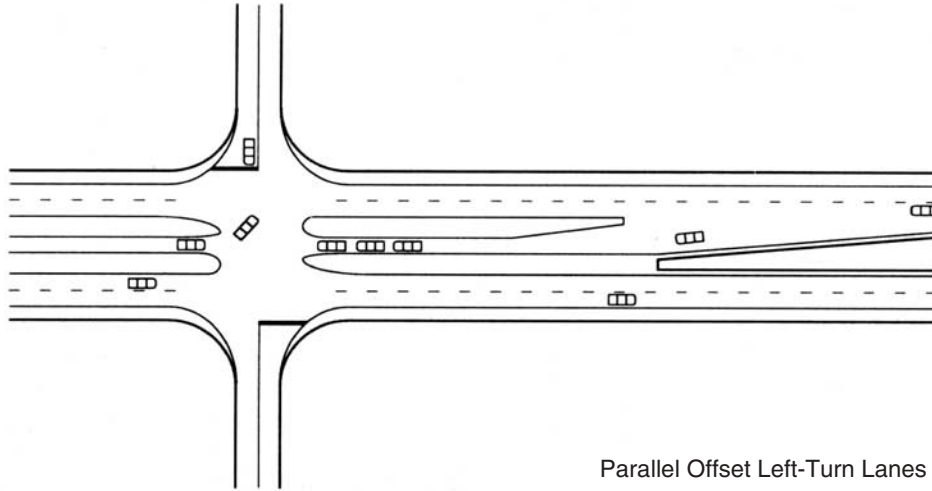


EXHIBIT V-13
Offset Left-Turn Lane (Wisconsin DOT)



EXHIBIT V-14

Improved Sight Distance Due to Offset Left-Turn Lane (Wisconsin DOT)



Strategy 3.1 B7: Improve Lighting at Intersections, Horizontal Curves, and Railroad Grade Crossings (T)

General Description

Roadway accidents at night are disproportionately higher in number and severity than during the day. However, older drivers are involved in fewer nighttime accidents than in daytime accidents. This fact may be due to a number of factors, including reduced exposure—older drivers as a group drive less at night—and a self-regulation process whereby those who drive at night are the most fit and capable to perform all functional requirements of the driving task. Although older drivers drive less at night, lighting provides a particular benefit to older drivers because visual acuity deteriorates with age. Visual acuity may, in fact, be one of the key differences between older and younger drivers. The *Older Driver Handbook* (Staplin et al., 1998) has extensively documented that an older driver's ability to safely execute a planned action is not significantly worse than that of a younger driver.

A “planned action,” however, requires that a driver have sufficient preview distance such that he can anticipate necessary vehicle maneuvers. The importance of fixed lighting for older drivers can, therefore, be understood in terms of both the reduced visual acuity and the need to prepare farther in advance for unusual or unexpected roadway elements, such as intersections, horizontal curves, and railroad grade crossings. Thus, improved lighting at these roadway elements will provide older drivers with additional preview distance and more time to prepare a planned action.

For more information on improving lighting at intersections and horizontal curves, see Strategies 17.1 E2, 17.2 D1 and 15.2 A9 in the companion guides for addressing unsignalized intersection collisions, signalized intersection collisions, and horizontal curve collisions, respectively.

Strategy 3.1 B8: Improve Roadway Delineation (T)

General Description

This strategy focuses on providing older drivers with better visual cues (e.g., pavement markings along the roadway, raised channelization at intersections, and delineators at horizontal curves) to recognize roadway elements. Recognizing roadway elements is important in order for older drivers to maintain their lane and to safely negotiate through an intersection or a horizontal curve. Older drivers tend to have reduced visual acuity, reduced field of view, increased decision time, and slower response time. These factors combine to put older drivers at greater accident risk when approaching and negotiating an intersection or a horizontal curve. Furthermore, research findings describing driver performance differences related to pavement markings and delineation focus upon age-related deficits in spatial vision.

A variety of conspicuity-enhancing treatments are mandated in current practice. The *Manual on Uniform Traffic Control* (MUTCD), for example, provides guidelines on pavement markings and delineation contrast. However, taking the MUTCD guidelines a step further by providing wider lane lines or edgelines with raised pavement markers would better accommodate older drivers' reduced visual acuity.

Making older drivers more aware of roadway elements (e.g., pavement edges, intersections, and horizontal curves) through the use of enhanced pavement markings and delineation should improve overall safety. This heightened awareness will quicken older drivers' reaction times when conflicts occur. However, this strategy's effectiveness has not been quantified.

Pavement marking and other delineation devices can wear quickly and lose their retroreflectivity with time. Keeping such delineation properly maintained or improving its durability will also accommodate older drivers' reduced visual acuity.

For more information on improving roadway visibility, see Strategies 17.1 E1 and 15.2 A2 in the companion guides for addressing unsignalized intersection collisions and horizontal curve collisions, respectively.

Information on Agencies or Organizations Currently Implementing the Strategy

The Iowa DOT conducted a focus group of older drivers and found that their most requested improvement is better pavement markings. So, improving roadway delineation is a priority of the Iowa DOT.

The Wisconsin DOT provides black contrast tape with yellow and white delineation, which has been found to be an effective tool, eliciting favorable public opinion.

The Atlanta District of TxDOT provides thermoplastic white on black striping for lane lines and edgelines (see Exhibit V-15).

EXHIBIT V-15

Thermoplastic White on Black Striping (Atlanta District, TxDOT)



Strategy 3.1 B9: Replace Painted Channelization with Raised Channelization (P)

General Description

One advantage of using raised channelization is that it gives a better indication to older drivers of the proper use of travel lanes at intersections than painted channelization gives. Raised channelization provides greater contrast and helps older drivers detect downstream geometric features, such as pavement width transitions, channelized turning lanes, and island and median features at an intersection. Older drivers' poor contrast sensitivity has been shown to relate to increased crash involvement, when incorporated into a series of vision tests that include visual acuity and horizontal visual field size.

However, older drivers may be negatively affected by a raised median if it is inadequately reflectorized. Raised channelization represents a fixed object—when struck, it poses a serious threat of loss of control, especially for aging drivers. Therefore, it is particularly important to ensure the visibility of raised surfaces for older drivers so that older drivers can detect the channelizing devices and select the paths accordingly.

A forthcoming change in accessibility policy concerning pedestrian street crossings at channelized intersections may have substantial implications for future intersection-channelization design policy.

EXHIBIT V-16

Strategy Attributes for Replacing Painted Channelization with Raised Channelization (P)

Attribute	Description
Technical Attributes	
Target	The target for this strategy should be any intersection with painted channelization where older drivers find it difficult to see the painted channelization. The strategy is particularly appropriate for intersections with patterns of crashes related to improper lane use.

(continued on next page)

EXHIBIT V-16 (Continued)

Strategy Attributes for Replacing Painted Channelization with Raised Channelization (P)

Attribute	Description
Expected Effectiveness	<p>The California Department of Public Works conducted a series of studies to investigate the difference in accident experience with raised versus painted channelization. The department found that raised traffic islands are more effective than painted islands are in reducing frequencies of night accidents, particularly in urban areas; little difference was found between raised versus painted channelizing islands at rural intersections (Neuman, 1985).</p> <p>Another study (McFarland et al., 1979) not only documents the safety benefit of left-turn channelization but also demonstrates the additional benefits of raised channelization. At unsignalized intersections with painted channelization separating the left-turn lane from the through lane, McFarland et al. found that total accident frequency was reduced for rural, suburban, and urban areas by 50, 30, and 15 percent, respectively. When raised channelization was used, the accident reductions were 60, 65, and 70 percent in rural, suburban, and urban areas, respectively.</p>
Key to Success	<p>The key to success for this strategy is to ensure the visibility of raised surfaces for older drivers so that older drivers can detect the channelizing devices and select the paths accordingly.</p> <p>If the raised channelization is reflectorized, another key to success is the ability and commitment of the highway agency to adequately maintain the reflectorization.</p>
Potential Difficulties	<p>Older drivers—having poorer vision, slower physical reaction time, less awareness, and less ability to maneuver the vehicle—may be negatively affected by a raised median (Transportation Research Board, 1991). Also, because raised medians are fixed objects, they pose serious threat of loss of control when struck, especially for older drivers.</p>
Appropriate Measures and Data	<p>Key process measures are the number of intersection approaches where painted channelization was replaced with raised channelization and the number of potential conflicts eliminated by the improvements.</p> <p>Crash frequency and severity, by type (by age group), are key safety effectiveness measures. If feasible, both total crashes and crashes related to channelization should be analyzed separately. Driver behavior (e.g., vehicle paths, erratic maneuvers, and conflicts) may be used as surrogate safety measures. Traffic volume data are needed to represent exposure.</p>
Associated Needs	None identified.

Organizational and Institutional Attributes

Organizational, Institutional and Policy Issues	Nearly any highway agency can implement this strategy.
Issues Affecting Implementation Time	This strategy does not require a long development process. Raised channelization may take from 3 months to 1 year to implement.
Costs Involved	Costs to install raised channelization may vary, but will likely be in the middle range of intersection improvements.
Training and Other Personnel Needs	Training regarding use of this strategy should be provided in highway agency courses covering the use of traffic control devices, with special emphasis on older drivers' needs.
Legislative Needs	None identified.

EXHIBIT V-16 (Continued)

Strategy Attributes for Replacing Painted Channelization with Raised Channelization (P)

Attribute	Description
Other Key Attributes	
Compatibility of Different Strategies	This strategy can be used in conjunction with most other strategies for improving the roadway and driving environment to better accommodate older drivers' special needs.
Other Key Attributes to a Particular Strategy	None identified.

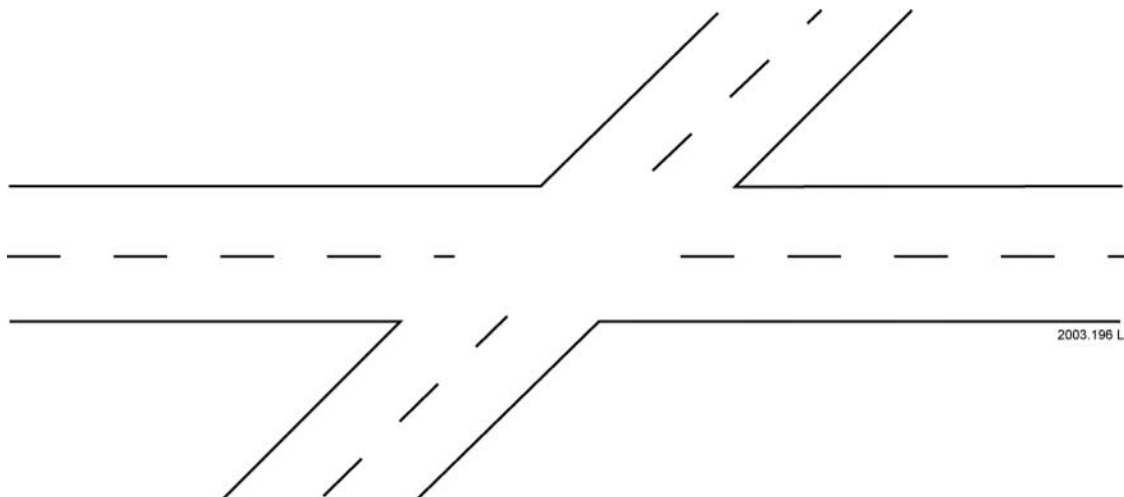
Strategy 3.1 B10: Reduce Intersection Skew Angle (T)**General Description**

Intersections where two roadways intersect at an angle of less than 60 degrees are considered skewed intersections (see Exhibit V-17).

An intersection whose skew angle is between 60 and 75 degrees is also considered undesirable. Skewed intersections pose particular problems for older drivers. Many older drivers experience a decline in head and neck mobility. A restricted range of motion reduces an older driver's ability to effectively scan to the rear and sides of his or her vehicle to observe blind spots. Therefore, older drivers' diminished physical capabilities may affect the performance at skewed intersections, where drivers must turn their heads farther than at a right-angle intersection. This obviously creates more of a problem in determining appropriate gaps.

Reducing intersection skew angle lessens the amount of head and neck rotation required of older drivers and provides a wider field of view for the driver to recognize conflicts and select appropriate gaps. Therefore, it is recommended that in the design of new facilities or

EXHIBIT V-17
Skewed Intersection



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redesign of existing facilities, intersecting roadways meet at a 90-degree angle or be skewed as little as possible.

For more information on reducing intersection skew angle, see Strategy 17.1 B16 in the guide for addressing unsignalized intersection collisions.

Strategy 3.1 B11: Improve Traffic Control at Work Zones (T)

General Description

Work zones often violate driver expectancy. Coupled with the functional deficits associated with normal aging, older drivers are at greater risk when negotiating work zones. Therefore, work zones deserve special consideration with respect to older drivers. To improve driver expectancy through a work zone, traffic control devices must provide adequate notice to drivers describing the condition ahead, the location, and the required response. Once a driver reaches the work zone, all signing, channelization, and delineation must be conspicuous and unambiguous in providing guidance through the work area.

To enhance the performance of older drivers through work zones, the *Older Driver Handbook* (<http://ntl.bts.gov/DOCS/older/intro/index.html>) provides recommendations for improved traffic control at work zones that relate specifically to the following areas:

- Advance signing for lane closures,
- Variable message sign practices,
- Channelization practices,
- Delineation of crossovers or alternative travel paths, and
- Temporary pavement markings.

Information on Agencies or Organizations Currently Implementing the Strategy

In advance of work zones, Arizona DOT provides large signs that indicate that fines will be doubled for speeding within work zones. The DOT has found this approach to be very effective in reducing speeds.

To improve the visibility of signing at work zone locations, Iowa DOT provides highly reflective orange signing with lime green contrast trim.

EXHIBIT V-18

Strategy Attributes for Improving Traffic Control at Work Zones (T)

Attribute	Description
Technical Attributes	
Target	This strategy targets work zones that violate older drivers' expectancy, given reduced or impaired visual, cognitive, and/or psychomotor abilities.
Expected Effectiveness	It is difficult to quantify the effectiveness of this strategy. However, studies have shown that more accidents occur on highway segments containing work zones than on the same segments before the work zones were installed (Staplin et al., 1998). Improving the traffic control through work zones is expected to better meet driver expectancy for older drivers and for others, which can reduce accidents.

EXHIBIT V-18 (Continued)
 Strategy Attributes for Improving Traffic Control at Work Zones (T)

Attribute	Description
Keys to Success	<p>There are several keys to this strategy's success. First, highway agencies must review their policies on work zone traffic control to identify ways to improve the policies. As indicated in the general description, the <i>Older Driver Highway Design Handbook</i> (Staplin et al., 1998, http://ntl.bts.gov/DOCS/older/rs/) provides recommendations for improving traffic control in five specific areas. Second, implementation of the improvements must be done in a consistent manner throughout all work zones in the region. Finally, maintenance of the traffic control at work zones (e.g., construction barrels and temporary striping) is key to the success of this strategy. Barrels often get moved—sometimes into the direct path of vehicles—and reflectivity of signing, striping, and other delineation treatments is not always maintained.</p>
Potential Difficulties	<p>Agencies must routinely check all traffic control devices to verify that they are conspicuous, that they are properly placed, and that they convey the intended message according to the work zone traffic control plan. With all the dust and dirt in work zones, traffic control devices can become displaced or dirty and/or lose their conspicuity, thus becoming difficult for drivers to see and interpret properly. In other cases traffic control devices may be hit by construction equipment or passing traffic and may no longer work. If a device is missing, broken, obscured, etc., the agency must act quickly to remedy the situation.</p>
Appropriate Measures and Data	<p>A key process measure is the number of work zones where improvements to the traffic control plan were identified and implemented.</p> <p>Crash frequency and severity, by type (by age group), are key safety effectiveness measures. Traffic volume data are needed to represent exposure.</p>
Associated Needs	<p>Agencies may wish to conduct a public information campaign to educate drivers on new work zone traffic control policies.</p>
Organizational and Institutional Attributes	
Organizational, Institutional and Policy Issues	<p>Agencies are encouraged to conduct a thorough review of their work zone traffic control policies. A cooperative regional effort is desired to attain consistency.</p>
Issues Affecting Implementation Timeframe	<p>Because a review of the agency's work zone traffic control policy may be required, this strategy may require several months.</p>
Costs Involved	<p>Costs to implement this strategy are expected to be minimal.</p>
Training and Other Personnel Needs	<p>Training regarding this strategy should be provided in highway agency training courses that cover the use of traffic control devices at work zones.</p>
Legislative Needs	<p>None identified.</p>
Other Key Attributes	
Compatibility of Different Strategies	<p>This strategy can be used in conjunction with most other strategies for improving safety.</p>
Other Key Attributes to a Particular Strategy	<p>None identified.</p>

Objective 3.1 C—Identify Older Drivers at Increased Risk of Crashing and Intervene

Strategy 3.1 C1: Strengthen the Role of Medical Advisory Boards (T)

General Description

According to a recent National Highway Traffic Safety Administration (NHTSA) study, 35 states and the District of Columbia have medical advisory boards (MABs), although many of the MABs are relatively inactive (Lococo, 2003). Most operate under the auspices of state transportation, public safety, or motor vehicle departments. Board members are typically nominated or appointed by the state medical association, motor vehicle administrator, or governor's office and are practicing physicians or health professionals from a variety of fields, including ophthalmology, neurology, internal medicine, cardiology, orthopedics, optometry, and psychiatry. Although MAB members are sometimes involved in the review of individual cases, they generally serve in a policy setting and/or advisory capacity.

With the growth in the older driver population, MABs in a few states have been rejuvenated to deal with the increased number and complexity of cases involving older adults with chronic medical conditions (e.g., dementia and arthritis) and general declines in functional capabilities. However, information is just now being gathered on how these boards function and how important a role they play in ensuring the competency of older drivers. In Maryland, the MAB has played a very active role in evaluating individual cases of suspected medical impairment and has helped to bring together a broad coalition of medical and nonmedical professionals to assist older adults in making appropriate driving decisions. In contrast, the California MAB, consisting of specialty panels of physicians, other health professionals, and representatives of various state agencies, is only convened when needed to make formal policy recommendations with regard to medically and functionally impaired drivers. Specially trained department of motor vehicles staff members make individual driving assessments and decisions (Raleigh and Janke, 2001; Lococo, 2003).

To better understand the role and functioning of MABs, NHTSA collaborated with the American Association of Motor Vehicle Administrators (AAMVA) to conduct a 2003 survey of all state MABs (see Lococo, 2003, available on AAMVA's Web site at <http://www.aamva.org/Documents/drvSummaryofMedicalAdvisoryBoardPractices.pdf>). The next step of the project is to identify best practices in this area. State MABs are again being surveyed to help identify the most important aspects of a medical review program. The results of this effort should provide valuable feedback to the states as well as ideas for modifying and strengthening MABs to better address older adults' safety and mobility needs.

In the meantime, states can conduct their own systematic review to determine whether their MAB can play a broader role in ensuring the safety of licensed drivers of *any age* with medical conditions or functional impairments that can compromise the ability to safely operate a motor vehicle. Where possible, information about the MAB could be posted on motor vehicle department and state medical association Web sites so that the general public, as well as the medical profession, can become better informed about the MAB's existence and role. Also, states should ensure that gerontologists and/or geriatricians are represented on the MABs.

EXHIBIT V-19**Strategy Attributes for Strengthening the Role of Medical Advisory Boards (T)**

Attribute	Description
<i>Technical Attributes</i>	
Target	The target audiences for this strategy are state departments of motor vehicles, MABs, and medical associations. The actual target of the activities is drivers of any age who experience significant declines in driving capability due to medical impairments.
Expected Effectiveness	<p>There have been no studies evaluating the effectiveness of state MABs, per se. However, a NHTSA-funded study currently underway has documented state practices with regard to MABs and is developing a report on best practices (see Lococo [2003] for the completed review of current practices). Studies have also been conducted of the effectiveness of various programs that might involve an MAB, such as required reporting of drivers with medical conditions that may adversely affect their driving or the evaluation of a program for identifying and assessing impaired older drivers. A 1986 evaluation of Pennsylvania’s “Older Driver Reexamination Program” demonstrated clear safety benefits for drivers age 60 and older (Freedman et al., 1986). Under the program, a sample of drivers, age 45 and older, were selected for retesting prior to renewing their license. For drivers age 60 and older, the program was shown to be effective in discovering medical and visual conditions requiring licensing restrictions, revocation, or remediation. In the Canadian province of Saskatchewan, drivers with identified medical conditions who participated in the Medical Review Program over 10 years (1980–1989) were found to have fewer at-fault crashes than a matched sample of nonparticipating drivers (Medgyesi and Koch, 1994).</p> <p>The MAB in Maryland, under the leadership of Dr. Robert Raleigh, has played a particularly active role in establishing and evaluating a Model Driver License Improvement Program. Information on this program is available from Staplin and Lococo (2003).</p>
Keys to Success	Anticipated keys to success include a commitment by the department of motor vehicles and the state medical association to create and support a strong and active MAB. The appointment of gerontologists, ophthalmologists, optometrists, and others who specialize in treating older adults can also help ensure that the needs of this population are addressed.
Potential Difficulties	Creating a strong and active MAB where one does not already exist is no simple task. However, the vast majority of states already have at least the basic structure in place. In these states, the greatest barrier to strengthening the program may be a lack of commitment by the motor vehicle department and state medical association. In addition, some states may lack clear guidelines for assisting MAB members in performing their function. States that rely entirely on volunteer service may experience greater difficulty in filling available positions on the MAB. Finally, the greatest difficulty may simply lie in changing the status quo, especially in states that have had relatively inactive MABs in the past.
Appropriate Measures and Data	<p>Process measures include whether an MAB is in place, the composition of the MAB, and the existence of guidelines covering its activities.</p> <p>Institutional impact measures include data on the MAB’s activities, including cases reviewed, the disposition of these cases, and assistance provided to the department of motor vehicles with regard to medical issues and driving.</p>

(continued on next page)

EXHIBIT V-19 (Continued)

Strategy Attributes for Strengthening the Role of Medical Advisory Boards (T)

Attribute	Description
Associated Needs	<p>Effectiveness is to be ultimately measured by comparing the crash experience of groups affected by the programs, either with control populations or those not affected.</p> <p>Associated needs primarily pertain to support from the department of motor vehicles and the state medical association, as well as individual physicians and other medical professionals willing to serve on the board. It may require special effort to inform department of motor vehicles personnel of the potential benefit of this strategy. Also, board members may require special training in order to carry out their new or expanded responsibilities, and these training materials will need to be developed (see training and other personnel needs below).</p>
Organizational and Institutional Attributes	
Organizational, Institutional and Policy Issues	Legislation and/or policy changes may be necessary to expand or change the MAB's role or to create an MAB where none currently exists.
Issues Affecting Implementation Timeframe	The primary issues affecting implementation time is whether resources (both financial and personnel) can be made available to the effort of evaluating and expanding/strengthening the role of the MAB and the current level of functioning of the state's MAB.
Costs Involved	Costs will vary depending on the MAB's current status and level of expertise, but should be fairly minimal.
Training and Other Personnel Needs	Physicians, ophthalmologists, and other health care professionals who are asked to serve on the state's MAB may or may not be knowledgeable of the medical aspects of driving, the impact of various medical conditions and functional impairments on driving ability, how age affects abilities related to driving, and the significance of mobility to the elderly. Education and training in all of these areas may be necessary. While the state medical association might provide some of this training, licensing personnel and members of the highway safety community could also be called upon to participate in seminars and other training opportunities. In all such training, it must be emphasized that neither age nor the diagnosis of a medical condition is sufficient for determining fitness to drive; rather, driving decisions should be based on an individual's demonstrated functional abilities related to driving (see Strategy 3.1 B2).
Legislative Needs	As noted above, in some states legislation may be needed to create an MAB where none exists or to expand the composition and/or responsibilities of an existing MAB.
Other Key Attributes	
None identified.	

Information on Agencies or Organizations Currently Implementing this Strategy

According to the most recent available data, 35 states and the District of Columbia currently have MABs; however, they appear to vary significantly in terms of composition, activity level, primary responsibilities, and modes of operation. As noted above, a NHTSA study currently underway will greatly expand knowledge of current practices and offer guidance to states on increasing the effectiveness of MABs.

Strategy 3.1 C2: Update Procedures for Assessing Medical Fitness to Drive (P)

States vary considerably with respect to how they identify and evaluate medically at-risk drivers, and they decide motorists' fitness to drive. While most states have procedures or guidelines in place for licensing persons with identified medical conditions and/or functional impairments, many of these guidelines are outdated, incomprehensive, and based on disease diagnosis rather than level of functional impairment. NHTSA has issued a report on older driver issues, including an Annotated Research Compendium of Driver Assessment Techniques for Age-Related Functional Impairments (see <http://www.nhtsa.dot.gov/people/injury/olddrive/safe/safe-toc.htm>)

The Association for the Advancement of Automotive Medicine (AAAM), working with NHTSA, recently completed a detailed literature review summarizing knowledge about various categories of medical conditions (cerebral vascular, nervous system, musculoskeletal, etc.), their prevalence, and potential impact on driving ability (Dobbs, 2002). The American Medical Association (AMA) used this report in developing a physician's guide for assessing patients' medical fitness to drive (AMA, 2003). In addition to recommendations for licensing drivers with specific medical conditions, the guide includes information on driver assessment strategies, rehabilitation options, counseling practices, and additional resources for both physician and patient.

The AMA guide is being marketed to physicians and other health professionals nationwide. Drawing from both the AMA guide and the AAAM review, it is recommended that state motor vehicle departments review and update their own guidelines for licensing persons with medical conditions and/or functional impairments. The guidelines should encompass all medical conditions known to affect driving ability and be based upon level of functional impairment rather than disease diagnosis per se. For example, rather than recommend revoking the licenses of persons diagnosed with Alzheimer's Disease (AD), the guideline might recommend that healthcare professionals periodically reevaluate AD and relate licensing decisions to patients' cognitive performance level.

As an alternative to developing their own guidelines, states might support the AAMVA in developing an updated set of national recommended guidelines for assessing medical fitness to drive and then adopt these national guidelines as their own. The benefit would be greater consistency across states, as well as economy of effort (i.e., each state does not need to "reinvent the wheel").

The resulting guidelines should be incorporated as appropriate into training materials for driver license examiners and other field representatives. State motor vehicle departments should also work with their MAB and/or state medical association to educate physicians about the guidelines and to encourage them to incorporate the AMA materials into their practices.

In addition, states that require driver's licenses to be renewed in person have further opportunities for identifying drivers *of any age* with medical conditions or functional impairments that could adversely affect their driving. In a survey of license examiners in all 50 states and the District of Columbia, how a person looks when they come through the door at the department of motor vehicles was the single most important criterion for identifying an impaired driver (Cobb and Coughlin, 1997). Earlier, Petrucelli and Malinowski (1992) had concluded that "the examiner's personal contact with the applicant is the only routine opportunity to detect potential problems of the functionally impaired driver. This opportunity should not be lost because of inadequate training."

The recently updated *Model Driver Screening and Evaluation Program: Guidelines for Motor Vehicle Administrators* (Staplin and Lococo, 2003) strongly recommends in-person license renewals with a requirement that department of motor vehicles line personnel complete a very brief checklist of structured observations. Guidelines from Wisconsin are offered as an example (see Appendix 8). These guidelines, based on visual inspection, were not judged to be discriminatory under current ADA regulations. The program also recommends that training be provided to department of motor vehicles line personnel to assist them in carrying out this responsibility.

If mail-in renewal practices are permitted, the program recommends a policy requiring third-party screening for gross impairments in relevant visual, mental, and physical abilities, along with clear guidelines for conducting, documenting, and reporting the results of these procedures to the department of motor vehicles prior to granting license renewal. The program also recommends that both in-person and mail-in renewals incorporate forms for renewal applicants to self-report medical conditions or symptoms on the license renewal application. A form used by the Utah Driver License Division is offered as an example (see Appendix 9).

EXHIBIT V-20

Strategy Attributes for Updating Procedures for Assessing Medical Fitness to Drive (P)

Attribute	Description
Technical Attributes	
Target	The target audience for this strategy is state motor vehicle departments along with state MABs and/or state medical associations.
Expected Effectiveness	<p>There have been a number of evaluations of the impact of state programs for licensing persons with medical impairments. One of the most recent is a study carried out in the state of Utah (Diller et al., 1999). Drivers in Utah are required to identify any medical problems when renewing their license and, depending upon their assigned functional ability level, may be given either an unrestricted license or a license with restrictions or be denied a license. For the recent study, rates of adverse driving events (crashes, at-fault crashes, and citations) experienced by drivers who had self-reported medical conditions and who had either restricted or unrestricted driver's licenses were compared with a sample of age- and sex-matched controls. Drivers in the medical review program were found to have only modestly elevated rates of adverse driving events compared with the matched controls, suggesting that the program was having the intended effect of lowering crash rates. In an unpublished evaluation carried out in Saskatchewan, drivers with medical conditions who were identified and placed into a medical review program were found to have lower at-fault crash rates than a control group with similar medical impairments who were not identified to licensing authorities (Medgyesi and Koch, 1994).</p> <p>Other evaluations include evaluations of medically impaired drivers in California (Waller, 1965; Janke, 1994), an evaluation of medically restricted drivers in Oklahoma (Davis et al., 1973), and an evaluation of restricted drivers in North Carolina (Popkin and Stewart, 1992). In general, these studies have shown that while identifying and placing driving restrictions on the licenses of persons with medical impairments can lower their crash risk, it still remains elevated compared with unrestricted drivers.</p>

EXHIBIT V-20 (Continued)

Strategy Attributes for Updating Procedures for Assessing Medical Fitness to Drive (P)

Attribute	Description
	In a recent California study, department of motor vehicles staff's use of structured observation methods was found to significantly increase the number of drivers identified with medical or functional impairments (Janke and Hersch, 1997).
Keys to Success	Involvement of the state medical association and/or state MAB is advisable in developing appropriate guidelines. It is critical that the guidelines be objective and based upon an individual's level of physical, mental, and/or sensory function, as opposed to disease diagnosis. Licensing personnel must also be trained in proper use of the guidelines. Provision should be made for temporary license reinstatement where appropriate to allow those affected to seek further evaluation and/or training.
Potential Difficulties	The primary difficulty is in making appropriate recommendations for licensing in the absence of firm data on the impact of certain medical conditions and related functional impairments on driving safety. Also, there may be public opposition to increased screening and/or reporting. If additional screening and/or assessment procedures are incorporated into the license renewal process, it should be recognized that these procedures may result in increased time and costs for licensing agencies.
Appropriate Measures and Data	<p>Process measures include whether a procedure is in place for reviewing and updating existing state procedures or guidelines and whether appropriate parties are involved in the process. Other process measures include whether licensing guidelines are updated to reflect current knowledge and practice and the number of licensing personnel trained in their use.</p> <p>Effectiveness can be measured in terms of the degree to which the procedures or programs in place are successful in identifying at-risk drivers, the disposition status of the identified drivers, and ultimately their involvement in crashes compared with either a control group or those not involved in the program.</p>
Associated Needs	Input and support from the medical and public health communities are needed.
Organizational and Institutional Attributes	
Organizational, Institutional, and Policy Issues	To be effective, this strategy requires that state motor vehicle departments work cooperatively with the medical community, including the state medical association and MABs. Legislative or policy changes may be needed to allow departments of motor vehicles to require in-person license renewals or to require self-reporting of potential medical impairments.
Issues Affecting Implementation Timeframe	States that already have medical guidelines and working relationships with state MABs and/or state medical associations should be able to carry out this strategy within a shorter timeframe than states lacking these resources. In addition, adequate time will be needed to train driver license examiners in implementing any new guidelines or procedures.
Costs Involved	Costs associated with updating medical guidelines primarily involve dedication of staff time to assemble the necessary participants in the review process and to develop the revised guidelines. Larger costs will likely be associated with training of licensing personnel in implementing any new guidelines or procedures and establishing a system for following up with the identified cases (for example, if a medical report or an on-road drive test is required).

(continued on next page)

EXHIBIT V-20 (Continued)

Strategy Attributes for Updating Procedures for Assessing Medical Fitness to Drive (P)

Attribute	Description
Training and Other Personnel Needs	Medical personnel may need to be involved in the initial training efforts, and some “train the trainer” programs may be needed. However, adequate guidelines should be in place so that identification of impaired drivers is incorporated into ongoing training of licensing personnel. As noted above, additional staffing may be needed to accommodate any increase in caseload as a result of implementing the new procedures for identifying at-risk drivers.
Legislative Needs	None identified.
Other Key Attributes	
None identified.	

Information on Agencies or Organizations Currently Implementing this Strategy

Most states already have guidelines in place for the licensing of medically impaired drivers. Examples of recent state guidelines include the following:

- *State of Utah Functional Ability in Driving: Guidelines and Standards for Health Care Professionals.* Utah State Driver License Medical Advisory Board. 1992. (See Appendix 9; also included as an appendix in the report by Diller et al., 1999)
- *The North Carolina Physician’s Guide to Driver Medical Evaluation.* Injury Control Section, Division of Epidemiology, North Carolina Department of Environment, Health, and Natural Resources. 1995.

In addition, both Wisconsin and Florida have guidelines for license examiners to follow in identifying potentially impaired drivers:

- *Wisconsin Driver Licensing Manual, State of Wisconsin.* Section 235 “Evaluating Medical Conditions of Disabilities.”
- *Florida Examiner’s Manual.* Chapter 9 “Medicals & Department Re-Examinations” and Chapter 11 “Restrictions/ Adaptive Equipment.”
- Staplin, L., and K. H. Lococo. *Model Driver Screening and Evaluation Program. Volume III: Guidelines for Motor Vehicle Administrators.* Final Report for NHTSA Project Number DTNH22-96-C-05140, May 2003. [Available online at <http://www.nhtsa.dot.gov/people/injury/olddrive/modeldriver/>]

Strategy 3.1 C3: Encourage External Reporting of Impaired Drivers to Licensing Authorities (T)**General Description**

In addition to identifying at-risk drivers internally, through the license renewal process, at-risk drivers can also be identified externally through reporting by physicians, law enforcement officers, and private citizens (usually either family members or friends of an

older adult). Each of these avenues for identifying high-risk drivers is briefly addressed below, as are suggestions for involvement by state motor vehicle departments.

Reporting by physicians and other medical professionals. Currently, only six states (California, Delaware, Nevada, New Jersey, Oregon, and Pennsylvania) require physicians to report patients with potential driving impairments (most often recurrent loss of consciousness) to licensing authorities; however, 31 states provide immunity from legal action to physicians who do report patients (Lococo, 2003). A recent report by the AMA Council on Ethical and Judicial Affairs clarifies the physician's role in reporting patients with physical or mental impairments that may adversely affect driving abilities (AMA, 1999; see Appendix 10). The report outlines the following conditions for reporting: (1) the patient has identified and documented impairments clearly related to the ability to drive; (2) the patient poses a clear risk to public safety; (3) alternatives to reporting, including remediation and training, driving restrictions, and patient and family counseling, are insufficient; and (4) the patient does not voluntarily comply with the physician's recommendation to discontinue driving. In these limited cases, the AMA guidelines state that "it is desirable and ethical for physicians to notify the Department of Motor Vehicles about the medical conditions that may impair safe driving to enable the Department of Motor Vehicles to determine whether or not the patient can continue to drive."

There are significant impediments to full compliance with the AMA recommendations (Staplin et al., 2003). These include the requirement that physicians be able to identify and document the physical or mental impairments clearly related to the ability to drive and the requirement that the driver must pose a clear risk to public safety. Standardized assessment tools and better guidelines are needed. The recently completed NHTSA/AAAM guidelines (Dobbs, 2002) and NHTSA's ongoing activity with the AMA (see Strategy 3.1 B2 above) should provide a stronger basis for more consistent programs across states, as well as more consistent compliance within states that have reporting laws in place. State motor vehicle departments should work with their state medical associations and MABs to educate physicians about the importance of discussing driving with their patients and advising them to self-report if the physicians feel that the patient's driving ability may be compromised. By doing this, physicians will lessen the need to report impaired drivers to state licensing authorities.

Reporting by law enforcement. With regard to reporting by law enforcement personnel, a survey of driver licensing agencies in seven states (California, Connecticut, Florida, Michigan, Oregon, Texas, and Wisconsin) indicated that 24 percent of all referrals submitted come from law enforcement officers (Sterns et al., 2001). While officers are generally not qualified to make medical judgments about an individual's ability to drive, they can be trained to recognize behavioral indicators of age-related impairments and to make appropriate referrals. NHTSA recognizes the important role that law enforcement can play in identifying high-risk older drivers and has prepared an informational pamphlet outlining various "cues" an officer should pay attention to when encountering a potentially impaired older driver (NHTSA, 1998; see Appendix 11). The cues are all performance based rather than age based. They include a lack of awareness of the current date and time, inability to communicate, stumbling over words, difficulty finding and removing one's driver license, and difficulty walking short distances. The identified cues were field tested by Florida State Troopers in Pinellas County during routine crash investigations and traffic stops. The pamphlet also offers suggestions for ways law enforcement officers can intervene to assist the impaired older driver. Since this time, a training video has been developed for law enforcement officers and distributed to highway patrol offices nationwide (Hunt, 2000), and work is underway to develop a training course specifically to address aging driver issues.

Reporting by family and friends. Finally, many states have specific systems in place for family members and friends to report potentially impaired drivers. In a survey of driver license administrators, almost all respondents indicated that it would be feasible to have a family member or friend refer a driver they felt might be impaired to the department of motor vehicles (Staplin et al., 2003). Family and friends were found to account for about 10 percent of referrals to the seven state departments of motor vehicles surveyed by Sterns et al. (2001), with family members accounting for the largest share. While reports typically cannot be made anonymously, in most situations the referral source is kept confidential. A popular view of an approach to this strategy can be found at <http://www.ec-online.net/Knowledge/Articles/safedriving.html>.

EXHIBIT V-21

Strategy Attributes for External Reporting of Drivers with Functional Impairments (T)

Attribute	Description
Technical Attributes	
Target	The target of this strategy is impaired or at-risk older drivers in the general driving population, along with the physicians and other health professionals, law enforcement officials, and/or family members who can help to identify these at-risk older drivers to licensing authorities.
Expected Effectiveness	<p>State systems to encourage reporting of impaired older drivers by physicians or other health professionals, law enforcement personnel, and private citizens have been shown to increase the number of cases reported. In Pennsylvania, reporting by physicians increased substantially in 1994 following an information campaign in which letters were sent to 46,000 physicians in the state informing them of potential legal consequences of not reporting. Currently the state processes approximately 16,000 medical referrals per year, with 49 percent of these for drivers age 45 and older. In addition, it receives approximately 2,000 reports from law enforcement personnel and 500 referrals from family members for drivers of all ages (Lococo, 2003). Oregon has also increased its number of cases reported each year to more than 5,000, with about 55 percent of these drivers age 55 and above. The Oregon referrals result from a combination of health provider, law enforcement, department of motor vehicles staff, and private citizen reporting (Sterns et al., 2001). In Missouri, “Driver Condition Report” forms are being made available at licensing offices through the state, and the form can also be downloaded from the Driver License Bureau website (http://www.dor.state.mo.us/mvdl/drivers/unsafe.htm). The Wisconsin Department of Motor Vehicles is evaluating the effectiveness of its Driver Condition/Behavior Report system for identifying high-risk drivers and improving their safety. Preliminary results of the evaluation indicate that, while the number of crashes and citations for drivers with behavior reports are still higher than those of the overall population, there is a significant reduction in incidents following submission of the reports (McCullough et al., 2001).</p>
	<p>Research has shown that traffic crashes and stops for traffic violations are the primary opportunities law enforcement officers have for making referrals (McKnight and Urquijo, 1993).</p>
	<p>The NHTSA “Cues for Law Enforcement” was field evaluated by Florida State Troopers in Pinellas County during a 1-month period in 1998 and found to offer effective guidelines for identifying potentially impaired older drivers encountered in traffic crash investigations or traffic stops (NHTSA, 1998; see Appendix 11).</p>

EXHIBIT V-21 (Continued)

Strategy Attributes for External Reporting of Drivers with Functional Impairments (T)

Attribute	Description
	Further evaluations are needed to determine the ultimate effectiveness of the strategy in reducing older-driver crashes.
Keys to Success	Keys to success include (1) having the necessary systems in place, including any needed reporting forms, (2) publicizing the systems (e.g., to physicians, at driver licensing offices, on department of motor vehicles Web sites), (3) making reports confidential (but not necessarily anonymous), (4) providing appropriate training and materials to law enforcement officers, (5) working with the MAB and state medical association to help educate physicians and other health professionals, and (6) having a system in place to follow up on the resulting referrals. Holding physicians harmless for reporting, but making them culpable for not reporting, can increase physician compliance with reporting laws.
Potential Difficulties	Potential difficulties include the logistics of educating and training physicians and law enforcement personnel and possibly opposition by some groups to reporting by private citizens (especially nonfamily members). In addition, appropriate procedures and programs need to be in place to assist individuals whose driving privileges are restricted or revoked to help counter the negative effects (both psychological and practical) for the driver.
Appropriate Measures and Data	The key process measure is the documentation of the completion of the six items listed above in “Keys to Success.” Impact measures include the number of reported cases (along with information on the source and reason for reporting and the disposition of the reported cases) and the change in crash involvement of elderly drivers.
Associated Needs	Cooperation and support of the medical community, including the state medical association, as well as the law enforcement community, are essential. Extensive public information and education programs will be needed to gain public awareness and involvement.
Organizational and Institutional Attributes	
Organizational, Institutional and Policy Issues	As noted above, this strategy requires collaboration with both the medical community and law enforcement agencies. Legislation may be needed to require physician reporting and/or to provide immunity from legal action by patients who are reported.
Issues Affecting Implementation Timeframe	The timeframe for this strategy will be affected by the extent that systems are already in place (e.g., required reporting by physicians and law enforcement reporting of impaired drivers).
Costs Involved	Costs will vary depending upon which reporting systems are used. The greatest costs may lie in training law enforcement officers and conducting a public information and education campaign. Minimal costs would be associated with reporting systems for physicians and family/friends, other than the cost of following up on the referrals.
Training and Other Personnel Needs	As noted above, both physicians and law enforcement officers will require education and training in procedures for identifying at-risk drivers.
Legislative Needs	None identified.
Other Key Attributes	
	None identified.

Information on Agencies or Organizations Currently Implementing this Strategy

The Oregon Department of Motor Vehicles has taken a comprehensive approach to addressing the safety and mobility needs of its aging driving population through its At-Risk Driver Program (requiring physician and other health provider reporting of drivers with certain cognitive or functional impairments); Volunteer Medical Program (for reporting by law enforcement and family or friends); and public outreach campaign (with the theme, “Shifting Gears in Later Years”). More information on these programs is contained in Appendix 12 and on the following Web sites:

- <http://www.odot.state.or.us/dmv/DriverLicensing/atriskquestions.htm>
- <http://www.oregonsafemobility.org>

Other sample programs and activities include the following:

- Florida’s outreach program to encourage reporting of unsafe drivers (<http://www.hsmv.state.fl.us/ddl/helpful.html>)
- Missouri’s program for reporting unsafe drivers (<http://www.dor.state.mo.us/mvdl/drivers/unsafe.htm>)
- Minnesota’s outreach efforts to encourage voluntary reporting of at-risk drivers (<http://www.dps.state.mn.us/dvs/AtRisk/AtRiskset.htm>)
- The Ocean County, New Jersey, Safe Outreach for Seniors (SOS) program for law enforcement reporting to health professionals (Howell and Macaluso, 2001)
- The Pinellas County, Florida, project with NHTSA for law enforcement reporting

Strategy 3.1 C4: Provide Remedial Assistance to Help Functionally Impaired Older Drivers (T)

General Description

This strategy builds on previous strategies under this objective and is a key element in a comprehensive program to address older adults’ safety as well as mobility needs. Given the importance of driving to maintain independence and to preserve health and quality of life, if functional deficiencies that impair driving abilities are identified and remedial options exist, remedial assistance should be made available to the driver. Remedial programs provide ideal opportunities for the public and private sectors to work together toward a common goal and for departments of motor vehicles to join with other agencies and the medical and health communities to facilitate something that the agencies could not accomplish on their own.

Driver remediation can be carried out by the department of motor vehicles, which can impose nighttime driving restrictions on drivers whose vision does not meet required standards. The department of motor vehicles can also mandate that mirrors or other adaptive equipment be added to the driver’s vehicle. If the driver’s deficiencies are more complex and/or if medical conditions are involved, the department of motor vehicles can refer the case to the MAB for its assessment and recommendation.

Options also exist beyond the department of motor vehicles. In particular, a growing number of occupational therapists are trained to evaluate and provide remedial assistance to drivers with functional impairments. While not all functional losses can be successfully treated, occupational therapists are especially well qualified to assist some older adults who otherwise might be forced to stop driving. Another option is local driving schools. Not every driving school has staff qualified to evaluate and retrain the older driver, but those that do can provide a valuable service that can potentially benefit larger numbers of older drivers. The challenge with both these options comes in how the department of motor vehicles can work cooperatively with other agencies and with the health community to promote the use of these options.

The recently completed Model Driver Screening and Evaluation Program (Staplin and Lococo, 2003; <http://www.nhtsa.dot.gov/people/injury/olddrive/modeldriver/>) recommends that states have specific guidelines in place to impose appropriate restrictions on the licenses of impaired drivers. It also encourages departments of motor vehicles to provide drivers with information on remediation options outside the department of motor vehicles and how these options can be accessed. Table 5 in the report's *Guidelines for Motor Vehicle Administrators* provides examples of licensing restrictions and adaptive equipment requirements that licensing officials can impose to help counteract physical impairments common to the elderly. Table 6 provides information on a broad range of additional remedial options to help impaired older adults drive safely longer.

The above NHTSA report also recognizes the important role that education and counseling activities can play in helping older adults to recognize potential impairments that could affect driving and to access available resources to help extend their safe driving years. Included in these activities are self-assessments guides, which also typically contain suggestions for addressing any identified deficiencies. Examples of such guides are included under Strategy 3.1 D2.

EXHIBIT V-22

Strategy Attributes for Remediating Older Driver Functional Impairments (T)

Attribute	Description
Technical Attributes	
Target	The targets of this strategy are older adults with visual, cognitive, and/or psychomotor impairments that place the adults at increased risk of crashing.
Expected Effectiveness	<p>The effectiveness of this strategy varies, depending upon the specific type of action taken for the driver. Overall effectiveness of such a program has not been studied.</p> <p>See Technical Attributes for Strategy 3.1 C2, Update Procedures for Assessing Medical Fitness to Drive, for information on the effectiveness of licensing restrictions on older driver crash rates.</p> <p>Data with respect to the effectiveness of other remediation strategies are less clear, especially since these are not carried out in driver license settings. The Model Driver Screening and Evaluation Program (Staplin and Lococo, 2003), piloted in Maryland, included driver counseling and rehabilitation as components of the model program. However, further research is needed to determine the long-term crash-reduction and mobility-enhancement benefits of the program.</p>

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EXHIBIT V-22 (Continued)

Strategy Attributes for Remediating Older Driver Functional Impairments (T)

Attribute	Description
Keys to Success	<p>A study carried out in St. Louis, Missouri, found that driver remediation through adaptive equipment and training, under the direction of an occupational therapist specially trained in driver rehabilitation, helped a significant proportion of impaired drivers (many of whom were recuperating from stroke) resume driving. At the same time, however, the evaluation process identified other drivers who were found to be unsafe, but who had no prior knowledge of their inability to drive safely (Hunt, 2000).</p> <p>Owsley (2001) reported that providing counseling and education to drivers with identified visual impairments increased driving safety by promoting greater self-regulation and by reducing driving exposure. In addition, Owsley's research has shown that cataract surgery reduces the risk of crashes by one-half, compared with older drivers who elect not to have the surgery (Owsley et al., 2002).</p> <p>Some keys to success include (1) having clear guidelines for license examiners to use in making decisions regarding the licensing of drivers with identified functional impairments (e.g., time-of-day restrictions on driving or vehicle equipment requirements), (2) having an MAB to assist in making decisions about the licensing status of drivers with more serious medical impairments, and (3) linking department of motor vehicles offices with private-sector facilities (e.g., driver rehabilitation centers, certified driving rehabilitation specialists, and local driving schools) to provide additional evaluation and remedial help when needed.</p>
Potential Difficulties	<p>Researchers have identified a number of barriers to the implementation of remedial programs for impaired older drivers (Staplin, personal communication): (1) lack of information and education (neither the public nor the health community are well informed of the resources available for assessing, referring, and treating older adults); (2) inadequate infrastructure for comprehensive program offerings for older individuals (in particular, the absence of MABs or similar units to provide overall program administration and oversight); (3) insufficient scientific/technical data to support development of better remediation practices (i.e., data linking specific remediation strategies to specific levels of risk reduction); and (4) inadequate financing and funding (both with regard to the costs of remediation to individuals and overall program funding).</p>
Appropriate Measures and Data	<p>Process measures include the number of drivers who are identified with various functional impairments and the licensing disposition of those drivers who are referred for remediation.</p> <p>Measures of program effectiveness would include the final disposition status of drivers referred for remedial assistance, and any available driving performance or crash measures for these drivers, for comparison with either control groups or with drivers not involved in the program.</p>
Associated Needs	<p>Associated needs include an active MAB or similar advisory capability and collaborations within the local community with potential service providers.</p>
Organizational and Institutional Attributes	
Organizational, Institutional and Policy Issues	<p>This strategy benefits from an active MAB to help define appropriate policies and procedures with regard to remediation of identified impairments and from collaborations with the private sector to provide needed remedial services.</p>

EXHIBIT V-22 (Continued)

Strategy Attributes for Remedying Older Driver Functional Impairments (T)

Attribute	Description
Issues Affecting Implementation Timeframe	Time requirements for implementing the strategy can vary depending upon the current status and role of the MAB, the existence and completeness of available guidelines, and prior experience in collaborating with the private sector. The strategy might initially be piloted within one or two communities.
Costs Involved	Costs would vary highly depending upon the particular program components.
Training and Other Personnel Needs	These needs would vary depending on the particular program components, but should be minimal (assuming that most of the more in-depth evaluation and remedial services are provided by the private sector rather than department of motor vehicles staff).
Legislative Needs	None identified.
Other Key Attributes	
None identified.	

Information on Agencies or Organizations Currently Implementing this Strategy

The Maryland Research Consortium profiled in Appendix 13 is strongly committed both to identifying at-risk drivers and to providing remediation and counseling where needed. The goals of its Remediation and Counseling Contributions to Safe Mobility Working Group were to (1) provide a mechanism to refer and place at-risk individuals in appropriate remedial treatments and track treatment outcomes; (2) remediate older drivers whose functional disabilities are correctable; (3) counsel older drivers faced with restriction or cessation of driving; and (4) identify mechanisms to fund evaluation, training, rehabilitation, equipment purchase, and counseling services regarding maintaining safe mobility. Another working group of the consortium addressed mobility options for individuals facing driving restriction or cessation.

Below are examples of programs offering more in-depth driver remediation services that may or may not be linked to departments of motor vehicles:

- The Tampa Bay Regional Planning Council’s “Getting in Gear” program (in cooperation with the Florida Department of Highway Safety and Motor Vehicles) [<http://www.agingcarefl.org/services/programs/gear>]
- The Ohio State University’s “Older Driver Evaluation Program” [<http://medicine.osu.edu/geriatrics/91.cfm>]
- The Maryville University, St Louis, “Community Mobility and Driving Rehabilitation Program”
- The Beth Israel Deaconess Medical Center, Boston, Massachusetts, “DriveWise” program
- The Orlando, Florida, “Adaptive Mobility Services, Inc.” [<http://www.adaptivemobility.com/>]

- The University of Alabama at Birmingham’s “Driver Assessment Clinic”
- The Sinai Rehabilitation Center, Baltimore, Maryland, “Driver Evaluation and Training Program”
- The Bryn Mawr Rehab Hospital, Malvern, Pennsylvania, “Adapted Driving Program” [http://www.mainlinehealth.org/br/article_625.asp]
- The Penn State Rehabilitation Center, Hershey, Pennsylvania, “Driver Evaluation and Training Program” [<http://www.hmc.psu.edu/rehab/services/mobility.htm>]

Objective 3.1 D—Improve the Driving Competency of Older Adults in the General Driving Population

Strategy 3.1 D1: Establish Resource Centers within Communities to Promote Safe Mobility Choices (T)

General Description

The decision to stop driving is seldom easy for older adults. Driving offers a level of freedom and independence not generally afforded by other transportation modes, and the older adult who is still capable of driving is felt to be competent and self-sufficient. Family members also struggle with the decision about whether older parents should stop driving and how the older parents will get places if they do stop driving. In most cases, there is no place to turn for advice or assistance or even for encouragement and support.

One solution that has evolved from a series of focus groups conducted in states and communities across the nation is to provide a “one-call-does-it-all” telephone number that older adults or their family members can access for assistance. Working the “one-stop hotline” are trained mobility managers who can provide guidance and assistance with all aspects of driving and transportation for seniors. The mobility managers provide information and materials to help the older adult make appropriate decisions about continuing or stopping driving and are trained to make referrals where appropriate for driving evaluations, driver rehabilitation and training, vehicle modification, etc. They are also knowledgeable about transportation options within a local community and about all aspects of trip planning. While many states and local areas may maintain lists of available transportation services, what seems to be missing is a personal mobility manager to help older adults access these services.

At the state level, the one-stop hotline can be housed within the department of motor vehicles or the state office on aging. Locally, it can be housed at driver license offices, at area agencies on aging, or even senior centers. Since many of the services and referrals are at the local level, one approach to offering such one-stop shopping is to have the actual hotline operate out of local offices, but have these programs supported by the various state agencies. For example, the state motor vehicle department makes information available on medical conditions, driving record, driver evaluation, driver training, and driver rehabilitation options; the transportation or transit department provides information about alternative transportation options; and the office on aging assists with accessing transportation services locally. Programs can operate with some paid staff, but also use volunteers, especially at the local level. The overall goal of such

programs is to assist older adults in continuing to drive as long as they can do so safely and in maintaining their mobility through other options once they are no longer capable of driving. By meeting this goal, the programs increase older driver safety as well as mobility.

In New York State, the office for the aging operates a toll-free hotline number for people to call when they need assistance with an aging driver safety situation. And in Erie County, New York, an Older Driver Family Assistance Help Network is being pilot tested for families, friends, and caregivers concerned about an aging loved one who is driving at risk. The network, with a broad public and private membership, supplies information about available services, addresses challenging family situations involving at-risk older drivers, works to identify and remove barriers to accessing services, and advocates for public policy changes (see Appendix 14).

In Florida, this strategy for promoting safe mobility is being carried a step further. Rather than just hotline telephone numbers, Senior Safety Resource Centers are being pilot tested in four communities (to be expanded to six), and a business plan is being developed for making them financially viable community undertakings. The Florida Department of Highway Safety and Motor Vehicles is serving as the lead agency in this effort. The Senior Safety Resource Centers offer tiered driving assessments (including both clinical and behind-the-wheel), as well as education and counseling regarding remediation and alternative mobility options. Florida also hopes to create a mobile resource unit that will travel to urban and rural communities across the state. A Web site is planned to publicize the centers. For more information, contact Selma Sauls from the Florida Department of Safety and Motor Vehicles at 850-487-0867 or Sauls.Selma@hsmv.state.fl.us.

Another option for a safety resource center is to host “senior fun days” to familiarize older adults with available transportation alternatives. For example, seniors might be given free bus passes and assisted in taking the bus to assorted destinations. Discount coupons at the destinations could add to the incentive to explore means of transportation other than driving.

EXHIBIT V-23

Strategy Attributes for Safe Mobility Resource Centers (T)

Attribute	Description
<i>Technical Attributes</i>	
Target	The target of this strategy is all older adults, and especially those who need to transition from driving to not driving.
Expected Effectiveness	A number of states and localities have some variation of the “one-stop mobility management” model in place. These are identified below. While none of the programs have undergone a comprehensive evaluation, all have demonstrated considerable success in terms of contacts made and positive feedback from older persons and, in some cases, family members as well. Better evaluations are needed for this strategy.
Keys to Success	The keys to success include strong collaboration between state and local department of motor vehicles offices and other agencies and departments interested in senior transportation issues, including area agencies on aging, social service departments, and private groups providing transportation services; feedback from the target audience in developing the program; and broad-based marketing of the program once it is implemented.

(continued on next page)

EXHIBIT V-23 (Continued)

Strategy Attributes for Safe Mobility Resource Centers (T)

Attribute	Description
Potential Difficulties	<p>Older adults may feel threatened by resource centers associated with the department of motor vehicles, particularly if the centers offer driving evaluations and/or referrals. Therefore, it may be best to house resource centers in less threatening environments (e.g., a senior center) and make access to services confidential and/or anonymous.</p> <p>It can be difficult to establish the necessary collaborations.</p> <p>Adequate funding may not be available to provide the level of service desired.</p> <p>At least initially, substantial public information and education efforts may be needed to publicize the resource centers.</p>
Appropriate Measures and Data	<p>The primary process measures would be the number of contacts made to the program, volume of materials distributed, the number of referrals made, etc. (i.e., services provided).</p> <p>To further evaluate program processes, information might be gathered on such matters as how the person learned about the program and how satisfied he or she was with the assistance received.</p> <p>It would be difficult to directly measure any reduction in crashes associated with this strategy. However, surrogates may be used, such as the probable reduction in crashes due to individuals no longer driving or reduced levels of driving exposure.</p>
Associated Needs	<p>Materials and resources will need to be developed. These include printed materials as well as locations where people can go for driver evaluations, training, vehicle modification, etc.</p> <p>An associated public information and education effort will be needed to market the service.</p>
Organizational and Institutional Attributes	
Organizational, Institutional and Policy Issues	This strategy depends upon cooperation between the state motor vehicle department and other agencies that might be more closely linked to transportation service providers as well as medical and rehabilitation facilities.
Issues Affecting Implementation Timeframe	Relationships with other departments and agencies and availability of existing resources will affect the implementation timeframe.
Costs Involved	Some costs would be associated with developing necessary program materials, publicizing the program, and training individuals to run the program. There may also be significant costs in staffing and housing the program, although volunteers might provide at least some staffing at the local level.
Training and Other Personnel Needs	See above. All program staff and volunteers would require some training in order to administer the program.
Legislative Needs	Although not required, supporting legislation can be beneficial to such a program.
Other Key Attributes	
None identified.	

Information on Agencies or Organizations Currently Implementing this Strategy

Example programs related to this strategy include the following:

- New York State’s “Help Network” initiative, building on the state’s “When You Are Concerned” handbook. A demonstration project in Buffalo/Erie County has involved more than 20 community agencies. The goal is to identify a lead agency in each county to serve as the initial point of contact for age-related driving questions. For further information on the Erie County Help Networks program, go to <http://www.erie.gov/depts/seniorservices/driving.phtml>.
- Florida’s Senior Safety Resource Centers, supported by the Florida Department of Highway Safety and Motor Vehicles and the Florida At-Risk Driver Council. For further information, contact Selma Sauls at 850-487-0867 or via e-mail at Sauls.Selma@hsmv.state.fl.us.
- The “Getting in Gear” program offered by the Tampa Bay Regional Planning Council/Area Agency on Aging (now part of the Florida Senior Safety Resource Centers). Information available at <http://www.agingcarefl.org/services/programs/gear>.
- The Beverly Foundation’s “Supplemental Transportation Programs (STPs) for Seniors” program designed to expand the use of community-based STPs (see <http://www.seniordrivers.org/STPs/>).

In addition, sample materials that might be used at such resource centers include the following:

- P. R. LePore. *When You Are Concerned*. 2000. [Available online at <http://aging.state.ny.us/caring/concerned/index.htm>]
- The Hartford Group. *At the Crossroads: A Guide to Alzheimer’s Disease, Dementia & Driving*. 2000. [Available online at <http://www.thehartford.com/alzheimers/>]
- The Beverly Foundation. *Supplemental Transportation Programs for Seniors*. AAA Foundation for Traffic Safety. 2001. [Available online at <http://www.seniordrivers.org/STPs/>]
- NHTSA. *Adapting Motor Vehicles for People with Disabilities* (brochure). [Available online at <http://www.nhtsa.dot.gov/cars/rules/adaptive/brochure/index.html>]

Strategy 3.1 D2: Provide Educational and Training Opportunities to the General Older Driver Population (T)

General Description

The vast majority of older drivers will not have medical conditions or functional impairments that significantly impair their driving abilities. They will not come to the attention of licensing authorities and not require the assistance of driver rehabilitation specialists. Nevertheless, their risk of crashing may be increased because of the normal physiological changes that accompany aging, including slower reaction times, poorer nighttime vision, reduced depth perception, reduced visual contrast sensitivity, and reduced ability to divide attention.

There are a number of available options for educating and training the overall population of older drivers. The most obvious is a “refresher” driving class, such as the AARP’s Driver Safety Program (formerly 55-Alive), the American Automobile Association’s (AAA’s) Safe Driving for Mature Operators Program, or the National Safety Council’s Coaching the Mature Driver Program. These courses typically involve 6–10 hours of classroom instruction and include such topics as current traffic laws and regulations, traffic situations that pose special problems for older drivers, defensive driving skills, the effects of aging on driving, and ways older adults can compensate for these changes. The AARP’s course is by far the most popular, with over 8 million drivers having taken it since 1979. Still, this translates into only a small fraction of all older drivers on the roadway. More importantly, courses such as these have not been shown to have significant safety benefits in terms of reduced crashes (although they may increase drivers’ comfort level and in some cases their overall driving exposure).

A potentially attractive, although more costly, alternative is the combining of classroom instruction with a behind-the-wheel driving evaluation and, if needed, follow-up training. This approach has been taken by the Traffic Improvement Association of Oakland County, Michigan, in updating and expanding its AAA-based course. A similar program has been sponsored by the Connecticut AAA. Although these courses are more expensive to offer because of the added one-on-one driving time, they have generated very positive comments from participants. They have not, however, been implemented on a large enough scale to allow for formal evaluation of their safety and mobility benefits.

There is also a growing body of materials designed to help older adults “self-evaluate” their driving abilities. A recent example is the “Driving Decisions Workbook” developed by researchers at the University of Michigan Transportation Research Institute (Eby et al., 2000; see Appendix 15). The Pennsylvania Department of Transportation also developed a booklet entitled, “Driving Safely As You Get Older: A Personal Guide” for distribution at driver’s license offices (Decina et al., 1999). “Drivers 55+: Check Your Own Performance” is available on the AAA Foundation for Traffic Safety Web site (<http://seniordrivers.org/>).

There is also some evidence that increased physical fitness and joint flexibility can improve the performance of older adults behind the wheel. The AAA Foundation Web site contains descriptions of exercises that can help older adults improve their range of motion. The Web site includes videos demonstrating the exercises.

Older driver safety materials of a more general nature have been developed by a wide variety of agencies and organizations in both the public and private sectors. While it is unlikely that these materials by themselves are directly responsible for reductions in crashes, they do serve to increase public awareness of issues affecting older drivers and steps that can be taken to increase safety.

State motor vehicle departments and driver license offices can make materials and information available on their Web sites and at local driver licensing offices. Materials can also be made available to other agencies and organizations (area agencies on aging, senior centers, etc.) having regular contact with older adults. At a more personal level, driver licensing examiners can be encouraged to attend gatherings of seniors to speak on issues affecting older adults.

EXHIBIT V-24

Strategy Attributes for Educating and Training the General Older Driver Population (T)

Attribute	Description
Technical Attributes	
Target	The target of this strategy is the general population of licensed older drivers (and the overall driving population as well).
Expected Effectiveness	<p>While some evaluations have been performed, much more is needed before the effectiveness of these methods can be quantified.</p> <p>Classroom “driver refresher” courses have generally not been shown to significantly reduce crash risk among program participants. A 1994 report by the California Department of Motor Vehicles concluded that completion of a Mature Driver Improvement course was not associated with a reduction in crashes (Janke, 1994). The more comprehensive driver refresher courses incorporating actual on-road driving have received very positive feedback from participants (Stuart Packard and Associates, 1999), but have not been implemented and evaluated on a broad enough scale to assess changes in crash risk.</p> <p>Efforts to increase general public awareness about aging driver issues have generally not been evaluated in terms of safety impact. However, there have been efforts to assess public response to the materials. In Pennsylvania, a research study is being carried out to determine how many older adults read and responded to their “Driving Safely As You Get Older” booklet, mailed to 3,000 drivers.</p> <p>Eby et al. (2000) developed an older driver self-evaluation instrument and were able to show that it increased older adults’ general knowledge and self-awareness and was perceived as a useful tool for generating discussions within the families of older drivers.</p>
Keys to Success	The primary key to success is getting older adults to participate in the available programs and/or to use the available materials. Programs need to be made widely available and be extensively marketed to the older driver population. Materials also need to be made widely available through avenues other than the department of motor vehicles, such as senior centers, churches, councils on aging, etc.
Potential Difficulties	The greatest difficulty would appear to be the costs involved in either creating or distributing appropriate materials and programs, as well as marketing these on a large-scale basis to the driving public.
Appropriate Measures and Data	<p>Process measures of program effectiveness include the number of drivers participating in the various programs, number of program materials distributed, etc.</p> <p>Measures of effectiveness might include survey data on changes in driving habits, adaptations to reduced abilities, increased knowledge of driving rules and regulations, etc. More direct crash-related measures might be used to compare “time-to-next-crash” or “-citation” (i.e., recidivism measures) for those exposed to the program/materials, vs. a control group.</p>
Associated Needs	Familiarity with existing materials and programs.
Organizational and Institutional Attributes	
Organizational, Institutional and Policy Issues	Most of the available programs and materials have been privately developed. Thus, there may be policy issues involved in state agencies recommending and using such programs and materials.

(continued on next page)

EXHIBIT V-24 (Continued)

Strategy Attributes for Educating and Training the General Older Driver Population (T)

Attribute	Description
Issues Affecting Implementation Timeframe	This is assumed to be an ongoing, long-term strategy.
Costs Involved	There would be costs involved in developing any needed materials, printing or producing the materials, and marketing the program to the driving public. These costs could be highly variable depending on the nature of the materials and the size of the target audience.
Training and Other Personnel Needs	None identified.
Legislative Needs	None identified.
Other Key Attributes	
None identified.	

Information on Agencies or Organizations Currently Implementing this Strategy

Pennsylvania distributes its “Driving Safely As You Get Older: A Personal Guide” at driver licensing offices statewide. The guide presents simple tests to help drivers be aware of changes in their physical or mental abilities that are likely to increase their risks when driving and identifies things older drivers can do to keep driving safely. For information on availability of the guide, contact PennDOT.

The New York State Office for the Aging produced “When You Are Concerned: A Guide for Families Concerned about the Safety of an Older Driver” and makes copies of this available upon request. Report copies can also be downloaded from the web [<http://www.aging.state.ny.us/caring/concerned>].

Florida distributes a wide variety of safety materials through its Senior Safety Resource Centers. Included is the booklet, “Is it Time to Stop Driving? Plain Talk About Driving and Memory Problems,” prepared by Ruth Tappen and Kathleen Jett at Florida Atlantic University.

Maryland DOT helped to develop “Driving Safely While Aging Gracefully” for distribution at driver license offices. [<http://www.nhtsa.dot.gov/people/injury/olddrive/Driving%20Safely%20Aging%20Web/index.html>]

Oregon DOT’s “Shifting Gears in Later Years” program (see Appendix 12) makes many resources available to older drivers and their families (see <http://www.oregonsafemobility.org/>). Also, Oregon State University, with the Pacific Northwest Extension System, produced “Driving Decisions in Later Life,” (see http://extension.oregonstate.edu/harney/FCD/driving_decisions.html)

The Illinois DOT Traffic Safety Division and the Chicago Traffic Center teamed to produce the Drive Wise, Stay Alive Mature Driver Program and, more recently, a booklet and video

entitled “Keeping the Keys—Mobility, Freedom, Choice.” Information on both can be obtained from the Chicago Traffic Center, telephone 312-603-2600.

The Hartford Group publishes *At the Crossroads: A Guide to Alzheimer’s Disease, Dementia & Driving*. 2000 [available online at <http://www.thehartford.com/alzheimers/>].

Many private groups (AAA, AARP, Alzheimer’s Association, State Farm Insurance, etc.) make materials available to the public and may allow distribution through state department of motor vehicles offices. In addition, the following materials are available from NHTSA:

- “Safe Driving for Older Adults” [<http://www.nhtsa.dot.gov/people/injury/olddrive/OlderAdultswebsite>]
- “Driving Safety While Aging Gracefully” [<http://www.nhtsa.dot.gov/people/injury/olddrive/Driving%20Safely%20Aging%20Web/index.html>]
- A series of three pamphlets for driving with macular degeneration, glaucoma, and cataracts.

Objective 3.1 E—Reduce the Risk of Injury and Death to Older Drivers and Passengers Involved in Crashes

Strategy 3.1 E1: Increase Seatbelt Use by Older Drivers and Passengers (P)

General Description

As noted in the overall description of the problem, the increased risk of older persons dying in crashes may be as much a result of their increased fragility as increased propensity to accidents. Compared with younger drivers, older drivers are four times more likely to die in a crash. This is despite the fact that their crashes generally occur at lower speeds and are less likely to involve alcohol, speed, and other exacerbating factors.

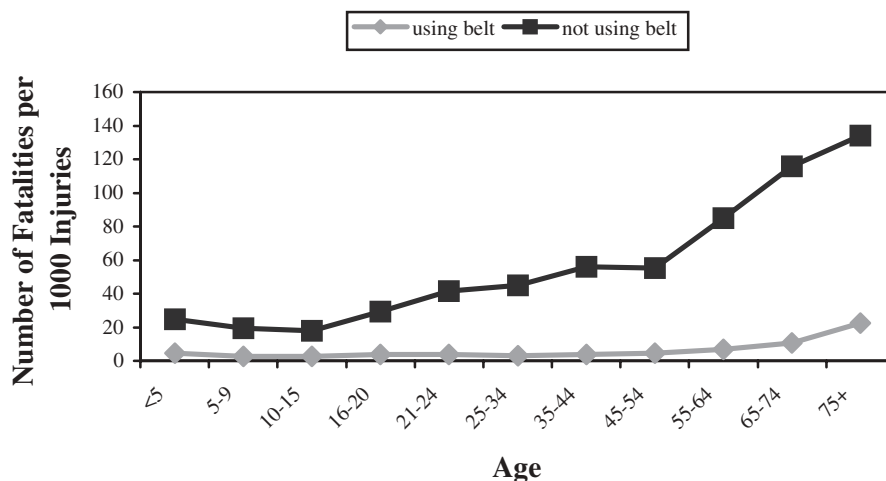
The auto industry has only recently begun paying attention to the special needs of a growing population of increasingly fragile drivers and passengers. But it will be many years before the changes being designed into new automobiles to better protect older drivers (and, in fact, *all* drivers) significantly affect the numbers of older adults dying on U.S. highways. In the meantime, getting every older driver and passenger to buckle up is a solution that can have an immediate and dramatic impact.

Seatbelt use is already high among this age group—according to the 2002 National Occupant Protection Use Survey, an estimated 82 percent of adults age 70 and older buckle up, compared with an overall population estimate of 75 percent (see Glassbrenner, 2003, for the 2003 survey results). Because the use rate is so high, agencies and organizations that typically have been involved in efforts to promote seatbelt use may be inclined to focus their efforts elsewhere. This, however, is a mistake if the goal is to reduce overall traffic fatalities. Exhibit V-25 shows that among belted occupants, the ratio of traffic fatalities to injuries remains fairly flat, rising only slightly in the oldest age groups. However, among unbelted occupants, there is a steep rise in the number of fatalities per 1,000 injuries beginning at about 55 years of age. Getting older drivers and passengers to buckle up can dramatically reduce their likelihood of dying in a crash.

EXHIBIT V-25

Fatality to Injury Ratios for Belted and Unbelted Occupants, 1999

(Source: Wagner and Gotschall, 2002)



To be most effective, efforts to increase seatbelt use among older drivers and passengers should be specially targeted to these populations. Example approaches might include educating physicians to talk to their older patients about the importance of always wearing their seatbelt and informational brochures that could be distributed through local senior centers, churches, etc. While enforcement efforts targeting older adults may not be appropriate, passage of a primary seatbelt law could prove especially beneficial in persuading the remaining noncompliant older adults to buckle up.

While seatbelt education and promotion programs have not been directed specifically at older drivers, there is enough evidence from the programs directed at the general population to suggest that a special effort of this type will be effective. However, evaluations of such specific programs are needed. The companion guide on increasing seatbelt use provides additional details.

Information on Agencies or Organizations Currently Implementing this Strategy

No state or local efforts have been identified that have specifically targeted older adults for increased seatbelt use.

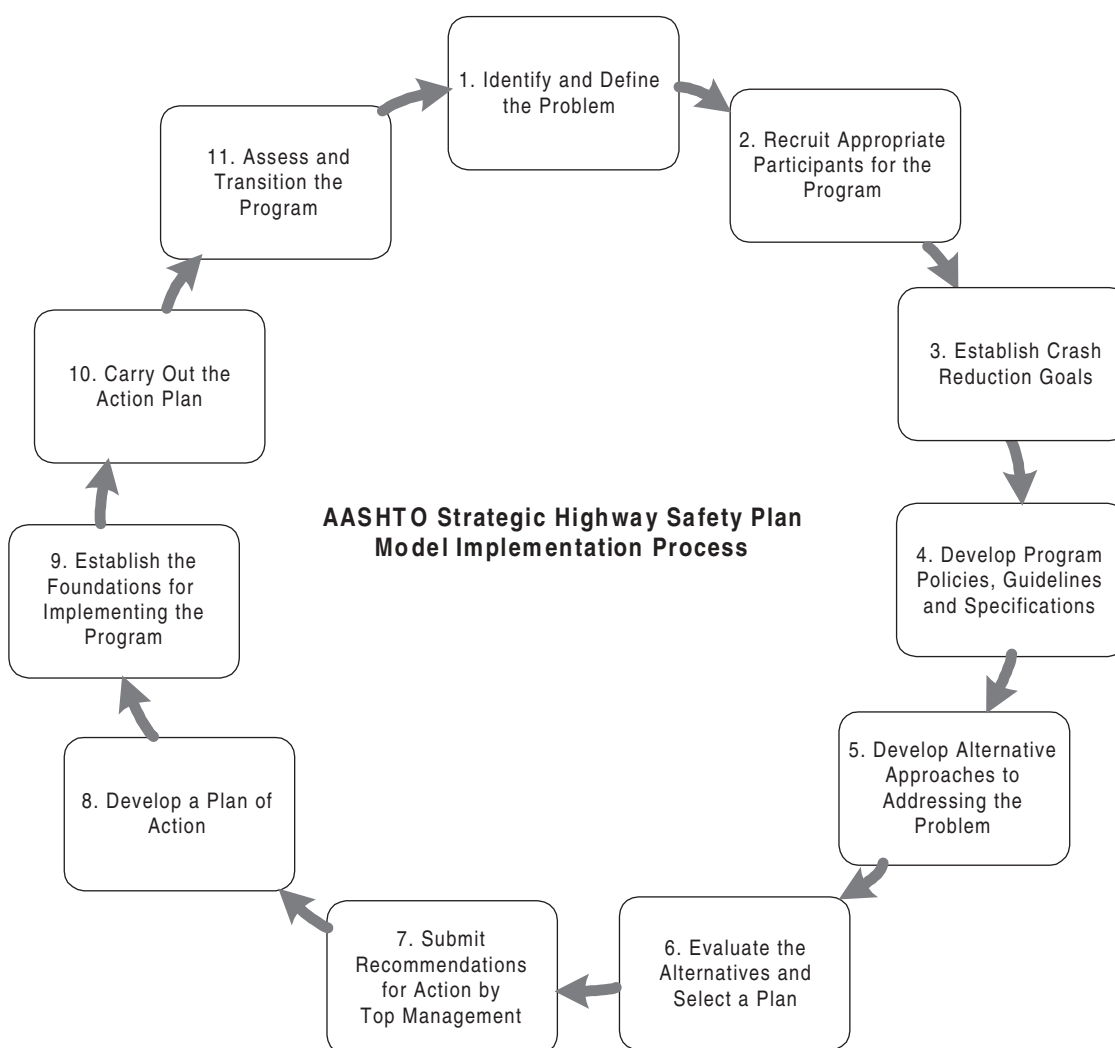
SECTION VI

Guidance for Implementation of the AASHTO Strategic Highway Safety Plan

Outline for a Model Implementation Process

Exhibit VI-1 gives an overview of an 11-step model process for implementing a program of strategies for any given emphasis area of the AASHTO Strategic Highway Safety Plan. After a short introduction, each of the steps is outlined in further detail.

EXHIBIT VI-1



Purpose of the Model Process

The process described in this section is provided as a model rather than a standard. Many users of this guide will already be working within a process established by their agency or working group. It is not suggested that their process be modified to conform to this one. However, the model process may provide a useful checklist. For those not having a standard process to follow, it is recommended that the model process be used to help establish an appropriate one for their initiative. Not all steps in the model process need to be performed at the level of detail indicated in the outlines below. The degree of detail and the amount of work required to complete some of these steps will vary widely, depending upon the situation.

It is important to understand that the process being presented here is assumed to be conducted only as a part of a broader, strategic-level safety management process. The details of that process, and its relation to this one, may be found in a companion guide. (The companion guide is a work in progress at this writing. When it is available, it will be posted online at <http://transportation1.org/safetyplan>.)

Overview of the Model Process

The process (see Exhibit VI-1, above) must be started at top levels in the lead agency's organization. This would, for example, include the CEO, DOT secretary, or chief engineer, as appropriate. Here, decisions will have been made to focus the agency's attention and resources on specific safety problems based upon the particular conditions and characteristics of the organization's roadway system. This is usually, but not always, documented as a result of the strategic-level process mentioned above. It often is publicized in the form of a "highway safety plan." Examples of what states produce include Wisconsin DOT's Strategic Highway Safety Plan (see [Appendix A](#)) and Iowa's Safety Plan (available at <http://www.iowasms.org/toolbox.htm>).

Once a "high-level" decision has been made to proceed with a particular emphasis area, the first step is to describe, in as much detail as possible, the problem that has been identified in the high-level analysis. The additional detail helps confirm to management that the problem identified in the strategic-level analysis is real and significant and that it is possible to do something about it. The added detail that this step provides to the understanding of the problem will also play an important part in identifying alternative approaches for dealing with it.

Step 1 should produce endorsement and commitments from management to proceed, at least through a planning process. With such an endorsement, it is then necessary to identify the stakeholders and define their role in the effort (Step 2). It is important at this step to identify a range of participants in the process who will be able to help formulate a comprehensive approach to the problem. The group will want to consider how it can draw upon potential actions directed at

- Driver behavior (legislation, enforcement, education, and licensing),
- Engineering,

- Emergency medical systems, and
- System management.

With the establishment of a working group, it is then possible to finalize an understanding of the nature and limitations of what needs to be done in the form of a set of program policies, guidelines, and specifications (Steps 3 and 4). An important aspect of this is establishing targets for crash reduction in the particular emphasis area (Step 3). Identifying stakeholders, defining their roles, and forming guidelines and policies are all elements of what is often referred to as “chartering the team.” In many cases, and in particular where only one or two agencies are to be involved and the issues are not complex, it may be possible to complete Steps 1 through 4 concurrently.

Having received management endorsement and chartered a project team—the foundation for the work—it is now possible to proceed with project planning. The first step in this phase (Step 5 in the overall process) is to identify alternative strategies for addressing the safety problems that have been identified while remaining faithful to the conditions established in Steps 2 through 4.

With the alternative strategies sufficiently defined, they must be evaluated against one another (Step 6) and as groups of compatible strategies (i.e., a total program). The results of the evaluation will form the recommended plan. The plan is normally submitted to the appropriate levels of management for review and input, resulting ultimately in a decision on whether and how to proceed (Step 7). Once the working group has been given approval to proceed, along with any further guidelines that may have come from management, the group can develop a detailed plan of action (Step 8). This is sometimes referred to as an “implementation” or “business” plan.

Plan implementation is covered in Steps 9 and 10. There often are underlying activities that must take place prior to implementing the action plan to form a foundation for what needs to be done (Step 9). This usually involves creating the organizational, operational, and physical infrastructure needed to succeed. The major step (Step 10) in this process involves doing what was planned. This step will in most cases require the greatest resource commitment of the agency. An important aspect of implementation involves maintaining appropriate records of costs and effectiveness to allow the plan to be evaluated after-the-fact.

Evaluating the program, after it is underway, is an important activity that is often overlooked. Management has the right to require information about costs, resources, and effectiveness. It is also likely that management will request that the development team provide recommendations about whether the program should be continued and, if so, what revisions should be made. Note that management will be deciding on the future for any single emphasis area in the context of the entire range of possible uses of the agency’s resources. Step 11 involves activities that will give the desired information to management for each emphasis area.

To summarize, the implementation of a program of strategies for an emphasis area can be characterized as an 11-step process. The steps in the process correspond closely to a 4-phase approach commonly followed by many transportation agencies:

- Endorsement and chartering of the team and project (Steps 1 through 4),
- Project planning (Steps 5 through 8),
- Plan implementation (Steps 9 and 10), and
- Plan evaluation (Step 11).

Details about each step follow. The Web-based version of this description is accompanied by a set of supplementary material to enhance and illustrate the points.

The model process is intended to provide a framework for those who need it. It is not intended to be a how-to manual. There are other documents that provide extensive detail regarding how to conduct this type of process. Some general ones are covered in [Appendix B](#) and [Appendix C](#). Others, which relate to specific aspects of the process, are referenced within the specific sections to which they apply.

Implementation Step 1: Identify and Define the Problem

General Description

Program development begins with gathering data and creating and analyzing information. The implementation process being described in this guide is one that will be done in the context of a larger strategic process. It is expected that this guide will be used when the strategic process, or a project-level analysis, has identified a potentially significant problem in this emphasis area.

Data analyses done at the strategic level normally are done with a limited amount of detail. They are usually the top layer in a “drill-down” process. Therefore, while those previous analyses should be reviewed and used as appropriate, it will often be the case that further studies are needed to completely define the issues.

It is also often the case that a core technical working group will have been formed by the lead agency to direct and carry out the process. This group can conduct the analyses required in this step, but should seek, as soon as possible, to involve any other stakeholders who may desire to provide input to this process. Step 2 deals further with the organization of the working group.

The objectives of this first step are as follows:

1. Confirm that a problem exists in this emphasis area.
2. Detail the characteristics of the problem to allow identification of likely approaches for eliminating or reducing it.
3. Confirm with management, given the new information, that the planning and implementation process should proceed.

The objectives will entail locating the best available data and analyzing them to highlight either geographic concentrations of the problem or over-representation of the problem within the population being studied.

Identification of existing problems is a *responsive approach*. This can be complemented by a *proactive approach* that seeks to identify potentially hazardous conditions or populations.

For the responsive type of analyses, one generally begins with basic crash records that are maintained by agencies within the jurisdiction. This is usually combined, where feasible, with other safety data maintained by one or more agencies. The other data could include

- Roadway inventory,
- Driver records (enforcement, licensing, courts), or
- Emergency medical service and trauma center data.

To have the desired level of impact on highway safety, it is important to consider the highway system as a whole. Where multiple jurisdictions are responsible for various parts of the system, they should all be included in the analysis, wherever possible. The best example of this is a state plan for highway safety that includes consideration of the extensive

mileage administered by local agencies. To accomplish problem identification in this manner will require a cooperative, coordinated process. For further discussion on the problem identification process, see [Appendix D](#) and the further references contained therein.

In some cases, very limited data are available for a portion of the roads in the jurisdiction. This can occur for a local road maintained by a state or with a local agency that has very limited resources for maintaining major databases. Lack of data is a serious limitation to this process, but must be dealt with. It may be that for a specific study, special data collection efforts can be included as part of the project funding. While crash records may be maintained for most of the roads in the system, the level of detail, such as good location information, may be quite limited. It is useful to draw upon local knowledge to supplement data, including

- Local law enforcement,
- State district and maintenance engineers,
- Local engineering staff, and
- Local residents and road users.

These sources of information may provide useful insights for identifying hazardous locations. In addition, local transportation agencies may be able to provide supplementary data from their archives. Finally, some of the proactive approaches mentioned below may be used where good records are not available.

Maximum effectiveness often calls for going beyond data in the files to include special supplemental data collected on crashes, behavioral data, site inventories, and citizen input. Analyses should reflect the use of statistical methods that are currently recognized as valid within the profession.

Proactive elements could include

- Changes to policies, design guides, design criteria, and specifications based upon research and experience;
- Retrofitting existing sites or highway elements to conform to updated criteria (perhaps with an appropriate priority scheme);
- Taking advantage of lessons learned from previous projects;
- Road safety audits, including on-site visits;
- Safety management based on roadway inventories;
- Input from police officers and road users; and
- Input from experts through such programs as the NHTSA traffic records assessment team.

The result of this step is normally a report that includes tables and graphs that clearly demonstrate the types of problems and detail some of their key characteristics. Such reports

should be presented in a manner to allow top management to quickly grasp the key findings and help them decide which of the emphasis areas should be pursued further, and at what level of funding. However, the report must also document the detailed work that has been done, so that those who do the later stages of work will have the necessary background.

Specific Elements

1. Define the scope of the analysis
 - 1.1. All crashes in the entire jurisdiction
 - 1.2. A subset of crash types (whose characteristics suggest they are treatable, using strategies from the emphasis area)
 - 1.3. A portion of the jurisdiction
 - 1.4. A portion of the population (whose attributes suggest they are treatable using strategies from the emphasis area)
2. Define safety measures to be used for responsive analyses
 - 2.1. Crash measures
 - 2.1.1. Frequency (all crashes or by crash type)
 - 2.1.2. Measures of exposure
 - 2.1.3. Decide on role of frequency versus rates
 - 2.2. Behavioral measures
 - 2.2.1. Conflicts
 - 2.2.2. Erratic maneuvers
 - 2.2.3. Illegal maneuvers
 - 2.2.4. Aggressive actions
 - 2.2.5. Speed
 - 2.3. Other measures
 - 2.3.1. Citizen complaints
 - 2.3.2. Marks or damage on roadway and appurtenances, as well as crash debris
3. Define measures for proactive analyses
 - 3.1. Comparison with updated and changed policies, design guides, design criteria, and specifications
 - 3.2. Conditions related to lessons learned from previous projects
 - 3.3. Hazard indices or risk analyses calculated using data from roadway inventories to input to risk-based models
 - 3.4. Input from police officers and road users
4. Collect data
 - 4.1. Data on record (e.g., crash records, roadway inventory, medical data, driver-licensing data, citations, other)
 - 4.2. Field data (e.g., supplementary crash and inventory data, behavioral observations, operational data)
 - 4.3. Use of road safety audits, or adaptations
5. Analyze data
 - 5.1. Data plots (charts, tables, and maps) to identify possible patterns, and concentrations (See [Appendixes Y, Z](#) and [AA](#) for examples of what some states are doing)

- 5.2. Statistical analysis (high-hazard locations, over-representation of contributing circumstances, crash types, conditions, and populations)
- 5.3. Use expertise, through road safety audits or program assessment teams
- 5.4. Focus upon key attributes for which action is feasible:
 - 5.4.1. Factors potentially contributing to the problems
 - 5.4.2. Specific populations contributing to, and affected by, the problems
 - 5.4.3. Those parts of the system contributing to a large portion of the problem
6. Report results and receive approval to pursue solutions to identified problems (*approvals being sought here are primarily a confirmation of the need to proceed and likely levels of resources required*)
 - 6.1. Sort problems by type
 - 6.1.1. Portion of the total problem
 - 6.1.2. Vehicle, highway/environment, enforcement, education, other driver actions, emergency medical system, legislation, and system management
 - 6.1.3. According to applicable funding programs
 - 6.1.4. According to political jurisdictions
 - 6.2. Preliminary listing of the types of strategies that might be applicable
 - 6.3. Order-of-magnitude estimates of time and cost to prepare implementation plan
 - 6.4. Listing of agencies that should be involved, and their potential roles (including an outline of the organizational framework intended for the working group). Go to Step 2 for more on this.

Implementation Step 2: Recruit Appropriate Participants for the Program

General Description

A critical early step in the implementation process is to engage all the stakeholders that may be encompassed within the scope of the planned program. The stakeholders may be from outside agencies (e.g., state patrol, county governments, or citizen groups). One criterion for participation is if the agency or individual will help ensure a comprehensive view of the problem and potential strategies for its resolution. If there is an existing structure (e.g., a State Safety Management System Committee) of stakeholders for conducting strategic planning, it is important to relate to this, and build on it, for addressing the detailed considerations of the particular emphasis area.

There may be some situations within the emphasis area for which no other stakeholders may be involved other than the lead agency and the road users. However, in most cases, careful consideration of the issues will reveal a number of potential stakeholders to possibly be involved. Furthermore, it is usually the case that a potential program will proceed better in the organizational and institutional setting if a high-level “champion” is found in the lead agency to support the effort and act as a key liaison with other stakeholders.

Stakeholders should already have been identified in the previous step, at least at a level to allow decision makers to know whose cooperation is needed, and what their potential level of involvement might be. During this step, the lead agency should contact the key individuals in each of the external agencies to elicit their participation and cooperation. This will require identifying the right office or organizational unit, and the appropriate people in each case. It will include providing them with a brief overview document and outlining for them the type of involvement envisioned. This may typically involve developing interagency agreements. The participation and cooperation of each agency should be secured to ensure program success.

Lists of appropriate candidates for the stakeholder groups are recorded in [Appendix K](#). In addition, reference may be made to the NHTSA document at <http://www.nhtsa.dot.gov/safecommunities/SAFE%20COMM%20Html/index.html>, which provides guidance on building coalitions.

Specific Elements

1. Identify internal “champions” for the program
2. Identify the suitable contact in each of the agencies or private organizations who is appropriate to participate in the program
3. Develop a brief document that helps sell the program and the contact’s role in it by
 - 3.1. Defining the problem
 - 3.2. Outlining possible solutions
 - 3.3. Aligning the agency or group mission by resolving the problem
 - 3.4. Emphasizing the importance the agency has to the success of the effort

- 3.5. Outlining the organizational framework for the working group and other stakeholders cooperating on this effort
- 3.6. Outlining the rest of the process in which agency staff or group members are being asked to participate
- 3.7. Outlining the nature of commitments desired from the agency or group for the program
- 3.8. Establishing program management responsibilities, including communication protocols, agency roles, and responsibilities
- 3.9. Listing the purpose for an initial meeting
4. Meet with the appropriate representative
 - 4.1. Identify the key individual(s) in the agency or group whose approval is needed to get the desired cooperation
 - 4.2. Clarify any questions or concepts
 - 4.3. Outline the next steps to get the agency or group onboard and participating
5. Establish an organizational framework for the group
 - 5.1. Roles
 - 5.2. Responsibilities

Implementation Step 3: Establish Crash Reduction Goals

General Description

The AASHTO Strategic Highway Safety Plan established a national goal of saving 5,000 to 7,000 lives annually by the year 2005. Some states have established statewide goals for the reduction of fatalities or crashes of a certain degree of severity. Establishing an explicit goal for crash reduction can place an agency “on the spot,” but it usually provides an impetus to action and builds a support for funding programs for its achievement. Therefore, it is desirable to establish, within each emphasis area, one or more crash reduction targets.

These may be dictated by strategic-level planning for the agency, or it may be left to the stakeholders to determine. (The summary of the Wisconsin DOT Highway Safety Plan in [Appendix A](#) has more information.) For example, Pennsylvania adopted a goal of 10 percent reduction in fatalities by 2002,¹ while California established a goal of 40 percent reduction in fatalities and 15 percent reduction in injury crashes, as well as a 10 percent reduction in work zone crashes, in 1 year.² At the municipal level, Toledo, Ohio, is cited by the U.S. Conference of Mayors as having an exemplary program. This included establishing specific crash reduction goals (http://www.usmayors.org/uscm/uscm_projects_services/health/traffic/best_traffic_initiative_toledo.htm). When working within an emphasis area, it may be desirable to specify certain types of crashes, as well as the severity level, being targeted.

There are a few key considerations for establishing a quantitative goal. The stakeholders should achieve consensus on this issue. The goal should be challenging, but achievable. Its feasibility depends in part on available funding, the timeframe in which the goal is to be achieved, the degree of complexity of the program, and the degree of controversy the program may experience. To a certain extent, the quantification of the goal will be an iterative process. If the effort is directed at a particular location, then this becomes a relatively straightforward action.

Specific Elements

1. Identify the type of crashes to be targeted
 - 1.1. Subset of all crash types
 - 1.2. Level of severity
2. Identify existing statewide or other potentially related crash reduction goals
3. Conduct a process with stakeholders to arrive at a consensus on a crash reduction goal
 - 3.1. Identify key considerations
 - 3.2. Identify past goals used in the jurisdiction
 - 3.3. Identify what other jurisdictions are using as crash reduction goals
 - 3.4. Use consensus-seeking methods, as needed

¹ Draft State Highway Safety Plan, State of Pennsylvania, July 22, 1999

² Operations Program Business Plan, FY 1999/2000, State of California, Caltrans, July 1999

Implementation Step 4: Develop Program Policies, Guidelines, and Specifications

General Description

A foundation and framework are needed for solving the identified safety problems. The implementation process will need to be guided and evaluated according to a set of goals, objectives, and related performance measures. These will formalize what the intended result is and how success will be measured. The overlying crash reduction goal, established in Step 3, will provide the context for the more specific goals established in this step. The goals, objectives, and performance measures will be used much later to evaluate what is implemented. Therefore, they should be jointly outlined at this point and agreed to by all program stakeholders. It is important to recognize that evaluating any actions is an important part of the process. Even though evaluation is not finished until some time after the strategies have been implemented, it begins at this step.

The elements of this step may be simpler for a specific project or location than for a comprehensive program. However, even in the simpler case, policies, guidelines, and specifications are usually needed. Furthermore, some programs or projects may require that some guidelines or specifications be in the form of limits on directions taken and types of strategies considered acceptable.

Specific Elements

1. Identify high-level policy actions required and implement them (legislative and administrative)
2. Develop goals, objectives, and performance measures to guide the program and use for assessing its effect
 - 2.1. Hold joint meetings of stakeholders
 - 2.2. Use consensus-seeking methods
 - 2.3. Carefully define terms and measures
 - 2.4. Develop report documenting results and validate them
3. Identify specifications or constraints to be used throughout the project
 - 3.1. Budget constraints
 - 3.2. Time constraints
 - 3.3. Personnel training
 - 3.4. Capacity to install or construct
 - 3.5. Types of strategies not to be considered or that must be included
 - 3.6. Other

Implementation Step 5: Develop Alternative Approaches to Addressing the Problem

General Description

Having defined the problem and established a foundation, the next step is to find ways to address the identified problems. If the problem identification stage has been done effectively (see [Appendix D](#) for further details on identifying road safety problems), the characteristics of the problems should suggest one or more alternative ways for dealing with the problem. It is important that a full range of options be considered, drawing from areas dealing with enforcement, engineering, education, emergency medical services, and system management actions.

Alternative strategies should be sought for both location-specific and systemic problems that have been identified. Location-specific strategies should pertain equally well to addressing high-hazard locations and to solving safety problems identified within projects that are being studied for reasons other than safety.

Where site-specific strategies are being considered, visits to selected sites may be in order if detailed data and pictures are not available. In some cases, the emphasis area guides will provide tables that help connect the attributes of the problem with one or more appropriate strategies to use as countermeasures.

Strategies should also be considered for application on a systemic basis. Examples include

1. Low-cost improvements targeted at problems that have been identified as significant in the overall highway safety picture, but not concentrated in a given location.
2. Action focused upon a specific driver population, but carried out throughout the jurisdiction.
3. Response to a change in policy, including modified design standards.
4. Response to a change in law, such as adoption of a new definition for DUI.

In some cases, a strategy may be considered that is relatively untried or is an innovative variation from past approaches to treatment of a similar problem. Special care is needed to ensure that such strategies are found to be sound enough to implement on a wide-scale basis. Rather than ignoring this type of candidate strategy in favor of the more “tried-and-proven” approaches, consideration should be given to including a pilot-test component to the strategy.

The primary purpose of this guide is to provide a set of strategies to consider for eliminating or lessening the particular road safety problem upon which the user is focusing. As pointed out in the first step of this process, the identification of the problem, and the selection of strategies, is a complex step that will be different for each case. Therefore, it is not feasible to provide a “formula” to follow. However, guidelines are available. There are a number of texts to which the reader can refer. Some of these are listed in [Appendix B](#) and [Appendix D](#).

In addition, the tables referenced in [Appendix G](#) provide examples for linking identified problems with candidate strategies.

The second part of this step is to assemble sets of strategies into alternative “program packages.” Some strategies are complementary to others, while some are more effective when combined with others. In addition, some strategies are mutually exclusive. Finally, strategies may be needed to address roads across multiple jurisdictions. For instance, a package of strategies may need to address both the state and local highway system to have the desired level of impact. The result of this part of the activity will be a set of alternative “program packages” for the emphasis area.

It may be desirable to prepare a technical memorandum at the end of this step. It would document the results, both for input into the next step and for internal reviews. The latter is likely to occur, since this is the point at which specific actions are being seriously considered.

Specific Elements

1. Review problem characteristics and compare them with individual strategies, considering both their objectives and their attributes
 - 1.1. Road-user behavior (law enforcement, licensing, adjudication)
 - 1.2. Engineering
 - 1.3. Emergency medical services
 - 1.4. System management elements
2. Select individual strategies that do the following:
 - 2.1. Address the problem
 - 2.2. Are within the policies and constraints established
 - 2.3. Are likely to help achieve the goals and objectives established for the program
3. Assemble individual strategies into alternative program packages expected to optimize achievement of goals and objectives
 - 3.1. Cumulative effect to achieve crash reduction goal
 - 3.2. Eliminate strategies that can be identified as inappropriate, or likely to be ineffective, even at this early stage of planning
4. Summarize the plan in a technical memorandum, describing attributes of individual strategies, how they will be combined, and why they are likely to meet the established goals and objectives

Implementation Step 6: Evaluate Alternatives and Select a Plan

General Description

This step is needed to arrive at a logical basis for prioritizing and selecting among the alternative strategies or program packages that have been developed. There are several activities that need to be performed. One proposed list is shown in [Appendix P](#).

The process involves making estimates for each of the established performance measures for the program and comparing them, both individually and in total. To do this in a quantitative manner requires some basis for estimating the effectiveness of each strategy. Where solid evidence has been found on effectiveness, it has been presented for each strategy in the guide. In some cases, agencies have a set of crash reduction factors that are used to arrive at effectiveness estimates. Where a high degree of uncertainty exists, it is wise to use sensitivity analyses to test the validity of any conclusions that may be made regarding which is the best strategy or set of strategies to use. Further discussion of this may be found in [Appendix O](#).

Cost-benefit and cost-effectiveness analyses are usually used to help identify inefficient or inappropriate strategies, as well as to establish priorities. For further definition of the two terms, see [Appendix Q](#). For a comparison of the two techniques, see [Appendix S](#). Aspects of feasibility, other than economic, must also be considered at this point. An excellent set of references is provided within online benefit-cost guides:

- One is under development at the following site, maintained by the American Society of Civil Engineers: http://ceenve.calpoly.edu/sullivan/cutep/cutep_bc_outline_main.htm
- The other is *Guide to Benefit-Cost Analysis in Transport Canada*, September 1994, http://www.tc.gc.ca/finance/bca/en/TOC_e.htm. An overall summary of this document is given in [Appendix V](#).

In some cases, a strategy or program may look promising, but no evidence may be available as to its likely effectiveness. This would be especially true for innovative methods or use of emerging technologies. In such cases, it may be advisable to plan a pilot study to arrive at a minimum level of confidence in its effectiveness, before large-scale investment is made or a large segment of the public is involved in something untested.

It is at this stage of detailed analysis that the crash reduction goals, set in Step 3, may be revisited, with the possibility of modification.

It is important that this step be conducted with the full participation of the stakeholders. If the previous steps were followed, the working group will have the appropriate representation. Technical assistance from more than one discipline may be necessary to go through more complex issues. Group consensus will be important on areas such as estimates of effectiveness, as well as the rating and ranking of alternatives. Techniques are available to assist in arriving at consensus. For example, see the following Web site for an overview: http://web.mit.edu/publicdisputes/practice/cbh_ch1.html.

Specific Elements

1. Assess feasibility
 - 1.1. Human resources
 - 1.2. Special constraints
 - 1.3. Legislative requirements
 - 1.4. Other
 - 1.5. This is often done in a qualitative way, to narrow the list of choices to be studied in more detail (see, for example, [Appendix BB](#))
2. Estimate values for each of the performance measures for each strategy and plan
 - 2.1. Estimate costs and impacts
 - 2.1.1. Consider guidelines provided in the detailed description of strategies in this material
 - 2.1.2. Adjust as necessary to reflect local knowledge or practice
 - 2.1.3. Where a plan or program is being considered that includes more than one strategy, combine individual estimates
 - 2.2. Prepare results for cost-benefit and/or cost-effectiveness analyses
 - 2.3. Summarize the estimates in both disaggregate (by individual strategy) and aggregate (total for the program) form
3. Conduct a cost-benefit and/or cost-effectiveness analysis to identify inefficient, as well as dominant, strategies and programs and to establish a priority for the alternatives
 - 3.1. Test for dominance (both lower cost and higher effectiveness than others)
 - 3.2. Estimate relative cost-benefit and/or cost-effectiveness
 - 3.3. Test productivity
4. Develop a report that documents the effort, summarizing the alternatives considered and presenting a preferred program, as devised by the working group (for suggestions on a report of a benefit-cost analysis, see [Appendix U](#)).
 - 4.1. Designed for high-level decision makers, as well as technical personnel who would be involved in the implementation
 - 4.2. Extensive use of graphics and layout techniques to facilitate understanding and capture interest
 - 4.3. Recommendations regarding meeting or altering the crash reduction goals established in Step 3.

Implementation Step 7: Submit Recommendations for Action by Top Management

General Description

The working group has completed the important planning tasks and must now submit the results and conclusions to those who will make the decision on whether to proceed further. Top management, at this step, will primarily be determining if an investment will be made in this area. As a result, the plan will not only be considered on the basis of its merits for solving the particular problems identified in this emphasis area (say, vis-à-vis other approaches that could be taken to deal with the specific problems identified), but also its relative value in relation to investments in other aspects of the road safety program.

This aspect of the process involves using the best available communication skills to adequately inform top management. The degree of effort and extent of use of media should be proportionate to the size and complexity of the problem being addressed, as well as the degree to which there is competition for funds.

The material that is submitted should receive careful review by those with knowledge in report design and layout. In addition, today's technology allows for the development of automated presentations, using animation and multimedia in a cost-effective manner. Therefore, programs involving significant investments that are competing strongly for implementation resources should be backed by such supplementary means for communicating efficiently and effectively with top management.

Specific Elements

1. Submit recommendations for action by management
 - 1.1. "Go/no-go" decision
 - 1.2. Reconsideration of policies, guidelines, and specifications (see Step 3)
 - 1.3. Modification of the plan to accommodate any revisions to the program framework made by the decision makers
2. Working group to make presentations to decision makers and other groups, as needed and requested
3. Working group to provide technical assistance with the review of the plan, as requested
 - 3.1. Availability to answer questions and provide further detail
 - 3.2. Assistance in conducting formal assessments

Implementation Step 8: Develop a Plan of Action

General Description

At this stage, the working group will usually detail the program that has been selected for implementation. This step translates the program into an action plan, with all the details needed by both decision makers, who will have to commit to the investment of resources, and those charged with carrying it out. The effort involves defining resource requirements, organizational and institutional arrangements needed, schedules, etc. This is usually done in the form of a business plan, or plan of action. An example of a plan developed by a local community is shown in [Appendix X](#).

An evaluation plan should be designed at this point. It is an important part of the plan. This is something that should be in place before Step 9 is finished. It is not acceptable to wait until after the program is completed to begin designing an evaluation of it. This is because data are needed about conditions before the program starts, to allow comparison with conditions during its operation and after its completion. It also should be designed at this point, to achieve consensus among the stakeholders on what constitutes “success.” The evaluation is used to determine just how well things were carried out and what effect the program had. Knowing this helps maintain the validity of what is being done, encourages future support from management, and provides good intelligence on how to proceed after the program is completed. For further details on performing evaluations, see [Appendix L](#), [Appendix M](#), and [Appendix W](#).

The plan of action should be developed jointly with the involvement of all desired participants in the program. It should be completed to the detail necessary to receive formal approval of each agency during the next step. The degree of detail and complexity required for this step will be a function of the size and scope of the program, as well as the number of independent agencies involved.

Specific Elements

1. Translation of the selected program into key resource requirements
 - 1.1. Agencies from which cooperation and coordination is required
 - 1.2. Funding
 - 1.3. Personnel
 - 1.4. Data and information
 - 1.5. Time
 - 1.6. Equipment
 - 1.7. Materials
 - 1.8. Training
 - 1.9. Legislation
2. Define organizational and institutional framework for implementing the program
 - 2.1. Include high-level oversight group
 - 2.2. Provide for involvement in planning at working levels
 - 2.3. Provide mechanisms for resolution of issues that may arise and disagreements that may occur
 - 2.4. Secure human and financial resources required

3. Detail a program evaluation plan
 - 3.1. Goals and objectives
 - 3.2. Process measures
 - 3.3. Performance measures
 - 3.3.1. Short-term, including surrogates, to allow early reporting of results
 - 3.3.2. Long-term
 - 3.4. Type of evaluation
 - 3.5. Data needed
 - 3.6. Personnel needed
 - 3.7. Budget and time estimates
4. Definition of tasks to conduct the work
 - 4.1. Develop diagram of tasks (e.g., PERT chart)
 - 4.2. Develop schedule (e.g., Gantt chart)
 - 4.3. For each task, define
 - 4.3.1. Inputs
 - 4.3.2. Outputs
 - 4.3.3. Resource requirements
 - 4.3.4. Agency roles
 - 4.3.5. Sequence and dependency of tasks
5. Develop detailed budget
 - 5.1. By task
 - 5.2. Separate by source and agency/office (i.e., cost center)
6. Produce program action plan, or business plan document

Implementation Step 9: Establish Foundations for Implementing the Program

General Description

Once approved, some “groundwork” is often necessary to establish a foundation for carrying out the selected program. This is somewhat similar to what was done in Step 4. It must now be done in greater detail and scope for the specific program being implemented. As in Step 4, specific policies and guidelines must be developed, organizational and institutional arrangements must be initiated, and an infrastructure must be created for the program. The business plan or action plan provides the basis (Step 7) for this. Once again, the degree of complexity required will vary with the scope and size of the program, as well as the number of agencies involved.

Specific Elements

1. Refine policies and guidelines (from Step 4)
2. Effect required legislation or regulations
3. Allocate budget
4. Reorganize implementation working group
5. Develop program infrastructure
 - 5.1. Facilities and equipment for program staff
 - 5.2. Information systems
 - 5.3. Communications
 - 5.4. Assignment of personnel
 - 5.5. Administrative systems (monitoring and reporting)
6. Set up program assessment system
 - 6.1. Define/refine/revise performance and process measures
 - 6.2. Establish data collection and reporting protocols
 - 6.3. Develop data collection and reporting instruments
 - 6.4. Measure baseline conditions

Implementation Step 10: Carry Out the Action Plan

General Description

Conditions have been established to allow the program to be started. The activities of implementation may be divided into activities associated with field preparation for whatever actions are planned and the actual field implementation of the plan. The activities can involve design and development of program actions, actual construction or installation of program elements, training, and the actual operation of the program. This step also includes monitoring for the purpose of maintaining control and carrying out mid- and post-program evaluation of the effort.

Specific Elements

1. Conduct detailed design of program elements
 - 1.1. Physical design elements
 - 1.2. PI&E materials
 - 1.3. Enforcement protocols
 - 1.4. Etc.
2. Conduct program training
3. Develop and acquire program materials
4. Develop and acquire program equipment
5. Conduct pilot tests of untested strategies, as needed
6. Program operation
 - 6.1. Conduct program “kickoff”
 - 6.2. Carry out monitoring and management of ongoing operation
 - 6.2.1 Periodic measurement (process and performance measures)
 - 6.2.2 Adjustments as required
 - 6.3. Perform interim and final reporting

Implementation Step 11: Assess and Transition the Program

General Description

The AASHTO Strategic Highway Safety Plan includes improvement in highway safety management. A key element of that is the conduct of properly designed program evaluations. The program evaluation will have been first designed in Step 8, which occurs prior to any field implementation. For details on designing an evaluation, please refer to [Step 8](#). For an example of how the New Zealand Transport Authority takes this step as an important part of the process, see [Appendix N](#).

The program will usually have a specified operational period. An evaluation of both the process and performance will have begun prior to the start of implementation. It may also continue during the course of the implementation, and it will be completed after the operational period of the program.

The overall effectiveness of the effort should be measured to determine if the investment was worthwhile and to guide top management on how to proceed into the post-program period. This often means that there is a need to quickly measure program effectiveness in order to provide a preliminary idea of the success or need for immediate modification. This will be particularly important early in development of the AASHTO Strategic Highway Safety Plan, as agencies learn what works best. Therefore, surrogates for safety impact may have to be used to arrive at early/interim conclusions. These usually include behavioral measures. This particular need for interim surrogate measures should be dealt with when the evaluation is designed, back in Step 8. However, a certain period, usually a minimum of a couple of years, will be required to properly measure the effectiveness and draw valid conclusions about programs designed to reduce highway fatalities when using direct safety performance measures.

The results of the work is usually reported back to those who authorized it and the stakeholders, as well as any others in management who will be involved in determining the future of the program. Decisions must be made on how to continue or expand the effort, if at all. If a program is to be continued or expanded (as in the case of a pilot study), the results of its assessment may suggest modifications. In some cases, a decision may be needed to remove what has been placed in the highway environment as part of the program because of a negative impact being measured. Even a “permanent” installation (e.g., rumble strips) requires a decision regarding investment for future maintenance if it is to continue to be effective.

Finally, the results of the evaluation using performance measures should be fed back into a knowledge base to improve future estimates of effectiveness.

Specific Elements

1. Analysis
 - 1.1. Summarize assessment data reported during the course of the program
 - 1.2. Analyze both process and performance measures (both quantitative and qualitative)

- 1.3. Evaluate the degree to which goals and objectives were achieved (using performance measures)
- 1.4. Estimate costs (especially vis-à-vis pre-implementation estimates)
- 1.5. Document anecdotal material that may provide insight for improving future programs and implementation efforts
- 1.6. Conduct and document debriefing sessions with persons involved in the program (including anecdotal evidence of effectiveness and recommended revisions)
2. Report results
3. Decide how to transition the program
 - 3.1. Stop
 - 3.2. Continue as is
 - 3.3. Continue with revisions
 - 3.4. Expand as is
 - 3.5. Expand with revisions
 - 3.6. Reverse some actions
4. Document data for creating or updating database of effectiveness estimates

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Appendixes

The following appendixes are not published in this report. However, they are available online at <http://transportation1.org/safetyplan>.

- 1 Traffic Safety Among Older Adults: Recommendations for California
 - 2 Elderly Mobility and Safety—The Michigan Approach
 - 3 Sustaining Safe Mobility in Older Drivers
 - 4 Elderly Mobility & Safety Focus Group Research Report
 - 5 Discussion of Recommendations for Letter Height and Size of Roadway Signs
 - 6 ITE Recommended Method for Calculating All-Red Clearance Intervals
 - 7 Offset Treatments for Left-Turn Lanes
 - 8 Wisconsin Guidelines: Determining Driver Functional Ability by Visual Inspection
 - 9 State of Utah Functional Ability in Driving: Guidelines and Standards for Health Care Professionals
 - 10 American Medical Association Council on Ethical and Judicial Affairs Report on Impaired Drivers
 - 11 Cues for Law Enforcement
 - 12 Oregon’s Medically At-Risk Driver Program and Resources for the Mature Driver
 - 13 Model Driver Screening and Evaluation Program, Volume II: Maryland Pilot Older Driver Study
 - 14 “When You Are Concerned—A Handbook for Families, Friends and Caregivers Worried about the Safety of an Aging Driver”
 - 15 Driving Decisions Workbook
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- A Wisconsin Department of Transportation 2001 Strategic Highway Safety Plan
 - B Resources for the Planning and Implementation of Highway Safety Programs
 - C South African Road Safety Manual
 - D Comments on Problem Definition
 - E Issues Associated with Use of Safety Information in Highway Design: Role of Safety in Decision Making
 - F Comprehensive Highway Safety Improvement Model
 - G Table Relating Candidate Strategies to Safety Data Elements
 - H What is a Road Safety Audit?
 - I Illustration of Regression to the Mean
 - J Fault Tree Analysis
 - K Lists of Potential Stakeholders
 - L Conducting an Evaluation
 - M Designs for a Program Evaluation
 - N Joint Crash Reduction Programme: Outcome Monitoring
 - O Estimating the Effectiveness of a Program During the Planning Stages
 - P Key Activities for Evaluating Alternative Program
 - Q Definitions of Cost-Benefit and Cost-Effectiveness
 - R FHWA Policy on Life Cycle Costing
 - S Comparisons of Benefit-Cost and Cost-Effectiveness Analysis

T	Issues in Cost-Benefit and Cost-Effectiveness Analyses
U	Transport Canada Recommended Structure for a Benefit-Cost Analysis Report
V	Overall Summary of Benefit-Cost Analysis Guide from Transport Canada
W	Program Evaluation—Its Purpose and Nature
X	Traffic Safety Plan for a Small Department
Y	Sample District-Level Crash Statistical Summary
Z	Sample Intersection Crash Summaries
AA	Sample Intersection Collision Diagram
BB	Example Application of the Unsignalized Intersection Guide

Abbreviations used without definitions in TRB publications:

AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
IEEE	Institute of Electrical and Electronics Engineers
ITE	Institute of Transportation Engineers
NCHRP	National Cooperative Highway Research Program
NCTRP	National Cooperative Transit Research and Development Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
SAE	Society of Automotive Engineers
TCRP	Transit Cooperative Research Program
TRB	Transportation Research Board
U.S.DOT	United States Department of Transportation