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Countermeasures That Work:

A Highway Safety Countermeasure Guide
For State Highway Safety Offices
Sixth Edition, 2011



U.S. Department of Transportation
National Highway Traffic Safety
Administration



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National Highway Traffic Safety
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Preface to the Sixth Edition (2011)

This edition of *Countermeasures that Work* was prepared by the University of North Carolina Highway Safety Research Center (HSRC). Researchers who contributed to this edition include Arthur H. Goodwin, Libby J. Thomas, William L. Hall, and Mary Ellen Tucker. The original *Countermeasures That Work* was prepared in 2005 by James H. Hedlund, Ph.D., of Highway Safety North, with the assistance of Barbara Harsha, executive director of the Governors Highway Safety Association. The chapters on pedestrian and bicycle safety were added in the Second Edition by William A. Leaf of Preusser Research Group.

All chapters have been revised and updated for this edition. Information and research studies through May 31, 2010, have been reviewed and included as appropriate. Data has been updated to include information from the National Highway Traffic Safety Administration's (NHTSA's) Traffic Safety Facts 2009 annual report. Although no new chapters have been added to this edition, several countermeasures addressing drugged driving have been included in Chapter 1.

User Suggestions and Future Editions

NHTSA will update this guide annually and may expand it with additional problem areas and countermeasures as appropriate. In particular, NHTSA is considering adding sections on drugs other than alcohol and pupil transportation to the next edition. Users are invited to provide their suggestions and recommendations for the guide:

- How can it be improved, in form and content?
- Specific comments on information in the guide.
- Additional problem areas to include.
- Additional countermeasures to include for the current problem areas.
- Additional key references to include.

Please send your suggestions and recommendations to:

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Introduction

Purpose of the Guide

This guide is a basic reference to assist State Highway Safety Offices (SHSOs) in selecting effective, science-based traffic safety countermeasures for major highway safety problem areas.

The guide:

- describes major strategies and countermeasures that are relevant to SHSOs;
- summarizes their use, effectiveness, costs, and implementation time; and
- provides references to the most important research summaries and individual studies.

The guide is not intended to be a comprehensive list of countermeasures available for State use or a list of expectations for SHSO implementation. For a description of an optimal State countermeasure program, SHSOs should refer to the *Highway Safety Program Guidelines*, which delineate the principal components of each of the major program areas.

States should identify problem areas through systematic data collection and analysis and are encouraged to continue to apply innovation in developing appropriate countermeasures. The evaluations summarized in this guide allow SHSOs to benefit from the experience and knowledge gained by others and to select countermeasure strategies that either have proven to be effective or that have shown promise. States choosing to use innovative programs can contribute to the collective knowledge pool by carefully evaluating the effectiveness of their efforts and publishing the findings for the benefit of others.

How to Use the Guide

What's included: The guide contains a chapter for each problem area. Each chapter begins with a brief overview of the problem area's size and characteristics, the main countermeasure strategies, a glossary of key terms, and a few general references. Next, a table lists specific countermeasures and summarizes their use, effectiveness, costs, and implementation time. Each countermeasure is then discussed in approximately one page.

The guide provides an overview and starting point for readers to become familiar with the behavioral strategies and countermeasures in each program area. It has attempted to include countermeasures that have the most evidence of effectiveness as well as those that are used most regularly by SHSOs. Only those countermeasures that could be supported by traditional highway safety grant programs have been considered. In addition, updates to the guide are based only on published research. Unpublished programs and efforts are not included in this edition.

Some countermeasure areas are covered in more depth than others due to the availability of published research. For example, impaired driving has a long and rich research history while other topics, such as driver distraction and drowsiness, have received less attention. This difference in the availability of published research findings is due to a number of factors, including the relative scale of the problem areas, the availability of reliable data on the frequency

and characteristics of some safety problems, and the challenge of conducting scientifically valid studies in certain behavioral areas.

References are provided for each countermeasure. When possible, summaries of available research are cited, with Web links where available, so users can find most of the evaluation information in one place. If no summaries are available, one or two key studies are cited. There has been no attempt to list all research, current studies, or program information available on any countermeasure. Readers interested in any problem area or in specific countermeasures are urged to consult the references. Although all Web links in this guide were accurate at the time of publication, please note that Web links may change periodically. For broken links to NHTSA documents, we recommend searching NHTSA's behavioral safety research reports (ntlsearch.bts.gov/repository/ntlc/nhtsa/index.shtm). For broken links to other reports or documents, refer to the Web site for the agency that produced the report.

What's not included: Since the guide is intended as a tool for SHSO use, it does not include countermeasures for which SHSOs have little or no authority or responsibility, or that cannot be supported under typical highway safety grant programs. For example, the guide does not include vehicle- or roadway-based solutions. Also, it does not include countermeasures that already are in place in every State, such as .08 grams per deciliter blood alcohol concentration (BAC) laws. Finally, the guide does not include administrative or management topics such as traffic safety data systems and analyses, program planning and assessments, State and community task forces, or comprehensive community traffic safety programs.

What the effectiveness data mean: The effectiveness of any countermeasure can vary immensely from State to State or community to community. *What* is done is often less important than *how* it is done. The best countermeasure may have little effect if it is not implemented vigorously, publicized extensively, and funded satisfactorily. Evaluation studies generally examine and report on high-quality implementation because there is little interest in evaluating poor implementation. Also, the fact that a countermeasure is being evaluated usually gets the attention of those implementing it, so that it is likely to be done well. *The countermeasure effectiveness data presented in this guide probably shows the maximum effect that can be realized with high-quality implementation.* Many countermeasures have not been evaluated well, or at all, as noted in the effectiveness data. Effectiveness ratings are based primarily on demonstrated reductions in crashes; however, changes in behavior and knowledge are taken into account in the ratings when crash information is not available.

NCHRP Guides: The National Cooperative Highway Research Program (NCHRP) is developing a series of guides for State Departments of Transportation (DOTs) to use in implementing the American Association of State Highway and Transportation Officials (AASHTO) Strategic Highway Safety Plan. This guide draws heavily on the published NCHRP guides and on several draft guides. It differs from the NCHRP guides because it is written for SHSOs, contains only behavioral countermeasures, and is considerably more concise. Readers are urged to consult the NCHRP guides relevant to their interests. They are available at <http://safety.transportation.org/guides.aspx>.

NCHRP has also developed a framework for estimating the costs and benefits associated with behavioral countermeasures. Each of the countermeasures included in *Countermeasures that Work* was reviewed, and the potential savings of the countermeasures were projected. The subsequent report was designed to help States in selecting countermeasures that will result in the greatest reduction in crashes, injuries, and fatalities. Readers can find a copy of the report at http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_622.pdf.

Cochrane Reviews: In several of the chapters, Cochrane Reviews are cited. The Cochrane Collaboration is a nonprofit organization that produces and disseminates systematic reviews of the effects of healthcare interventions. The database of reviews is published quarterly as part of the Cochrane Library. More information about Cochrane Reviews can be found here: www.cochrane.org/.

Disclaimers: As with any attempt to summarize a large amount of sometimes-conflicting information, this guide is highly subjective. All statements, judgments, omissions, and errors are solely the responsibility of the authors and do not necessarily represent the views of the Governors Highway Safety Association (GHSA) or NHTSA. Users who disagree with any statement or who wish to add information or key references are invited to send their comments and suggestions for future editions (see bottom of page vii for details).

New traffic safety programs and research appear almost weekly. Web sites change frequently. This means that this guide was out of date even before it was published. Readers interested in a specific problem area or countermeasures are urged to contact NHTSA for up-to-date information.

Abbreviations, Acronyms, and Initials Used Throughout:

- AAA: was the American Automobile Association but now the organization uses only the initials
- AAAFTS: AAA Foundation for Traffic Safety
- AAMVA: American Association of Motor Vehicle Administrators
- AARP: was the American Association of Retired Persons but now the organization uses only the initials
- AASHTO: American Association of State Highway and Transportation Officials
- ADTSEA: American Driver and Traffic Safety Education Association
- ALR: administrative license revocation
- ALS: administrative license suspension
- AMA: American Medical Association
- ASA: American Society on Aging
- BAC: blood alcohol concentration, measured in grams per deciliter (g/dL)
- CDC: Centers for Disease Control and Prevention
- CPSC: Consumer Product Safety Commission
- CTIA: Cellular Telecommunications and Internet Association
- DOT: Department of Transportation (Federal or State)
- DWI: driving while intoxicated/driving while impaired

- DWS: driving while driver's license is suspended
- FHWA: Federal Highway Administration
- FMCSA: Federal Motor Carrier Safety Administration
- GDL: graduated driver licensing
- GHSA: Governors Highway Safety Association
- HOS: hours of service
- IIHS: Insurance Institute for Highway Safety
- ITS: Intelligent Transportation Systems
- MAB: medical advisory board
- MSF: Motorcycle Safety Foundation
- NCHRP: National Cooperative Highway Research Program
- NCSDR: National Center for Sleep Disorders Research
- NCUTLO: National Committee on Uniform Traffic Laws and Ordinances
- NHTSA: National Highway Traffic Safety Administration
- NIAAA: National Institute on Alcohol Abuse and Alcoholism (a branch of NIH)
- NIH: National Institutes of Health
- NMSL: National Maximum Speed Limit
- NSC: National Safety Council
- NSF: National Sleep Foundation
- NTSB: National Transportation Safety Board
- SFST: Standardized Field Sobriety Tests
- SHSO: State Highway Safety Office
- SMSA: National Association of State Motorcycle Safety Administrators
- STEP: selective traffic enforcement program
- TIRF: Traffic Injury Research Foundation
- TRB: Transportation Research Board
- UVC: Uniform Vehicle Code

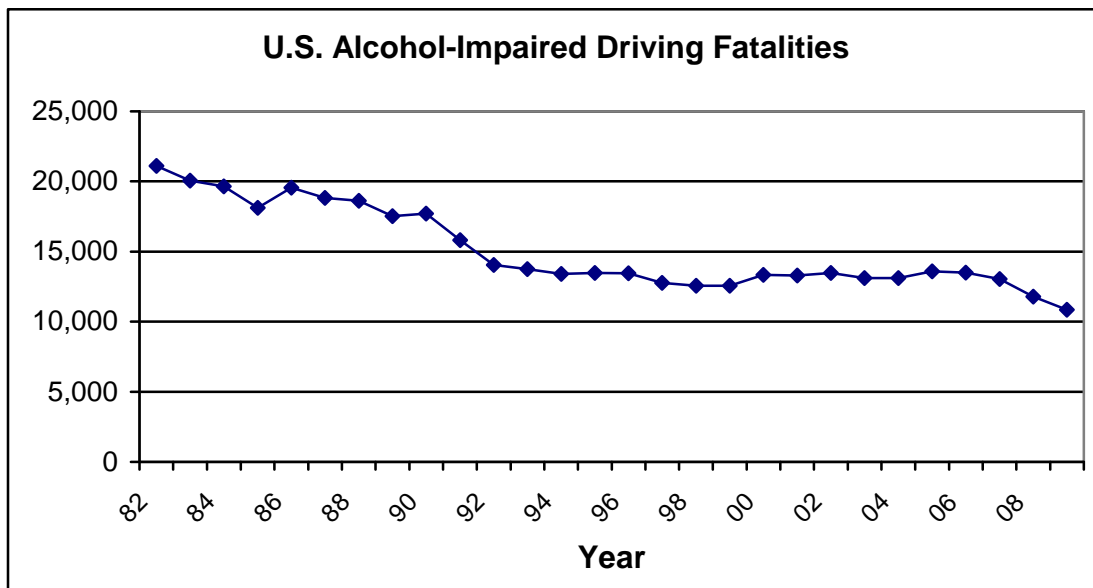
1. Alcohol-Impaired and Drugged Driving

Overview

In 2009, 10,839 people were killed in crashes involving alcohol-impaired drivers (i.e., a driver with a BAC level of $\geq .08$ g/dL), a decrease of 7.4% from the 11,711 fatalities in 2008 (NHTSA, 2010a). Fatalities in crashes involving an alcohol-impaired driver represent almost one-third of the total motor vehicle fatalities in the United States (NHTSA, 2010a). See NHTSA's most recent *Traffic Safety Facts* (NHTSA, 2010a) for the latest national and State data.

Trends. Alcohol-impaired driving dropped steadily from 1982 to the mid-1990s. A study showed that much of this decrease could be attributed to alcohol-related legislation (e.g., .08 BAC, administrative license revocation, and minimum drinking age laws) and to demographic trends (e.g., the aging of the population and the increased proportion of female drivers) (Dang, 2008). However, during this period there also was substantial public attention to the issue of alcohol-impaired driving, a growth of grassroots organizations such as Mothers Against Drunk Driving (MADD) and Remove Intoxicated Drivers (RID), increased Federal programs and funding, State task forces, increased enforcement and intensive publicity, all of which combined to help address this critical traffic safety problem.

As the chart shows, alcohol-impaired driving fatalities have changed very little between 1992 and 2006. There were declines in alcohol-impaired driving fatalities in 2007, 2008 and 2009, but these declines are likely due in part to the fact that vehicle miles traveled in the United States have fallen in recent years (NHTSA, 2009).



Source: NHTSA, 2010b

One age group showed an especially sizeable decrease in alcohol-related traffic fatalities. Between 1996 and 2005, the percentage of fatally injured 16-year-old drivers with positive

BACs (i.e., a BAC of .01 g/dL or higher) decreased by 16% (Ferguson, Teoh, & McCartt, 2007). It should be noted that most States implemented graduated driver licensing systems (GDL) during this time period. GDL systems have had a substantial impact on reducing the crash risk of young, beginning drivers. (For more information on young drivers and GDL, see Chapter 6.)

Drinking and driving characteristics. Drinking and driving is common, with at least 80 million trips made annually by drivers with a BAC of .08 or higher. Arrests are rare, with less than one arrest for every 50 trips by a driver over .08 BAC (Hedlund & McCartt, 2002). The 2007 National Roadside Survey has shown that 12.4% of drivers on weekend nights have a positive BAC, while 2.2% have a BAC of .08 or higher (Compton & Berning, 2009; Lacey et al., 2009a). This represents a significant reduction from 1996, when 16.9% of drivers had a positive BAC and 4.3% had a BAC of .08 or higher.

Many drinking drivers are “high risk,” based on one or more of the following (Century Council, 2008):

- Half of drinking drivers in crashes or arrests have BACs of .15 or higher.
- One-third of drinking drivers in crashes or arrests have a prior DWI conviction.
- One-quarter of drinking drivers in surveys have some indication of alcohol problems.

Alcohol-impaired driving fatalities are affected by several external factors, including geography, urbanization, road structure and conditions, and economic activity, as well as by a State’s laws and programs. For all of these reasons, both the current level of alcohol-impaired driving and the progress in reducing alcohol-impaired driving vary greatly from State to State. For example, comparing all 50 States and the District of Columbia:

- The proportion of drivers in fatal crashes with BACs of .08 or higher in 2009 ranged from 11% in the lowest State to 35% in the highest (NHTSA, 2010c).
- The proportion of drivers in fatal crashes with BACs of .01 or higher in 2009 ranged from 14% in the lowest State to 40% in the highest (NHTSA, 2010c).

Drugged driving characteristics. There is considerably less research on drugged driving than alcohol-impaired driving. However, two roadside surveys suggest it is not uncommon for drivers to have detectable levels of one or more drugs in their systems. Lacey et al. (2009b) collected oral fluid and blood samples from several thousand drivers across the United States in 2007 at different times of day on weekends. Among nighttime drivers who provided oral fluid and/or blood samples:

- 11.3% tested positive for an illegal drug;
- 3.9% tested positive for a medication (i.e., a prescription or over-the-counter drug); and
- 1.1% tested positive for both an illegal drug and a medication.

Marijuana was the most commonly detected illegal drug, followed by cocaine. Among those drivers who tested positive for an illegal drug, 28% also tested positive for alcohol (Lacey et al., 2009b).

In a roadside survey in Canada, researchers collected oral fluid samples from approximately 1,200 drivers at nighttime (Beirness & Beasley, 2009). Similar to the United States study, 10% of drivers tested positive for drug use. This was slightly higher than the percentage of drivers

who tested positive for alcohol use (8%). Of the drug positive cases, most (88%) involved a single drug, the most common being marijuana. Male drivers were more likely than female drivers to test positive for drugs (Beirness & Beasley, 2009). In both the United States and Canadian studies, it is important to keep in mind that a positive drug test does not necessarily indicate “impairment.” Many drugs can be detected in a blood test long after their effects have diminished. For example, marijuana can be detected for 30 days or longer among heavy users.

Although some countries such as Sweden and Finland have carefully tracked the prevalence of drugged driving (Ojaniemi et al., 2009), little is known about trends in drugged driving in the United States. One study from Washington State found a significant increase in methamphetamine use among fatally injured drivers between 1992 and 2002 (Schwilke, Sampaio dos Santos, & Logan, 2006). In part, this likely reflects larger trends in the drug’s popularity.

Research on whether – and how frequently – drug use contributes to crashes is limited. In one study, blood samples were collected from 1,882 drivers who died in a motor vehicle crash (Terhune et al., 1992). Drugs other than alcohol were detected in 17.8% of drivers, the most common being cannabis (6.7%), cocaine (5.3%), and benzodiazepines (2.9%). Although drugs are often detected among drivers involved in crashes, this does not necessarily imply drug impairment played a causal role in the crash. At present, the evidence is variable on whether cannabis and benzodiazepines increase crash risk, while relatively few studies have examined the risks associated with stimulants, opioids, and other drugs (Stewart, 2006).

Strategies to Reduce Impaired Driving

Four basic strategies are used to reduce alcohol-impaired crashes and drinking and driving:

- Deterrence: enact, publicize, enforce, and adjudicate laws prohibiting alcohol-impaired driving so that people choose not to drive impaired;
- Prevention: reduce drinking and keep drinkers from driving;
- Communications and outreach: inform the public of the dangers of impaired driving and establish positive social norms that make driving while impaired unacceptable; and
- Alcohol treatment: reduce alcohol dependency or addiction among drivers;

In this chapter, deterrence countermeasures are divided into four sections: (1) laws, (2) enforcement, (3) prosecution and adjudication, and (4) offender treatment, monitoring, and control. Prevention, intervention, communications, and outreach countermeasures are combined in a single section. Finally, the Underage Drinking and Alcohol-Impaired Driving section includes deterrence, prevention, and communications measures specific to this age group.

This chapter also briefly considers countermeasures to address drugs other than alcohol. Drugs pose quite different and difficult issues at every step, from estimating their prevalence and effect on driving, to developing effective laws and strategies for enforcement, prevention, and treatment. However, many of the countermeasures to address alcohol-impaired driving may also deter drugged driving.

Many other traffic safety countermeasures help reduce alcohol-impaired and drugged driving-related crashes and casualties but are not discussed in this chapter. Behavioral countermeasures,

such as those that increase seat belt use and reduce speeding, are discussed in other chapters. Vehicle and environmental countermeasures, such as improved vehicle structures and centerline rumble strips, are not included because State Highway Safety Offices have little or no authority or responsibility for them.

Resources

The agencies and organizations listed below can provide more information on impaired driving and links to numerous other resources.

- National Highway Traffic Safety Administration:
 - Impaired Driving - <http://www.nhtsa.gov/Impaired>
 - Impaired Driving (Alcohol-Related) Reports - [http://www.nhtsa.gov/Driving+Safety/Research+&+Evaluation/Impaired+driving+\(alcohol-related\)+reports](http://www.nhtsa.gov/Driving+Safety/Research+&+Evaluation/Impaired+driving+(alcohol-related)+reports)
 - Impaired Driving (Drug-Related) Reports - [http://www.nhtsa.gov/Driving+Safety/Research+&+Evaluation/Impaired+driving+\(drug-related\)+reports](http://www.nhtsa.gov/Driving+Safety/Research+&+Evaluation/Impaired+driving+(drug-related)+reports)
 - Behavioral Safety Research Reports - ntlsearch.bts.gov/repository/ntlc/nhtsa/index.shtm
- Governors Highway Safety Association: www.ghsa.org/html/issues/impaireddriving.html
- Insurance Institute for Highway Safety: www.iihs.org/research/topics/alcohol_drugs.html
- National Safety Council:
www.nsc.org/safety_road/DriverSafety/Pages/ImpairedDriving.aspx
- Centers for Disease Control and Prevention:
www.cdc.gov/MotorVehicleSafety/Impaired_Driving/impaired-drv_factsheet.html
- American Automobile Association:
www.aaapublicaffairs.com/Main/Default.asp?CategoryID=3&SubCategoryID=36
- Mothers Against Drunk Driving: www.madd.org
- Traffic Injury Foundation: www.tirf.ca

Key terms

- BAC: Blood alcohol concentration in the body, expressed in grams of alcohol per deciliter (g/dL) of blood, usually measured with a breath or blood test.
- DUID: Driving Under the Influence of Drugs
- DWI: the offense of driving while impaired by alcohol. In different States the offense may be called driving while intoxicated, driving under the influence (DUI), or other similar terms.
- MADD: Mothers Against Drunk Driving.
- PAS: Passive alcohol sensor, a device to detect alcohol presence in the air near a driver's face, used to estimate whether the driver has been drinking.
- PBT: Preliminary breath test device, a small hand-held alcohol sensor used to estimate or measure a driver's BAC.
- RID: Remove Intoxicated Drivers
- SFST: Standardized Field Sobriety Tests, a battery of three tests (One-Leg Stand, Walk-and-Turn, and Horizontal Gaze Nystagmus) used by law enforcement at the roadside to estimate whether a driver is at or above the legal limit of .08 BAC.
- Illegal *per se* law: A law that makes it an offense to operate a motor vehicle with a BAC at or above a specified level.

Countermeasures That Work

Countermeasures to reduce alcohol-impaired driving are listed below and discussed individually in the remainder of this chapter. The table is intended to give a rough estimate of each countermeasure’s effectiveness, use, cost, and time required for implementation. The symbols and terms used are described below. Effectiveness, cost, and time to implement can vary substantially from State to State and community to community. Costs for many countermeasures are difficult to measure, so the summary terms are very approximate. See each countermeasure discussion for more information.

1. Deterrence: Laws

Countermeasure	Effectiveness	Use	Cost	Time
1.1 ALR/ALS	★★★★★	High	High	Medium
1.2 Open containers	★★★	High	Low	Short
1.3 High-BAC sanctions	★★★	Medium	Low	Short
1.4 BAC test refusal penalties	★★★	Unknown	Low	Short
1.5 Alcohol-impaired driving law review	★★	Low	Medium	Medium

2. Deterrence: Enforcement

Countermeasure	Effectiveness	Use	Cost	Time
2.1 Sobriety checkpoints	★★★★★	Medium	High	Short
2.2 Saturation patrols	★★★★	High	Medium	Short
2.3 Preliminary Breath Test devices (PBTs) [†]	★★★★	High	Medium	Short
2.4 Passive alcohol sensors ^{††}	★★★★	Unknown	Medium	Short
2.5 Integrated enforcement	★★★	Unknown	Low	Short

[†] Proven for increasing arrests

^{††} Proven for detecting impaired drivers

3. Deterrence: Prosecution and Adjudication

Countermeasure	Effectiveness	Use	Cost	Time
3.1 DWI courts [†]	★★★★	Low	High	Medium
3.2 Limits on diversion and plea agreements ^{††}	★★★★	Medium	Low	Short
3.3 Court monitoring ^{††}	★★★	Low	Low	Short
3.4 Sanctions	★★	Varies	Varies	Varies

[†] Proven for reducing recidivism

^{††} Proven for increasing convictions

4. Deterrence: DWI Offender Treatment, Monitoring, and Control

Countermeasure	Effectiveness	Use	Cost	Time
4.1 Alcohol problem assessment, treatment	★ ★ ★ ★ ★	High	Varies	Varies
4.2 Alcohol interlocks [†]	★ ★ ★ ★ ★	Medium	Medium	Medium
4.3 Vehicle and license plate sanctions [†]	★ ★ ★ ★	Medium	Varies	Medium
4.4 DWI offender monitoring [†]	★ ★ ★ ★	Unknown	High	Varies
4.5 Lower BAC limit for repeat offenders	★ ★ ★ ★	Low	Low	Short

[†] Proven for reducing recidivism

5. Prevention, Intervention, Communications and Outreach

Countermeasure	Effectiveness	Use	Cost	Time
5.1 Alcohol screening and brief intervention	★ ★ ★ ★ ★	Medium	Medium	Short
5.2 Mass-media campaigns	★ ★ ★	High	High	Medium
5.3 Responsible beverage service	★ ★	Medium	Medium	Medium
5.4 Alternative transportation	★ ★	Unknown	Medium	Short
5.5 Designated drivers	★ ★	Medium	Low	Short

6. Underage Drinking and Alcohol-Impaired Driving

Countermeasure	Effectiveness	Use	Cost	Time
6.1 Minimum drinking age 21 laws	★ ★ ★	High	Low	Low
6.2 Zero-tolerance law enforcement	★ ★ ★	Unknown	Medium	Short
6.3 Youth programs	★ ★	High	Varies	Medium
6.4 School education programs	★	Unknown	Low	Long

7. Drugged Driving

Countermeasure	Effectiveness	Use	Cost	Time
7.1 Enforcement of drugged driving	★ ★ ★	Unknown	Medium	Short
7.2 Drugged driving laws	★	Medium [†]	Unknown	Short
7.3 Education regarding medication	★	Unknown	Unknown	Long

[†] Use for drug *per se* laws

Effectiveness:

- ★★★★★ - Demonstrated to be effective by several high-quality evaluations with consistent results
- ★★★★ - Demonstrated to be effective in certain situations
- ★★★ - Likely to be effective based on balance of evidence from high-quality evaluations or other sources
- ★★ - Effectiveness still undetermined; different methods of implementing this countermeasure produce different results
- ★ - Limited or no high-quality evaluation evidence

Effectiveness is measured by reductions in crashes or injuries unless noted otherwise. See individual countermeasure descriptions for information on effectiveness size and how effectiveness is measured.

Use:

- High: more than two-thirds of the States, or a substantial majority of communities
- Medium: between one-third and two-thirds of States or communities
- Low: less than one-third of the States or communities
- Unknown: data not available

Cost to implement:

- High: requires extensive new facilities, staff, equipment, or publicity, or makes heavy demands on current resources
- Medium: requires some additional staff time, equipment, facilities, and/or publicity
- Low: can be implemented with current staff, perhaps with training; limited costs for equipment, facilities, and publicity

These estimates do not include the costs of enacting legislation or establishing policies.

Time to implement:

- Long: more than one year
- Medium: more than three months but less than one year
- Short: three months or less

These estimates do not include the time required to enact legislation or establish policies.

Deterrence

Deterrence means enacting laws that prohibit driving while impaired, publicizing and enforcing those laws, and punishing the offenders. Deterrence works by changing behavior through the fear of apprehension and punishment. If drivers believe that impaired driving is likely to be detected and that impaired drivers are likely to be arrested, convicted and punished, many will not drive while impaired by alcohol. This strategy is called *general deterrence* when it influences the general driving public through well publicized and highly visible enforcement activities and subsequent punishment. In contrast, *specific deterrence* refers to efforts to influence drivers who have been arrested for impaired driving so they will not continue to drive while impaired by alcohol.

Deterrence works when consequences are swift, sure, and severe (with swift and sure being more important in affecting behavior than severe). All States have the basic laws in place to define impaired driving, set illegal *per se* limits at .08 BAC, and provide standard penalties.

Deterrence, however, is far from straightforward, and complexities can limit the success of deterrence measures. For instance:

- Detecting alcohol-impaired drivers is difficult. Alcohol-impaired driving is a common behavior, law enforcement agencies have limited resources, and (except at checkpoints) officers must observe some traffic violation or other aberrant behavior before they can stop a motorist.
- Conviction also may be difficult. DWI laws are extremely complicated (20 pages in some State codes); the evidence needed to define and demonstrate impairment is complex; judges and juries may not impose specified penalties for an action that they do not believe is a “real crime.”
- The DWI control system is complex. There are many opportunities for breakdowns in the system that allow impaired drivers to go unpunished.

DWI control system operations and management. The DWI control system consists of a set of laws together with the enforcement, prosecution, adjudication, and offender follow-up policies and programs to support the laws. In this complicated system, the operations of each component affect all the other components. Each new policy, law, or program affects operations throughout the system, often in ways that are not anticipated.

This guide documents 19 specific impaired-driving countermeasures in the deterrence section, in four groups: 1) laws, 2) enforcement, 3) prosecution and adjudication, and 4) offender treatment, monitoring, and control. But the overall DWI control system, including its management and leadership, is more important than any individual countermeasure.

Studies have highlighted the key characteristics of an efficient and effective DWI control system (Hedlund & McCartt, 2002; Robertson & Simpson, 2003):

- Training and education for law enforcement, prosecutors, judges, and probation officers;
- record systems that are accurate, up-to-date, easily accessible, and able to track each DWI offender from arrest through the completion of all sentence requirements;
- adequate resources for staff, facilities, training, equipment, and new technology; and

- coordination and cooperation within and across all components.

A few of the countermeasures discussed in this guide, such as BAC test refusal penalties (Chapter 1, Section 1.4), alcohol-impaired driving law review (1.5), and DWI courts (3.1), are directed at improving DWI system operations. In some instances, the most important action that SHSOs can take to reduce alcohol-impaired driving is to review and improve DWI control system operations, perhaps using a State DWI task force and/or a State alcohol program assessment.

Ulmer, Hedlund, and Preusser (1999) investigated why some States reduced alcohol-related traffic fatalities more than others. They concluded that there is no “silver bullet,” no single critical law, enforcement practice, or communications strategy. Once a State has effective laws, high-visibility enforcement, and substantial communications and outreach to support them, the critical factors are strong leadership, commitment to reducing impaired driving, and adequate funding. SHSOs should keep this in mind as they consider the specific countermeasures in this chapter.

1. Deterrence: Laws

1.1 Administrative License Revocation or Suspension (ALR or ALS)

Effectiveness: ★ ★ ★ ★ ★	Use: High	Cost: High	Time: Medium
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Administrative license revocation or suspension laws allow law enforcement and driver licensing authorities to revoke or suspend a driver's license if the driver fails or refuses to take a BAC test. The license revocation or suspension occurs very quickly: usually the arresting officer takes the license at the time that a BAC test is failed or refused. The driver typically receives a temporary license that allows the driver time to make other transportation arrangements and to request and receive an administrative hearing or review. In most jurisdictions, offenders may obtain an occupational or hardship license during part or all of the revocation or suspension period (NHTSA, 2007a). NHTSA recommends that ALR laws include a minimum license suspension of 90 days (NHTSA, 2006a). A model ALR law is provided by National Committee on Uniform Traffic Laws and Ordinances (NCUTLO, 2007).

ALR and ALS laws provide for swift and certain penalties for DWI, rather than the lengthy and uncertain outcomes of criminal courts. They also protect the driving public by removing some DWI offenders from the road (but see the discussion of driving with a suspended license, under “other issues,” below). More information about ALR laws can be found in the NCHRP Report 500 guide on reducing impaired-driving (NCHRP, 2005, Strategy C1) and NHTSA’s *Traffic Safety Facts* on ALR (NHTSA, 2008a).

Use: As of July 2010, 41 States and the District of Columbia had some form of ALR or ALS law (IIHS, 2010).

Effectiveness: A summary of 12 evaluations through 1991 found that ALR and ALS laws reduced crashes of different types by an average of 13% (Wagenaar, Zobek, Williams, & Hingson, 2000). Another study examining the effects of license suspension policies across the United States concluded that ALR reduces alcohol-related fatal crash involvement by 5%, saving an estimated 800 lives each year (Wagenaar & Maldonado-Molina, 2007). There is some evidence that ALR laws also are effective in reducing repeat offenses (Jones & Lacey, 2001).

Costs: ALR laws require funds to design, implement, and operate a system to record and process administrative license actions. In addition, a system of administrative hearing officers must be established and maintained. Some States have recovered ALR system costs through offender fees (Century Council, 2008; NHTSA, 2008a).

Time to implement: Six to 12 months are required to design and implement the system and to recruit and train administrative hearing officers.

Other issues:

- **Two-track system:** Under ALR or ALS laws, drivers face both administrative and criminal actions for DWI. The two systems operate independently. Drivers whose licenses have been suspended or revoked administratively still may face criminal actions that also may include license suspension or revocation. This two-track system has been challenged in some States. All State supreme courts have ruled against these challenges (NHTSA, 2008a).
- **Driving with a suspended license:** Some DWI offenders continue to drive with suspended or revoked licenses (Lenton, Fetherston, & Cercarelli, 2010; McCartt, Geary, & Nissen, 2002). For strategies to reduce driving with a suspended or revoked license, see NCHRP (2003), and Chapter 1, Sections 4.2, 4.3 and 5.4.
- **Hearings:** An effective ALR system will restrict administrative hearings to the relevant facts: that the arresting officer had probable cause to stop the vehicle and require a BAC test and that the driver refused or failed the test. Such a system will reduce the number of hearings requested, reduce the time required for each hearing, and minimize the number of licenses that are reinstated. When administrative hearings are not restricted in this way they can serve as an opportunity for defense attorneys to question the arresting officer about many aspects of the DWI case. This may reduce the chance of a criminal DWI conviction (Hedlund & McCartt, 2002). Officers often spend substantial time appearing in person at ALR hearings, and cases may be dismissed if an officer fails to appear. Some States use telephonic hearings to solve these problems (Wiliszowski, Jones, & Lacey, 2003).

1.2 Open Containers

Effectiveness: ★ ★ ★	Use: High	Cost: Low	Time: Short
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Open-container laws prohibit the possession of any open alcoholic beverage container and the consumption of any alcoholic beverage by motor vehicle drivers or passengers. These laws typically exempt passengers in buses, taxis, and the living quarters of mobile homes.

In 1998, Congress required States to enact open-container laws or have a portion of their Federal aid highway construction funds redirected to alcohol-impaired driving or hazard elimination activities (NHTSA, 2008b).

Use: As of August 2010, 41 States and the District of Columbia had open-container laws that complied with the Federal requirements (GHSA, 2010a).

Effectiveness: The only study of open-container law effectiveness (Stuster, Burns, & Fiorentino, 2002) examined four States that enacted laws in 1999. It found the proportion of alcohol-involved fatal crashes appeared to decline in three of the four States during the first 6 months after the laws were implemented, but the declines were not statistically significant. In general, the proportion of alcohol-involved fatal crashes was higher in States with no open-container law than in States with a law (Stuster et al., 2002). Survey data in both law and no-law States show strong public support for open-container laws (NHTSA, 2008b).

Costs: Open-container law costs depend on the number of offenders detected and the penalties applied to them.

Time to implement: Open-container laws can be implemented as soon as appropriate legislation is enacted.

1.3 High-BAC Sanctions

Effectiveness: ★ ★ ★	Use: Medium	Cost: Low	Time: Short
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Almost all States increase the penalties for the standard impaired driving (DWI) offense for repeat offenders. Some States also have increased the penalties for drivers with high BACs, typically .15 or .16 or higher.

High-BAC sanctions are based on the observation that many high-BAC drivers are habitual impaired driving offenders, even though they may not have a record of previous arrests and convictions. Moreover, drivers with high BACs put themselves and other road users at risk: 56% of the drinking drivers involved in fatal crashes in 2009 had BACs of .15 or greater (NHTSA, 2010a). Enhanced sanctions for high-BAC drivers vary by State, and may include mandatory assessment and treatment for alcohol problems, close monitoring or home confinement, installation of an ignition interlock, and vehicle or license plate sanctions (see Chapter 1, Sections 4.1, 4.2, 4.3 and 4.4). NHTSA recommends that sanctions for first-time offenders with high BACs be comparable to those for repeat offenders (NHTSA, 2008c).

Use: As of July 2010, 42 States and the District of Columbia have increased penalties for drivers with high BACs (GHSA, 2010a). In 2009, Oregon and Wyoming passed high-BAC laws (Savage, Teigen, & Farmer 2010). Wyoming's law requires anyone convicted of DWI with a BAC of .15 or higher to install an ignition interlock for six months.

Effectiveness: In the only evaluation of high-BAC sanctions to date, McCartt and Northrup (2003, 2004) found that Minnesota's law appears to have increased the severity of case dispositions for high-BAC offenders, although the severity apparently declined somewhat over time. They also found some evidence of an initial decrease in recidivism among high-BAC first offenders (which again dissipated with time). The BAC test refusal rate declined for first offenders and was unchanged for repeat offenders after the high-BAC law was implemented. The authors point out that Minnesota's law has a high threshold of .20 BAC, relatively strong administrative and criminal sanctions, and strong penalties for BAC test refusal.

Costs: High-BAC sanctions will produce increased costs if the high-BAC penalties are more costly per offender than the lower-BAC penalties. Over a longer period, if high-BAC sanctions reduce recidivism and deter alcohol-impaired driving, then costs will decrease.

Time to implement: High-BAC sanctions can be implemented as soon as appropriate legislation is enacted.

Other issues:

- **Test refusal:** High-BAC sanctions may encourage some drivers to refuse the BAC test unless the penalties for test refusal are at least as severe as the high-BAC penalties. See Chapter 1, Section 1.4.

1.4 BAC Test Refusal Penalties

Effectiveness: ★ ★ ★	Use: Unknown	Cost: Low	Time: Short
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All States have implied consent laws stipulating that people implicitly consent to be tested if they are suspected of impaired driving (NHTSA, 2008d). However, many drivers refuse to provide a breath or blood sample for a BAC test. In 2005, 22% of all drivers arrested for DWI refused the BAC test (Berning et al., 2008), a slight drop from the nationwide average of 25% in 2001 (Zwicker, Hedlund, & Northrup, 2005). A driver’s BAC is a critical piece of evidence in an alcohol-impaired driving case. The absence of a BAC test can make it more difficult to convict the impaired driver.

All States have established separate penalties for BAC test refusal, typically involving administrative license revocation or suspension. If the penalties for refusal are less severe than the penalties for failing the test, many drivers will refuse (see also Simpson & Robertson, 2001). The Model DWI code sets a more severe penalty for test refusal than for test failure (NCUTLO, 2007).

Reduced test refusal rates will help the overall DWI control system by providing better BAC evidence. Having a driver’s BAC may increase DWI and high-BAC DWI convictions, increase the likelihood that prior DWI offenses will be properly identified, and provide the court with better evidence for offender alcohol assessment. For a thorough discussion of issues related to BAC test refusal, see NHTSA’s 2008 *Report to Congress* (Berning et al., 2008). See also Voas et al. (2009) for a history of implied consent laws in the United States and a review of the research on breath test refusal.

Use: The relative penalties in each State for failing and refusing a BAC test cannot be categorized in a straightforward manner due to the complexity of State alcohol-impaired driving laws and the differences in how these laws are prosecuted and adjudicated. As of 2008, all States except Nevada imposed administrative sanctions for test refusal (NHTSA, 2008d). In 2007, new laws regarding testing or refusals were enacted in five States – Colorado, Kansas, Maine, New Mexico, and Wyoming (Savage, Sundeen, & Teigen, 2007). NHTSA (2007a) gives more detail on each State’s laws.

Effectiveness: Zwicker et al. (2005) found that test refusal rates appear to be lower in States where the consequences of test refusal are greater than the consequences of test failure. No study has examined whether stronger test refusal penalties are associated with reduced alcohol-impaired crashes.

Costs: There are no direct costs of increasing penalties for BAC test refusal.

Time to implement: Increased BAC test refusal penalties can be implemented as soon as appropriate legislation is enacted.

Other issues:

- **Criminalizing test refusal:** As of 2008, BAC test refusal was a criminal offense in 15 States (NHTSA, 2008d; Zwicker et al., 2005, Appendix A). Criminalizing test refusal decreases the likelihood that drinking drivers can avoid penalties by refusing to be tested. It also ensures the drinking driver will be identified as a repeat offender upon subsequent arrests.
- **Warrants:** To reduce breath test refusals and increase the number of drivers successfully prosecuted for DWI, some States issue warrants for drivers who refuse to provide breath tests. Issued by a judge or magistrate, the warrant requires the driver to provide a blood sample, by force if necessary. One study reviewed how warrants are used in four States – Arizona, Michigan, Oregon, and Utah (Hedlund & Beirness, 2007). They found that warrants may successfully reduce breath test refusals and result in more pleas, fewer trials, and more convictions. A disadvantage of warrants is they require additional time for law enforcement, and some judges are reportedly not satisfied that DWI cases justify the use of warrants to obtain BAC evidence.

1.5 Alcohol-Impaired Driving Law Review

Effectiveness: ★ ★	Use: Low	Cost: Medium	Time: Medium
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Alcohol-impaired driving laws in many States are extremely complex. They are difficult to understand, enforce, prosecute, and adjudicate, with many inconsistencies and unintended consequences. In many States, a thorough review and revision would produce a system of laws that would be far simpler and more understandable, efficient, and effective.

DWI laws have evolved over the past 30 years to incorporate new definitions of the offense of driving while impaired (illegal *per se* laws), new technology and methods for determining impairment (BAC tests, Standardized Field Sobriety Tests), and new sentencing and monitoring alternatives (electronic monitoring, alcohol ignition interlocks). Many States modified their laws to incorporate these new ideas without reviewing their effect on the overall DWI control system. The result is often an inconsistent patchwork. Robertson and Simpson (2003) summarized the opinions of hundreds of law enforcement officers, prosecutors, judges, and probation officials across the country: “Professionals unanimously support the simplification and streamlining of existing DWI statutes” (p. 18). See also Hedlund and McCartt (2002).

NCUTLO has prepared a model DWI law, which has been incorporated into the Uniform Vehicle Code (NCUTLO, 2007). It addresses BAC testing, BAC test refusals, higher penalties for high-BAC drivers, ALR hearing procedures, and many other issues of current interest. States can use the NCUTLO model as a reference point in reviewing their own laws. In addition, the Traffic Injury Research Foundation (TIRF) has a guidebook to assist policymakers in leading a strategic review of DWI systems, with the goal of streamlining systems and closing loopholes that can be exploited by offenders (Robertson, Vanlaar, & Simpson, 2007). A guidebook is also available from NHTSA to assist States in establishing an Impaired-Driving Statewide Task Force that can assist in reviewing key legislation and improving current DWI systems (Fell & Langston, 2009).

Use: No data are available on which States have reviewed and revised their DWI laws.

Effectiveness: To date, no studies have examined the effectiveness of law reviews in reducing alcohol-impaired crashes. The effect of a law review will depend on the extent of inconsistencies and inefficiencies in a State’s current laws. A law review can be an important action a State can take to address its alcohol-impaired driving problem, because a thorough law review will examine the function of the entire DWI control system and will identify problem areas. The immediate effect of a law review should be a more efficient and effective DWI control system.

Costs: The review will require substantial staff time. Implementation costs of course will depend on the extent to which the laws are changed.

Time to implement: It can take considerable time to identify qualified stakeholders and establish a task force to conduct the law review.

2. Deterrence: Enforcement

2.1 Sobriety Checkpoints

Effectiveness: ★ ★ ★ ★ ★	Use: Medium	Cost: High	Time: Short
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At a sobriety checkpoint, law enforcement officers stop vehicles at a predetermined location to check whether the driver is impaired. They either stop every vehicle or stop vehicles at some regular interval, such as every third or tenth vehicle. The purpose of checkpoints is to deter driving after drinking by increasing the perceived risk of arrest. To do this, checkpoints should be highly visible, publicized extensively, and conducted regularly. Fell, Lacey, and Voas (2004) provide an overview of checkpoint operations, use, effectiveness, and issues.

Use: Sobriety checkpoints are authorized in 38 States and the District of Columbia (NHTSA, 2008e), but few States conduct them often. According to GHSA (2010b), only 13 States conduct checkpoints on a weekly basis. The main reasons checkpoints are not used more frequently are lack of law enforcement personnel and lack of funding (Fell, Ferguson, Williams, & Fields, 2003).

Effectiveness: CDC’s systematic review of 11 high-quality studies found that checkpoints reduced alcohol-related fatal, injury, and property damage crashes each by about 20% (Elder et al., 2002). Similarly, a meta-analysis found that checkpoints reduce alcohol-related crashes by 17%, and all crashes by 10 to 15% (Erke, Goldenbeld, & Vaa, 2009). In recent years, NHTSA has supported a number of efforts to reduce alcohol-impaired driving using sobriety checkpoints. Evaluations of recent statewide campaigns in Connecticut and West Virginia involving sobriety checkpoints and extensive paid media found decreases in alcohol-related fatalities following the program, as well as fewer drivers with positive BACs at roadside surveys (Zwicker, Chaudhary, Maloney, & Squeglia, 2007; Zwicker, Chaudhary, Solomon, Siegler, & Meadows, 2007). In addition, a study examining demonstration programs in 7 States found reductions in alcohol-related fatalities between 11% and 20% in States that employed numerous checkpoints or other highly visible impaired driving enforcement operations and intensive publicity of the enforcement activities, including paid advertising (Fell, Langston, Lacey, & Tippetts, 2008). States with lower levels of enforcement and publicity did not demonstrate a decrease in fatalities relative to neighboring States. See also NHTSA’s Strategic Evaluation States initiative (NHTSA, 2007b; Syner et al., 2008), the *Checkpoint Strikeforce* program (Lacey et al., 2008), and the national Labor Day holiday campaign: *Drunk Driving. Over the Limit. Under Arrest* (Solomon et al., 2008).

Costs: The main costs are for law enforcement time and for publicity. A typical checkpoint requires several hours from each law enforcement officer involved. Law enforcement costs can be reduced by operating checkpoints with 3 to 5 officers, perhaps supplemented by volunteers, instead of the 10 to 12 or more officers used in some jurisdictions (NHTSA, 2002; NHTSA, 2006b; Stuster & Blowers, 1995). Law enforcement agencies in two rural West Virginia counties were able to sustain a year-long program of weekly low-staff checkpoints. The proportion of nighttime drivers with BACs of .05 and higher was 70% lower in these counties compared to drivers in comparison counties that did not operate additional checkpoints (Lacey, Ferguson,

Kelley-Baker, & Rider, 2006). NHTSA has a guidebook available to assist law enforcement agencies in planning, operating and evaluating low-staff sobriety checkpoints (NHTSA, 2006b).

Checkpoint publicity can be costly if paid media are used, although publicity can also include earned media.

Time to implement: Checkpoints can be implemented very quickly if officers are trained in detecting impaired drivers, SFST, and checkpoint operational procedures. See NHTSA (2002) for implementation information.

Other issues:

- **Legality:** Checkpoints currently are permitted in 38 States and the District of Columbia (NHTSA, 2008e). Checkpoints are permitted under the United States Constitution but some State courts have held that checkpoints violate their State's constitution. Some State legislatures have not authorized checkpoints. States where checkpoints are not permitted may use saturation patrols (see Chapter 1, Section 2.2).
- **Visibility:** Checkpoints must be highly visible and publicized extensively to be effective. Communication and enforcement plans should be coordinated. Messages should clearly and unambiguously support enforcement. Paid media may be necessary to complement news stories and other earned media, especially in a continuing checkpoint program (NCHRP, 2005, Strategy B1).
- **Arrests:** The primary purpose of checkpoints is to deter impaired driving, not to increase arrests. However, impaired drivers detected at checkpoints should be arrested and arrests should be publicized, but arrests at checkpoints should not be used as a measure of checkpoint effectiveness. Contacts would be a more appropriate measure.
- **Other offenses:** Checkpoints may also be used to check for valid driver licenses, seat belt use, outstanding warrants, stolen vehicles, and other traffic and criminal infractions.
- **Combining checkpoints with other activities:** To enhance the visibility of their law enforcement operations, some jurisdictions combine checkpoints with other activities, such as saturation patrols. For example, some law enforcement agencies conduct both checkpoints and saturation patrols during the same weekend. Others alternate checkpoints and saturation patrols on different weekends as part of a larger impaired driving enforcement effort.

2.2 Saturation Patrols

Effectiveness: ★ ★ ★ ★	Use: High	Cost: Medium	Time: Short
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A saturation patrol (also called a blanket patrol, “wolf pack,” or dedicated DWI patrol) consists of a large number of law enforcement officers patrolling a specific area for a set time to increase visibility of enforcement, as well as to detect and arrest impaired drivers. Like sobriety checkpoints, the primary purpose of saturation patrols is to deter driving after drinking by increasing the perceived risk of arrest. To do this, saturation patrols should be publicized extensively and conducted regularly. A less-intensive strategy is the “roving patrol” in which individual patrol officers concentrate on detecting and arresting impaired drivers in an area where impaired driving is common or where alcohol-involved crashes have occurred (Stuster, 2000). A “how-to” guide for planning and publicizing saturation patrols and sobriety checkpoints is available from NHTSA (NHTSA, 2002).

Use: A survey conducted by The Century Council (2008) reported that 44 States used saturation patrols.

Effectiveness: A demonstration program in Michigan revealed that saturation patrols can be effective in reducing alcohol-related fatal crashes when accompanied by intensive publicity (Fell et al., 2008). Michigan is prohibited by State law from conducting sobriety checkpoints. In addition, saturation patrols can be very effective in arresting impaired drivers. For example, in 2006 Minnesota’s 290 saturation patrols stopped 33,923 vehicles and arrested 2,796 impaired drivers (Century Council, 2008).

Costs: The main costs are for law enforcement time and for publicity. Saturation patrol operations are quite flexible in both the number of officers required and the time that each officer participates in the patrol. As with sobriety checkpoints, publicity can be costly if paid media is used.

Time to implement: Saturation patrols can be implemented within three months if officers are trained in detecting impaired drivers and in SFST. See NHTSA (2002) for implementation information.

Other issues:

- **Legality:** Saturation patrols are legal in all jurisdictions.
- **Publicity:** As with sobriety checkpoints, saturation patrols should be highly visible and publicized extensively to be effective in deterring impaired driving. Communication and enforcement plans should be coordinated. Messages should clearly and unambiguously support enforcement. Paid media may be necessary to complement news stories and other earned media, especially in a continuing saturation patrol program (NCHRP, 2005, Strategy B1).
- **Other offenses:** Saturation patrols are effective in detecting other driving and criminal offenses.

2.3 Preliminary Breath Test Devices (PBTs)

Effectiveness: ★★ ★★ ★†	Use: High	Cost: Medium	Time: Short
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† Proven for increasing arrests

A preliminary breath test device is a small hand-held alcohol sensor used to estimate or measure a driver’s BAC. Law enforcement officers use PBTs in the field to help establish evidence for a DWI arrest. The driver blows into a mouthpiece and the PBT displays either a numerical BAC level, such as .12, or a BAC range, such as a red light for BACs above .08.

Several PBT models are available commercially. They are quite accurate and generally reliable. NHTSA maintains a “Conforming Products List” of alcohol testing and screening instruments, including PBTs, that meet accuracy and reliability standards (NHTSA, 2004).

Use: PBTs are used in 33 States to provide evidence of alcohol use to support DWI arrests (Century Council, 2008). This evidence of alcohol use is admissible in court in approximately half the States, but in most States PBT evidence cannot be used to establish a driver’s BAC. California allows officers to use PBT evidence to enforce zero-tolerance laws for drivers under the age of 21: officers at the roadside can issue a citation and seize the driver’s license (Ferguson, Fields, & Voas, 2000).

Effectiveness: Law enforcement officers generally agree that PBTs are useful. Sixty-nine percent of the 2,731 law enforcement officers surveyed by Simpson and Robertson (2001) supported greater PBT availability and use. PBTs are especially valuable for two classes of drivers who may appear to perform normally on many tasks: drivers with a high tolerance to alcohol (Simpson & Robertson, 2001) and drivers under 21 who may be in violation of zero-tolerance laws (Ferguson et al., 2000). PBTs also can be useful at crash scenes where a driver is injured and unable to perform a Standardized Field Sobriety Test. There is some evidence that PBT use increases DWI arrests and reduces alcohol-involved fatal crashes (Century Council, 2008).

Costs: PBTs cost from \$200 to \$600 apiece. Many law enforcement departments have only a limited number of PBTs and many patrol officers do not have regular access to them. Officers surveyed by Simpson and Robertson (2001) estimated that three-fourths of all DWI arrests occur on routine patrols, so DWI detection would be substantially improved if every patrol officer had a PBT.

Time to implement: PBTs can be used as soon as they are purchased and officers are trained in their use and maintenance. PBT instruments must have regular calibration checks. Most law enforcement agencies have the facilities to conduct these checks.

Other issues:

- **The “one test” rule:** Some State statutes allow only one chemical BAC test to be taken from a driver arrested for DWI. These States do not use PBTs because an evidential BAC test cannot be requested if an officer previously has taken a PBT test in the field.
- **Other drugs:** A PBT will not detect the presence of drugs other than alcohol.

2.4 Passive Alcohol Sensors (PAS)

Effectiveness: ★★ ★★ ★†	Use: Unknown	Cost: Medium	Time: Short
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† Proven for detecting impaired drivers

A passive alcohol sensor is a device to detect alcohol presence in the air. The sensor usually is integrated into a flashlight or clipboard. Officers hold the flashlight or clipboard near the driver's mouth, where it measures alcohol presence in the air where the driver is breathing. The PAS can be used without the driver's knowledge and without any probable cause because the PAS is considered "an extension of the officer's nose" and records information that is "in plain view" (Preusser, 2000).

Several PAS models are available commercially. They generally are reliable and effective at detecting alcohol in the surrounding air. In one study, both breath samples and PAS measures were obtained from over 12,000 drivers. Results showed that PAS scores were a strong predictor of a driver's BAC status, leading to the conclusion that "the PAS can be an effective tool for officers when deciding whether to initiate a DWI investigation" (Voas, Romano, & Peck, 2006). NHTSA does not maintain a list of PAS models.

Use: PAS units typically are used at the vehicle window after a traffic stop or at a checkpoint. A PAS report of alcohol presence gives the officer probable cause to request further examination with SFSTs or a PBT device. No data are available on how many PAS units are in use.

Effectiveness: The PAS is especially effective at checkpoints, where officers must screen drivers quickly with little or no opportunity to observe the drivers on the road. Evaluations show that officers using a PAS at checkpoints can detect 50% more drivers at BACs of .10 and above than officers not using a PAS (Century Council, 2008; Farmer, Wells, Ferguson, & Voas, 1999; Fell et al., 2004; Voas, 2008). The PAS appears to be especially effective in assisting officers who rarely make arrests for DWI (Fell, Compton, & Voas, 2008).

Costs: PAS units cost from \$300 to \$700 apiece.

Time to implement: PAS units can be used as soon as they are purchased and officers are trained in their use and maintenance. Training can usually be accomplished quickly.

Other issues:

- **Acceptance by law enforcement:** Officers tend to dislike using the PAS. Common reasons given by officers for not using PAS units are that they require them to be closer to the drivers than they wish to be, they require some portion of officers' attention at a time when they may have other things to be concerned about (including personal safety), or they may keep officers from having a hand free. Other officers believe they can detect the odor of alcohol accurately without assistance from PAS devices (Preusser, 2000).
- **Other drugs:** As with a PBT, a PAS will not detect the presence of drugs other than alcohol.

2.5 Integrated Enforcement

Effectiveness: ★ ★ ★	Use: Unknown	Cost: Low	Time: Short
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Impaired drivers are detected and arrested through regular traffic enforcement and crash investigations as well as through special impaired driving checkpoints and saturation patrols. A third opportunity is to integrate impaired-driving enforcement into special enforcement activities directed primarily at other offenses such as speeding or seat belt nonuse, especially since impaired drivers often speed or fail to wear seat belts. (Such operations can be particularly effective when conducted at night.)

Use: There are no data on how frequently integrated enforcement methods are used.

Effectiveness: Jones, Joksch, Lacey, Wiliszowski, and Marchetti (1995) evaluated a three-site evaluation of integrated impaired driving, speed, and seat belt use enforcement. Sites that combined high publicity with increased enforcement reduced crashes likely to involve alcohol (such as single-vehicle nighttime crashes) by 10% to 35%. They concluded that the results were encouraging but not definitive. The *Massachusetts Saving Lives* comprehensive programs in six communities used integrated enforcement methods. The programs reduced fatal crashes involving alcohol by 42% (Hingson et al., 1996). About half the speeding drivers detected through these enforcement activities had been drinking and about half the impaired drivers were speeding. See also Jones and Lacey (2001, pp. 113-115), NCHRP (2005, Strategy B2), and Stuster (2000).

Costs: As with other enforcement strategies, the primary costs are for law enforcement time and for publicity.

Time to implement: Impaired driving can be integrated into other enforcement activities within three months if officers are trained in detecting impaired drivers and in SFST.

Other issues:

- **Publicity:** Integrated enforcement activities should be publicized extensively to be effective in deterring impaired driving and other traffic offenses. Paid media may be necessary to complement news stories and other earned media, especially in an ongoing program (NCHRP, 2005, Strategy B2).
- **Priorities:** Integrated enforcement activities send a message to the public and to law enforcement officers alike that traffic safety is not a single-issue activity.
- **Citizen reporting programs:** Six States have dedicated programs where drivers with cell phones can dial a special number to report suspected drunk drivers (Fiorentino, Cure, & Kipper, 2007). Such programs can generate support for law enforcement efforts and increase the perception in the community that drinking drivers will be caught. A study of a grassroots DWI witness reward program in Stockton, California, found a significant decrease in alcohol-related injury/fatality crashes following the program, relative to six comparison communities (Van Vleck & Brinkley, 2009). However, other studies of citizen reporting programs have been inconclusive (e.g., Kelley-Baker et al., 2006).

3. Deterrence: Prosecution and Adjudication

3.1 DWI Courts

Effectiveness: ★ ★ ★ ★ [†]	Use: Low	Cost: High	Time: Medium
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[†] Proven for reducing recidivism

A dedicated DWI court provides a systematic and coordinated approach to prosecuting, sentencing, monitoring, and treating DWI offenders. A DWI court's underlying goal is to change offenders' behavior by identifying and treating their alcohol problems and by holding offenders accountable for their actions.

Prosecutors and judges in DWI courts specialize in DWI cases. Probation officers monitor offenders closely and report any probation infraction to the judge immediately for prompt action. Restrictions and monitoring are gradually relaxed as offenders demonstrate responsible behavior. DWI courts follow the model established by almost 2,500 drug courts around the Nation (Huddleston, Marlowe, & Casebolt, 2008; NADCP, 2009; NCHRP, 2005, Strategy D3). See Brunson and Knighten (2005), Practice #1, for a comprehensive overview of DWI courts.

A DWI court can reduce recidivism because judge, prosecutor, probation staff, and treatment staff work together as a team to assure that alcohol treatment and other sentencing requirements are satisfied for offenders on an individual basis. A key feature of a DWI court is that the team meets regularly, giving all parties an opportunity to discuss the status of a case. Judges can then immediately revise restrictions, if appropriate. DWI courts can be more efficient and effective than regular courts because judges and prosecutors closely supervise the offenders and are familiar with the complex DWI laws, evidentiary issues, sentencing options, and the offenders. NHTSA (2003) describes the operation of a DWI court in Albuquerque, New Mexico.

Use: As of December 2009, NDCI reported 172 designated DWI courts and 354 hybrid DWI/drug courts, which are drug courts that also take DWI offenders (NDCI, 2010).

Effectiveness: Some individual program evaluations show that DWI courts can be successful. Low DWI recidivism rates have been found for graduates of DWI courts in Athens (Georgia), Maricopa County (Arizona), Los Angeles County (California), and elsewhere (Marlowe et al., 2009). For example, a study in Michigan found that DWI court participants were 19 times *less* likely to be rearrested for DWI within two years than a comparison group of offenders who were in traditional probation (Michigan Supreme Court & NPC Research, 2008).

Evaluations have shown that close monitoring and individualized sanctions for DWI offenders reduce recidivism (see Chapter 1, Section 4.4). When these are incorporated within a comprehensive DWI court program, their effect is likely to be even greater.

Costs: DWI court costs are difficult to estimate and compare with regular courts. Court operations may become more efficient as more judges and prosecutors specialize in DWI cases. Follow-up costs may be greater because more probation officers will be needed to reduce caseloads and to provide close monitoring, and because judges must allocate time to meet

regularly with probationers and to deal with any probation violations. Offenders can bear some of the monitoring and treatment costs (see Chapter 1, Sections 4.1, 4.2, 4.3, and 4.4). DWI courts may reduce long-term system costs substantially if they decrease DWI recidivism as expected. Moreover, DWI court programs are believed to cost far less than jail time, if used as an alternative to jail. According to one estimate, for every dollar invested in drug courts, taxpayers save up to \$3.36 (NADCP, 2009).

Time to implement: DWI courts can be implemented 4 to 6 months after the participating organizations agree on the program structure if enough trained prosecutors, judges, probation officers, and treatment providers are available. Otherwise, planning and implementation may require a year or more.

3.2 Limits on Diversion and Plea Agreements

Effectiveness: ★ ★ ★ ★ †	Use: Medium	Cost: Low	Time: Short
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† Proven for increasing convictions

Diversion programs defer sentencing while a DWI offender participates in some form of alcohol education or treatment. In many States, charges are dropped or the offender’s DWI record is erased if the education or treatment is completed satisfactorily.

Negotiated plea agreements are a necessary part of efficient and effective DWI prosecution and adjudication. However, plea agreements in some States allow offenders to eliminate any record of a DWI offense and to have their penalties reduced or eliminated.

Effective DWI control systems can use a variety of adjudication and sanction methods and requirements. The key feature is that an alcohol-related offense must be retained on the offender’s record (Hedlund & McCartt, 2002; NCHRP, 2005; NTSB, 2000; Robertson & Simpson, 2002a).

Use: As of 2006, 33 States provided for diversion programs in State law or statewide practice, and local courts and judges in some additional States also offer diversion programs (NHTSA 2006c). The Century Council (2008) documented diversion programs and plea agreement restrictions in several States.

Effectiveness: There are no studies that demonstrate that diversion programs reduce recidivism (NTSB, 2000) and there is substantial anecdotal evidence that diversion programs, by eliminating the offense from the offender’s record, allow repeat offenders to avoid being identified (Hedlund & McCartt, 2002). Eliminating or establishing limits on diversion programs should remove a major loophole in the DWI control system.

Wagenaar et al. (2000) reviewed 52 studies of plea agreement restrictions applied in combination with other DWI control policies and found that they reduced various outcome measures by an average of 11%. However, the effects of plea agreement restrictions by themselves cannot be determined in these studies. The only direct study of plea agreement restrictions was completed over 20 years ago (NHTSA, 1989; NTSB, 2000). It found that plea agreement restrictions reduced recidivism in all three study communities.

Costs: Costs for eliminating/limiting diversion programs can be determined by comparing the per-offender costs of the diversion program and the non-diversion sanctions. Similarly, costs for restricting plea agreements will depend on the relative costs of sanctions with and without the plea agreement restrictions. In addition, if plea agreements are restricted, some charges may be dismissed or some offenders may request a full trial, resulting in significant costs.

Time to implement: Eliminating/limiting diversion programs and restricting plea agreements statewide may require changes to a State’s DWI laws. Once legislation is enacted, policies and practices can be changed within three months. Individual prosecutor offices and courts also can change local policies and practices without statewide legislation.

3.3 Court Monitoring

Effectiveness: ★★ ★★ ★†	Use: Low	Cost: Low	Time: Short
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† Proven for increasing convictions

In court monitoring programs, citizens observe, track, and report on DWI court or administrative hearing activities. Court monitoring provides data on how many cases are dismissed or pled down to lesser offenses, how many result in convictions, what sanctions are imposed, and how these results compare across different judges and different courts. Court monitoring programs usually are operated and funded by citizen organizations such as MADD, although Mississippi has funded a statewide court monitor (Century Council, 2008).

Use: As of 2006, court monitoring programs were active in at least 13 States (Syner, 2006). It is generally believed that court monitoring has decreased substantially since the mid-1980s, when Probst, Lewis, Asunka, Hershey, and Oram (1987) identified over 300 programs in the United States.

Effectiveness: Shinar (1992) found that court-monitored cases in Maine produced higher conviction rates and stiffer sentences than unmonitored cases. Probst et al. (1987) found that judges, prosecutors, and other officials in 51 communities believed that court monitoring programs helped increase DWI arrests, decrease plea agreements, and increase guilty pleas.

Costs: The main requirement for a court monitoring program is a reliable supply of monitors. Monitors typically are unpaid volunteers from MADD, RID, or a similar organization. Modest funds are needed to establish and maintain court monitoring records and to publicize the results.

Time to implement: Court monitoring programs can be implemented very quickly if volunteer monitors are available. A few weeks will be required to set up the program and train monitors.

3.4 Sanctions

Effectiveness: ★ ★	Use: Varies	Cost: Varies	Time: Varies
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The standard court sanctions for DWI offenses are driver’s license suspension or revocation, fines, jail, and community service. All States use some combination of these sanctions. Details of each State’s laws may be found in NHTSA’s *Digest of Impaired Driving and Selected Beverage Control Laws* (NHTSA, 2007a). Some States set mandatory minimum levels for some sanctions, which often increase for second and subsequent offenders.

DWI offenders also may have their driver’s licenses revoked or suspended administratively and may have sanctions imposed on their vehicles or license plates. See Chapter 1, Section 1.1, Administrative License Revocation or Suspension, and Chapter 1, Section 4.3, Vehicle and License Plate Sanctions, for discussions of these sanctions. See also NHTSA’s *Guide to Sentencing DWI Offenders* (NHTSA, 2006d) for an overview of sanctions and sentencing practices for judges and prosecutors, with extensive references. The *Guide* also includes screening and brief intervention, alcohol treatment, and DWI courts.

License suspension or revocation: All States allow post-conviction license actions. Twenty-eight States set a mandatory minimum length for first offenders. This suspension or revocation typically runs concurrently with any administrative license action. In most States, offenders may obtain an occupational or hardship license during part or all of the revocation or suspension period (NHTSA, 2007a).

Although administrative license actions are highly effective in reducing crashes (see Chapter 1, Section 1.1), court-imposed license actions appear less effective. A study of 46 States found that post-conviction license suspension had no discernable effects on alcohol-related fatal crashes (Wagenaar & Maldonado-Molina, 2007). Court-imposed license actions have few direct costs. As with administrative license actions, they should be accompanied by strategies to reduce driving with a suspended or revoked license.

Fines: Most States impose fines on DWI offenders. Twenty-eight States have mandatory minimum fines for first offenders, typically ranging from \$250 to \$500 (NHTSA, 2007a). In addition to fines, offenders often face substantial costs for license reinstatement, mandated alcohol education or treatment, insurance rate increases, and legal fees. Available evidence suggests that fines appear to have little effect on reducing alcohol-impaired driving. For example, in examining alcohol-related fatal crashes across 32 States, Wagenaar et al. (2008) concluded that mandatory fines “do not have clearly demonstrable general deterrent or preventive effects” (p. 992). They do, however, help support the system financially.

Jail: All States allow some DWI offenders to be sentenced to jail. Eighteen States require some jail time for first offenders, though 11 of these States allow community service in lieu of jail. Forty-nine States require jail for third offenders, though even these offenders can substitute community service in 9 States (NHTSA, 2007a).

Jail is the most severe and most contentious of the DWI sanctions. Jail is expensive: estimated to be \$20,267 in Ohio per inmate per year, for example (Century Council, 2008). Judges and prosecutors may be reluctant to use limited jail space for DWI offenders rather than “real” criminals. Offenses with mandatory jail terms may be pled down, or judges simply may ignore the mandatory jail requirement (Robertson & Simpson, 2002b).

Research on the effectiveness of jail is equivocal at best (Jones & Lacey, 2001, p. 119; NTSB, 2000). Very short (48-hour) jail sentences for first offenders may be effective (NTSB, 2000) and the threat of jail may be effective as a deterrent (as is done in DWI and Drug Courts), but other jail policies appear to have little effect. Wagenaar et al. (2000) reviewed 18 studies and concluded: “The balance of the evidence clearly suggests the ineffectiveness of mandatory jail sentence policies” (p. 12). In fact, they find “numerous studies that indicate that [mandatory jail] might be a counterproductive policy” (p. 12) that increases alcohol-related crashes.

Community service: Many States allow community service as part of a DWI offender’s sentence and 11 States allow community service in lieu of mandatory jail for first-time offenders (NHTSA, 2007a). Community service can provide benefits to society if offenders perform useful work, but even if appropriate jobs can be found there are costs for program operation, offender supervision, and liability. The effects of community service programs on alcohol-impaired driving have not been evaluated (Century Council, 2008).

Victim Impact Panels: In some jurisdictions, DWI offenders are required to attend a Victim Impact Panel, in which offenders hear from individuals whose lives have been permanently altered by an impaired driver. The evidence on Victim Impact Panels has been mixed. A few studies have shown positive results (Fors & Rojek, 1999), although most studies suggest Victim Impact Panels do not reduce recidivism (Shinar & Compton, 1995; Wheeler, Rogers, Tonigan, & Woodall, 2004).

4. Deterrence: DWI Offender Treatment, Monitoring, and Control

4.1 Alcohol Problem Assessment and Treatment

Effectiveness: ★ ★ ★ ★ ★	Use: High	Cost: Varies	Time: Varies
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It is widely recognized that many DWI first offenders and most repeat offenders are dependent on alcohol or have alcohol use problems. They likely will continue to drink and drive unless their alcohol problems are addressed. A DWI arrest provides an opportunity to identify offenders with alcohol problems and to refer them to treatment as appropriate. However, treatment should not be provided in lieu of other sanctions or as part of a plea bargain or diversion program that eliminates the record of a DWI offense (see Chapter 1, Section 3.2).

Alcohol problem assessment can take many forms, from a brief paper-and-pencil questionnaire to a detailed interview with a treatment professional. Alcohol treatment can be even more varied, ranging from classroom alcohol education programs to long-term inpatient facilities. For brief overviews of alcohol assessment and treatment programs and further references see Century Council (2008), Dill and Wells-Parker (2006), Jones and Lacey (2001), NCHRP (2005, Strategy C4), and Robertson, Simpson, and Parsons (2008).

Use: At present, 36 States require alcohol assessment and treatment as part of their alcohol-impaired driving laws (MADD, 2010). However, it is likely that some judges in all States assign some form of treatment to some DWI offenders.

Effectiveness: Even the best of the many assessment instruments currently in use is subject to error. Chang, Gregory, and Lapham (2002) found that none correctly identified more than 70% of offenders who were likely to recidivate. However, the assessment process itself can have therapeutic benefits. See Chapter 1, Section 5.1 on alcohol screening and brief interventions.

Wells-Parker, Bangert-Drowns, McMillan, and Williams (1995) reviewed the studies evaluating treatment effectiveness. They found that, on average, treatment reduced DWI recidivism and alcohol-related crashes by 7 to 9%. Treatment appears to be most effective when combined with other sanctions and when offenders are monitored closely to assure that both treatment and sanction requirements are met (Century Council, 2008; Dill & Wells-Parker, 2006).

Costs: Trained personnel are required to assess offenders. Treatment expenses vary widely depending on program type. Offenders can bear some of the costs of both assessment and treatment, though provisions must be made for indigent offenders. Both assessment and treatment require good record systems to track offenders and monitor progress.

Time to implement: Implementation time also varies depending on program type. The simplest can be implemented in several months, while others may take years.

Other issues:

- **Treatment options:** Alcohol assessment and treatment programs are long-term and expensive investments. States and communities should carefully weigh the costs and

benefits of the many options available before implementing any such programs. Implementation time will depend on the specific programs chosen.

- **DWI Courts:** Alcohol problem assessment and treatment are an integral part of DWI courts. In addition, a DWI court can sanction offenders who fail to complete assigned treatment programs. See Chapter 1, Section 3.1.
- **Other mental health issues:** Alcohol assessment and treatment provide an opportunity to address other problems that may underlie or contribute to problems with alcohol. One study found that more than 60% of DWI repeat offenders have experienced other psychiatric disorders in addition to alcohol-related problems, such as post-traumatic stress disorder, anxiety disorders, and bipolar disorder (Shaffer et al., 2007). This is substantially higher than the rate of about 30% for the general population.

4.2 Alcohol Interlocks

Effectiveness: ★ ★ ★ ★ ★ †	Use: Medium	Cost: Medium	Time: Medium
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† Proven for reducing recidivism

An alcohol ignition interlock prevents a vehicle from starting unless the driver provides a breath sample with a BAC lower than a pre-set level, usually .02. Interlocks typically are used as a condition of probation for DWI offenders, to prevent them from driving while impaired by alcohol after their driver's licenses have been reinstated.

Interlocks are highly effective in allowing a vehicle to be started by sober drivers but not by alcohol-impaired drivers. A post-start retest requires the driver to remain sober while driving. A data recorder logs the driver's BAC at each test and can be used by probation officers to monitor the offender's drinking and driving behavior. Marques and Voas (2010) provide an overview of interlock use, effectiveness, operational considerations, and program management issues. Marques (2005), Beirness and Robertson (2005), and Robertson, Vanlaar, and Beirness (2006) summarize interlock programs in the United States and other countries and discuss typical problems and solutions. See also Brunson and Knighten (2005), Practice #5, NCHRP (2003, Strategy C2), and presentations from the 10th Annual International Alcohol Interlock Symposium (TIRF, 2008). NHTSA offers an ignition interlock toolkit to assist policymakers, highway safety professions, and advocates (Sprattler, 2009). In addition, TIRF offers an alcohol interlock curriculum for practitioners (TIRF, 2010).

Use: As of July 2010, 47 States and the District of Columbia allow interlocks to be used for some DWI offenders (IIHS, 2010). The only exceptions are Alabama, South Dakota, and Vermont; however, Vermont passed a law in 2010 allowing for interlock use that will take effect in 2011. In 13 States interlocks are mandatory for all convicted offenders, including first offenders (IIHS, 2010). Thirty-six States considered legislation pertaining to interlocks in 2010, with new laws passing in 18 States (NCSL, 2010).

Despite widespread laws, only a small percent of eligible offenders have an interlock installed. However, interlock use has more than doubled in the past 5 years, from 101,000 in 2006 to 212,000 in 2010 (Roth, 2010). Use of interlocks is substantially higher when they are required as a prerequisite to license reinstatement. For example, among DWI offenders in Florida who were subject to the State's interlock requirement, 93% installed interlocks once they qualified for reinstatement (Voas, Tippetts, Fisher, & Grosz, 2010). Use of interlocks is also higher when interlocks are offered as an alternative to home confinement via electronic monitoring (Roth, Marques, & Voas, 2009).

Effectiveness: Beirness and Marques (2004) summarized 10 evaluations of interlock programs in the United States and Canada. Interlocks cut DWI recidivism at least in half, and sometimes more, compared to similar offenders without interlocks. After the interlock was removed, the effects largely disappeared, with interlock and comparison drivers having similar recidivism rates. A Cochrane review of 11 completed and 3 ongoing studies reached similar conclusions (Willis, Lybrand, & Bellamy, 2006). One limitation of interlock research is that study participants often are not randomly assigned to interlock or no-interlock groups, so there may be

important pre-existing differences between groups. However, the preponderance of evidence suggests that interlocks are an effective method for preventing alcohol-impaired driving while they are installed.

Costs: Interlock programs are managed by private interlock equipment providers. Costs in 2006 averaged about \$175 to install an interlock and \$2.25 per day while the interlock is installed. The offenders usually pay these costs (Marques, 2006). Illinois passed legislation in 2008 that creates a special fund to reimburse interlock providers when they install a device in the vehicle of an indigent offender (Savage et al., 2009).

Time to implement: Interlock programs may require enabling legislation. Once authorized, interlock programs require 4 to 6 months to implement a network of interlock providers.

Other issues:

- **Barriers to use:** Interlocks have demonstrated their effectiveness in controlling impaired driving while they are installed. In light of this success, their limited use may be due to several factors, such as long license suspension periods during which offenders are not eligible for any driving, judges who lack confidence in the interlock technology or who fail to enforce “mandatory” interlock requirements, and interlock costs. See Beirness and Marques (2004), Beirness, Clayton, and Vanlaar (2008), Beirness and Robertson (2005), and NCHRP (2003, Strategy C2) for discussion.
- **Public support:** There is strong support for ignition interlocks among the general public. In a national survey, 84% of respondents approved of requiring interlocks in the vehicles of convicted DWI offenders (McCartt, Wells, & Teoh, 2010). Moreover, almost two-thirds (64%) of respondents favored having alcohol detection technology in *all* vehicles.

4.3 Vehicle and License Plate Sanctions

Effectiveness: ★★ ★★ ★†	Use: Medium	Cost: Varies	Time: Short
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† Proven for reducing recidivism

In recent years many States have implemented sanctions affecting a DWI offender’s license plate or vehicle. These sanctions are intended to prevent the offender from driving the vehicle while the sanctions are in effect, and also to deter impaired driving by the general public. Vehicle and plate sanctions include:

- Special license plates for drivers whose licenses have been revoked or suspended. The plates allow family members and other people to drive the offender’s vehicle but permit law enforcement to stop the vehicle to verify that the driver is properly licensed.
- License plate impoundment. Officers seize and impound or destroy the license plate.
- Vehicle immobilization. Vehicles are immobilized on the offender’s property with a “boot” or “club.”
- Vehicle impoundment. Vehicles are stored in a public impound lot.
- Vehicle forfeiture. Vehicles are confiscated and sold at auction.

NHTSA (2008f) and Voas, Fell, McKnight, and Sweedler (2004) give an overview of vehicle and license plate sanctions and are the basic references for the information provided below. See also Brunson and Knighten (2005), Practice #4, and NCHRP (2003), Strategies B1, B2, and C1. All vehicle and license plate sanctions require at least several months to implement.

Use, effectiveness, and costs:

- Special license plates: Permitted in Georgia, Hawaii, Michigan, Minnesota, New Jersey, and Ohio (Voas, McKnight, Falb, & Fell, 2008). Ohio requires special plates for all first-time offenders with a BAC of .17 and above and for all repeat offenders. Effectiveness and costs have not been evaluated in any State. In the 1990s Oregon and Washington adopted a version of this strategy by allowing arresting officers to place a “zebra stripe” sticker on the license plate at the time of arrest. Oregon’s program proved effective in reducing DWI recidivism but Washington’s did not. Use has been discontinued in both States (NCHRP, 2003, Strategy B1; NHTSA 2008f).
- License plate impoundment: Used in 17 States (McKnight, Watson, Voas, & Fell, 2008). In Minnesota, license plate impoundment was shown to reduce recidivism when administered by the arresting officer (Rogers, 1995). Since plate impoundment does not involve the courts, it occurs quickly, consistently, and efficiently (NCHRP, 2003, Strategy B2; NHTSA, 2008f; NTSB, 2000). Fourteen States allow for impounding a vehicle’s registration (McKnight et al., 2008).
- Vehicle immobilization: Laws in 16 States allow vehicle immobilization (Voas et al., 2008). An evaluation in Ohio found that immobilization reduced recidivism (Voas, Tippetts, & Taylor, 1998). Costs are minimal compared to impoundment or forfeiture (NCHRP, 2003, Strategy C1; NTSB, 2000).
- Vehicle impoundment: 27 States and the District of Columbia allow for vehicle impoundment and some use it extensively (Voas et al., 2008). Vehicle impoundment reduces recidivism while the vehicle is in custody and to a lesser extent after the vehicle has been released. The strategy is costly, as storage fees can be \$20 daily and owners may

abandon low-value vehicles rather than pay substantial storage costs (NCHRP, 2003, Strategy C1; NTSB, 2000). In California, impoundment programs are administered largely by towing contractors and supported by fees paid when drivers reclaim their vehicles or by the sale of unclaimed vehicles. An evaluation of California's impoundment law found both first-time and repeat offenders whose vehicles were impounded had fewer subsequent arrests for driving with a suspended license and fewer crashes (De Young, 1997).

- **Vehicle forfeiture:** Thirty-five States have provisions allowing vehicle forfeiture for impaired driving and/or driving with a suspended license (Voas et al., 2008); however, there is little information on its use or effectiveness. Vehicle forfeiture programs must pay storage costs until the vehicles are sold or otherwise disposed (NCHRP, 2003, Strategy C1; NTSB, 2000).

Other issues:

- **To whom are vehicle sanctions applied:** Most vehicle sanctions have been applied to repeat offenders rather than first offenders, although some States also apply vehicle sanctions to high-BAC first offenders (e.g., a BAC of .15 or higher). If someone other than the offender owns the vehicle, the vehicle owner should be required to sign an affidavit stating they will not allow the offender to drive the vehicle while the suspension is in effect (NHTSA, 2008f).
- **Administrative issues:** All license plate and vehicle sanctions require an administrative structure to process the license plates or vehicles. Laws should permit officers to impound vehicles or license plates at the time of arrest so offenders do not have the opportunity to transfer vehicle ownership (NHTSA, 2008f).

4.4 DWI Offender Monitoring

Effectiveness: ★ ★ ★ ★ †	Use: Unknown	Cost: High	Time: Varies
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† Proven for reducing recidivism

The most successful methods for controlling convicted DWI offenders and reducing recidivism have the common feature that they monitor offenders closely. Close monitoring can be accomplished at various levels and in various ways, including a formal intensive supervision program, home confinement with electronic monitoring, and dedicated detention facilities. South Dakota’s 24/7 Sobriety Project is one example of an intensive supervision program. Participants are multiple offenders who are required to use no alcohol or drugs as a condition of remaining in the community and avoiding incarceration. The program includes daily breath testing, SCRAM ankle bracelets that monitor for alcohol consumption, and random drug testing. If an offender tests positive for alcohol or drugs, they are taken into custody and appear before a judge within 24 hours. The goal of the program is to ensure that sanctions are swift and certain.

For overviews of DWI offender monitoring and further references, see Century Council (2008), Jones and Lacey (2001), and NCHRP (2005, Strategy D4). DWI courts and alcohol ignition interlocks, which are discussed in Chapter 1, Sections 3.1 and 4.2, also assist in monitoring offenders closely. Guidelines for community supervision of DWI offenders are available from NHTSA (Dunlap, Mullins, & Stein, 2008).

Use: There are no data showing how extensively these programs are used.

Effectiveness: Intensive supervision programs, home confinement with electronic monitoring, and dedicated detention facilities all have been evaluated in individual settings and show substantial reductions in DWI recidivism. Recidivism was reduced by one-half in an intensive supervision program (Lapham, Kapitula, C’de Baca, & McMillan, 2006) and by one-third in an electronic monitoring program (Bruson & Knighten, 2005; Jones, Wiliszowski, & Lacey, 1996). A dedicated detention facility in Baltimore County had a 4 percent recidivism rate one year after program completion, compared to a normal recidivism rate of 35 percent for offenders (Century Council, 2008).

Costs: All close monitoring programs are more expensive than the standard high-caseload and low-contact probation but less expensive than jail. Electronic monitoring fees typically range from \$3 to \$15 per day (NCHRP, 2005, Strategy D3). New Mexico estimated that intensive supervision costs \$2,500 per offender per year compared to \$27,500 per offender per year for jail (Century Council, 2008). Dedicated detention facility costs can approach jail costs: \$37 per day in the Baltimore County dedicated detention facility compared to \$45 per day for jail (Century Council, 2008). Offenders can bear some program costs, especially for the less expensive alternatives (Century Council, 2008).

Time to implement: All close monitoring programs require many months to plan and implement. Dedicated facilities require years to plan and build.

4.5 Lower BAC Limits for Repeat Offenders

Effectiveness: ★ ★ ★ ★	Use: Low	Cost: Low	Time: Short
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All States now have an illegal *per se* BAC limit of .08. All States also have a BAC limit of .02 or lower for drivers under the age of 21. These laws reinforce the minimum drinking age 21 laws in all States that prohibit people under 21 from purchasing or possessing alcohol in public. As of 2001, 5 States also lowered the BAC limit for people convicted of DWI, to emphasize that they should not be driving after drinking even moderate amounts (Jones & Rodriguez-Iglesias, 2004).

Use: It is currently not known how many States have established lower BAC limits for drivers with one or more DWI offenses.

Effectiveness: In 1988, Maine established a .05 BAC limit for 1 year after a first DWI offense and for 10 years after a subsequent offense. Violators received an administrative license suspension. In 1995, this BAC limit was lowered to .00. Hingson, Heeren, and Winter (1998) evaluated the 1988 law and concluded that it reduced the proportion of repeat offender drivers in fatal crashes by 25%. Jones and Rodriguez-Iglesias (2004) evaluated the overall effects of both laws, using data from 1988-2001. They also concluded that the laws contributed to a reduction in the proportion of repeat offenders in fatal crashes, primarily due to a reduction in drivers at BACs of .10 and higher.

Costs: Implementation and operation costs are minimal. Jones and Rodriguez-Iglesias (2004) found that Maine’s laws had little or no effect on the operations of the DWI control system.

Time to implement: Lower BAC limit laws can be implemented as soon as legislation is enacted.

5. Prevention, Intervention, Communications, and Outreach

Prevention and intervention.

Prevention and intervention strategies seek to reduce drinking, or to prevent driving by people who have been drinking. Prevention and intervention work through laws, policies, and programs that:

- control hours, locations, and promotions of alcohol sales;
- implement responsible alcohol service practices;
- control alcohol purchase and use through increased alcohol taxes and restrictions on consumption in public locations such as parks and sports facilities; or
- provide alternatives to driving for people who have been drinking.

Prevention and intervention measures are especially important for those under 21. These are discussed in the Youth section that follows.

Many prevention and intervention measures fall under the authority of a State's alcohol control board rather than the SHSO. However, the SHSO can be a critical partner in many prevention and intervention activities. Only countermeasures directly associated with drinking and driving are discussed in this section. For information regarding more general countermeasures directed at alcohol see Grube and Stewart (2004), Toomey and Wagenaar (1999), and Alcohol Epidemiology Program (2000).

Communications and outreach.

Communications and outreach strategies seek to inform the public of the dangers of driving while impaired by alcohol and to promote positive social norms of not driving while impaired. As with prevention and intervention, education through various communications and outreach strategies is especially important for youth under 21. Education may occur through formal classroom settings, news media, paid advertisements and public service announcements, and a wide variety of other communication channels such as posters, billboards, Web banners, and the like.

Communications and outreach strategies are a critical part of many deterrence and prevention strategies. This section discusses only stand-alone communications and outreach countermeasures.

5.1 Alcohol Screening and Brief Interventions

Effectiveness: ★ ★ ★ ★ ★	Use: Medium	Cost: Medium	Time: Short
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Alcohol screening uses a few questions to estimate the level and severity of alcohol use and to determine whether a person may be at risk of alcohol misuse or dependence (SAMHSA, 2007). Brief interventions are short, one-time encounters with people who may be at risk of alcohol-related injuries or other health problems. Brief interventions focus on the awareness of the problem and motivation toward behavior change (SAMHSA, 2007). The combination of alcohol screening and brief intervention is most commonly used with injured patients in emergency departments or trauma centers. Patients are screened for alcohol use problems and, if appropriate, are counseled on how alcohol can affect injury risk and overall health. Patients also may be referred to a follow-up alcohol treatment program. Brief interventions take advantage of a “teachable moment” when a patient can be shown that alcohol use can have serious health consequences. Dill, Wells-Parker, and Soderstrom (2004) provide a summary of alcohol screening and brief intervention studies.

Use: Approximately one-half of trauma centers screen patients for alcohol problems and one-third use some form of brief intervention (NCHRP, 2005, Strategy A4; Schermer et al., 2003). Alcohol screening and brief interventions also are used in colleges, primary care medical facilities, and social service settings (NCHRP, 2005, Strategy A4; Jones & Lacey, 2001). NHTSA offers a toolkit to assist in conducting screening and brief intervention on college campuses (Quinn-Zobeck, 2007).

Effectiveness: Many studies show that alcohol screening and brief intervention in medical facilities can reduce drinking and self-reported driving after drinking (D’Onofrio & Degutis, 2002; Moyer, Finney, Swearingen, & Vergun, 2002; Wilk, Jensen, & Havighurst, 1997). Dill et al. (2004) reviewed nine studies that evaluated alcohol screening and brief intervention effects on injury. These studies generally found that alcohol screening and brief intervention reduced both drinking and alcohol-related traffic crashes and injuries.

Costs: Alcohol screening and brief intervention in medical facilities require people with special training to administer the intervention.

Time to implement: Procedures for alcohol screening and brief intervention are readily available, for example from the American College of Emergency Physicians (ACEP, 2006) or the National Institute on Alcohol Abuse and Alcoholism (NIAAA, 2005), and can be implemented as soon as staff is identified and trained.

Other issues:

- **Alcohol exclusion laws:** An alcohol exclusion law (Uniform Accident and Sickness Policy Provision Law or UPPL) allows insurance companies to deny payment to hospitals for treating patients who are injured while impaired by alcohol or a non-prescription drug (NHTSA, 2008g). These laws may cause hospitals to be reluctant to determine the BAC of an injured driver and may limit the use of alcohol screening (although screening does not measure the patient’s BAC). As of July 2010, alcohol exclusion laws were in effect in

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38 States (GHSA, 2010a), though the extent to which insurance companies deny payment is, at best, sporadic.

5.2 Mass Media Campaigns

Effectiveness: ★ ★ ★	Use: High	Cost: High	Time: Medium
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A mass media campaign consists of intensive communications and outreach activities regarding alcohol-impaired driving that use radio, television, print, and other mass media, both paid and/or earned. Mass media campaigns are a standard part of every State’s efforts to reduce alcohol-impaired driving. Some campaigns publicize a deterrence or prevention measure such as a change in a State’s DWI laws or a checkpoint or other highly visible enforcement program. Others promote specific behaviors such as the use of designated drivers, illustrate how impaired driving can injure and kill, or simply urge the public not to drink and drive. Campaigns vary enormously in quality, size, duration, funding, and every other way imaginable. Effective campaigns identify a specific target audience and communications goal and develop messages and delivery methods that are appropriate to, and effective for, the audience and goal (Williams, 2007).

Use: Most States use some form of alcohol-impaired driving mass media campaign every year. Mass media campaigns are an essential part of many deterrence and prevention countermeasures that depend on public knowledge to be effective. Congress provides funding for two paid media campaigns yearly (during the two weeks leading up to Labor Day and the last two weeks of December), which are designed to publicize the National Impaired Driving Crackdown.

Effectiveness: Most mass media campaigns are not evaluated. Elder et al. (2004) studied the few available high-quality evaluations. The campaigns being evaluated were carefully planned, well-funded, well-executed, achieved high levels of audience exposure (usually by using paid advertising), had high-quality messages that were pre-tested for effectiveness, and were conducted in conjunction with other impaired-driving activities. These mass media campaigns were associated with a 13% reduction in alcohol-related crashes. Levy, Compton, and Dienstfrey (2004) documented the costs and media strategy of a high-quality national media campaign and its effects on driver knowledge and awareness.

Costs: High-quality and effective mass media campaigns are expensive. Funds are needed for market research, design, pre-testing, and production. Paid advertising expenses depend on the media chosen and the media markets needed to reach the target audience.

Time to implement: A high-quality mass media campaign will require at least 6 months to research, plan, produce, and distribute.

Other issues:

- **Campaign quality:** Poor-quality or stand-alone campaigns that are not tied to program activities are unlikely to be effective. Similarly, although public service announcements are a relatively inexpensive way to deliver messages about impaired driving, they are likely to be aired infrequently, reach small audiences, miss the target audience and have little or no effect. To be successful, mass media campaigns must be carefully pre-tested, communicate information not previously known, be long-term, and have substantial funding (Williams, 2007).

- **Comprehensive media strategy:** Mass media campaigns should be planned as part of an overall communications and outreach strategy that supports specific impaired driving activities, such as enforcement.
- **Social norms campaigns:** Social norms marketing campaigns are a more recent approach to reducing alcohol-related crashes. They are built on the premise that an individual's behavior is influenced by his or her perceptions of how most people behave. A study in Montana demonstrates the potential effectiveness of this approach. Surveys of young adults age 21 to 34 in Montana revealed that only 20% had driven in the previous month after consuming two or more alcoholic drinks, although more than 90% thought their peers had done so. Based on this finding, a paid media campaign was developed with the normative message, "MOST Montana Young Adults (4 out of 5) Don't Drink and Drive." By the end of the campaign, there was a 13.7% decrease in young adults who reported driving after drinking relative to a comparison community (Linkenbach & Perkins, 2005).

5.3 Responsible Beverage Service

Effectiveness: ★ ★	Use: Medium	Cost: Medium	Time: Medium
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Responsible beverage service covers a range of alcohol sales policies and practices that prevent or discourage restaurant and bar patrons from drinking to excess or from driving while impaired by alcohol. Server training programs teach servers how to recognize the signs of intoxication and how to prevent intoxicated patrons from further drinking and from driving. Management policies and programs include limits on cheap drinks and other promotions, support for designated driver programs, strong commitment to server training, and strong support for servers who refuse alcohol to intoxicated patrons. NCHRP (2005, Strategy A2) provides an overview of responsible beverage service. See also Wagenaar and Tobler (2007) for a review and discussion of the research literature on this issue.

Beginning in the early 1980s, a major effort was undertaken to encourage alcohol servers to comply with laws prohibiting the sale of alcoholic beverages to visibly intoxicated patrons. Since that time, many “server intervention” programs have been developed as a means of securing more responsible behavior on the part of servers. Some States have mandatory programs that require at least some alcohol retail employees to attend a server training course. Other States have voluntary programs that provide incentives for retailers to participate (e.g., liability protection or insurance discounts). The quality of server training programs can vary considerably. Wagenaar and Tobler (2007) note that many server training laws “are not optimally designed, do not ensure quality training, and do not ensure all servers are consistently trained, or retained periodically” (p. 158).

Server training programs are the only segment of responsible beverage service for adults that has been documented and evaluated well. Activities directed at people under 21 are discussed separately in Chapter 1, Sections 6.1 through 6.4.

Use: As of 2005, 17 States had some form of mandatory server training program in place; another 15 States had voluntary programs (Wagenaar & Tobler, 2007).

Effectiveness: The findings on the effectiveness of server training have been mixed. In their systematic review, Shults et al. (2001) found five high-quality evaluations of server training programs. They concluded that “intensive, high-quality, face-to-face server training, when accompanied by strong and active management support, is effective in reducing the level of intoxication in patrons” (p. 80). When server training programs are not intensive and are not supported, they are unlikely to result in greater refusals of service to intoxicated patrons.

Few studies have examined the effect of server training on alcohol-impaired crashes. An evaluation of a statewide server training program in Oregon found a 23% reduction in single-vehicle nighttime injury crashes following the program (Holder & Wagenaar, 1994). However, Molof and Kimball (1994) reviewed the same Oregon program and observed no decline in alcohol-related fatalities.

Costs: A typical alcohol server course takes about 4 to 8 hours. Course costs can be borne by the servers themselves, their employers, or the State.

Time to implement: Server training courses are offered by several private vendors and can be implemented in a few weeks. A statewide requirement for server training or more general responsible beverage service policies would require time to enact any necessary legislation, establish policies, and provide for program administration.

Other issues:

- **Program quality:** The quality of responsible beverage service programs can vary enormously, from excellent to abysmal. Management support can vary from enthusiastic to nonexistent. Shults et al. (2001) clearly limit their conclusions to high-quality programs with strong management support. The Alcohol Epidemiology Program (2000) cites several server training program evaluation studies that found no effect and notes that these programs may have been poorly supported or implemented.
- **Responsible beverage service is more than server training:** Grube and Stewart (2004) emphasize that management policy and its implementation may be at least as important as server training in determining responsible beverage service program effectiveness.
- **Enforcement of responsible beverage service:** Enforcement of alcohol service laws is key, but largely lacking. Mosher et al. (2009) identified three main reasons for this: (1) a lack of societal and political will to address violations; (2) limited resources for enforcement operations; and (3) statutory provisions that make collection of evidence overly burdensome. As a result, action against licensed establishments has historically been limited to case law action involving serious crashes. Although alcohol enforcement by police is almost exclusively directed toward drivers, research has demonstrated that enforcement of alcohol service laws can help ensure alcohol retailers follow responsible serving practices. For example, an enforcement program in Michigan resulted in a three-fold increase in refusals of service to “pseudo-patrons” who simulated intoxication (McKnight & Streff, 1994).

5.4 Alternative Transportation

Effectiveness: ★ ★	Use: Unknown	Cost: Medium	Time: Short
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Alternative transportation describes methods by which people can get to and from places where they drink without having to drive. Alternative transportation supplements normal public transportation provided by subways, buses, taxis, and other means.

Ride service programs transport drinkers home from, and sometimes to and between, drinking establishments using taxis, private cars, buses, tow trucks, and even police cars. Some will drive the drinker's car home along with the drinker. Most operate only for short periods of the year, such as the Christmas and New Year's holidays. Many are free; some charge users a minimal fee; some are operated commercially on a for-profit basis. Ride service programs are relatively inexpensive and easy for communities to implement. Although it can be difficult to measure the effectiveness of these programs, they can play a role in a community's efforts to reduce drinking and driving. For an overview, see Decina, Foss, Tucker, Goodwin, and Sohn (2009), Jones and Lacey (2001, pp. 133-134), and NCHRP (2003, Strategy E1).

Use: During the 1980s, 325 programs were in operation in 44 States and the District of Columbia (Harding, Apsler, & Goldfein, 1987). There is limited information on ride service programs currently in operation, although some data is available on the NHTSA Buzzed Driving Facebook page: www.facebook.com/buzzeddrivingisdrunkdriving.

Effectiveness: Three studies have evaluated ride service programs. The first examined one year-round and one holiday program. Both functioned smoothly and delivered rides but neither demonstrated any effect on crashes (Molof et al., 1995). The second study examined a year-round program in Aspen, Colorado, and concluded that it reduced injury crashes in the surrounding county by 15% (Lacey, Jones, & Anderson, 2000). Finally, a program in Wisconsin that provided rides to and from bars using older luxury vehicles resulted in a 17% decline in alcohol-related crashes during the first year (Rothschild, Mastin, & Miller, 2006). The program became largely self-sustaining through fares and tavern contributions. These three programs and others are summarized in Decina et al. (2009). After reviewing select programs, Decina et al. (2009) concluded that a model alternative transportation program (i.e., one that reduces alcohol-related crashes) should be continually available, free to users, and convenient and easy to use.

Costs: The major ride service program costs are for the rides that are provided. Short-term ride service programs can be operated largely with donated rides. Year-round programs need enough steady funding to accommodate demand (NCHRP, 2003, Strategy E1).

Time to implement: Short-term ride service programs can be established and operated informally in a few weeks. Longer-term programs need to establish long-term strategies for funding and managing the program.

5.5 Designated Drivers

Effectiveness: ★ ★	Use: Medium	Cost: Low	Time: Short
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Designated drivers are individuals who agree not to drink so they can drive their friends who have been drinking. Formal designated driver programs in drinking establishments provide incentives such as free soft drinks for people who agree to be designated drivers. Usually, though, designated driver arrangements are completely informal.

The designated driver concept has been questioned on two grounds: (1) designated drivers may still drink, though perhaps less than the passengers; and (2) it may encourage passengers to drink to excess. In a survey of drinkers age 21 to 34, 62% said they did not drink the last time they served as a designated driver, and only 3% said they had three or more drinks. However, almost half reported drinking more than usual the last time someone else served as the designated driver (Rivara et al., 2007).

Use: The designated driver concept is widely understood and accepted. Surveys show that designated driver use is common. For example, about one-third of college students in a national survey in 1993 reported that they had served as a designated driver, and one-third of students who drink had ridden with a designated driver (Hedlund, Ulmer, & Preusser, 2001).

Effectiveness: Because designated drivers are informally determined and somewhat imprecisely defined, it's no surprise there is little data on the impact of designated drivers on crashes. CDC's systematic review found insufficient evidence to determine the effectiveness of designated driver programs (Ditter et al., 2005). A review from Australia concluded that designated driver programs can successfully increase awareness and use of designated drivers, but evidence for changes in alcohol-related crashes is inconclusive (Nielson & Watson, 2009). However, the authors note the lack of supporting evidence "does not necessarily mean that such programs should be discouraged. On the contrary, it highlights the need for them to be better implemented and evaluated" (Nielson & Watson, 2009, p.36).

Costs: The only costs associated with informal designated driver programs are for publicity. Designated drivers can be promoted independently or can be included with other impaired driving publicity. Establishments that operate formal designated driver programs have minimal costs for the drinks provided and for publicity.

Time to implement: Designated driver promotion can be implemented in a few weeks and formal programs can be established equally quickly.

6. Underage Drinking and Alcohol-Impaired Driving

Teenagers drink and drive less often than adults, but they are more likely to crash when they do drink and drive (Williams, 2003). Teenagers are inexperienced with both driving and drinking. Consequently, they have a higher crash risk at all BAC levels than adult drivers (Mayhew et al., 1986; Zador, Krawchuck, & Voas, 2000). Alcohol-related crashes among teenagers are typically associated with driving at nighttime, on weekends, and with passengers (Bingham, Shope, Parow, & Raghunathan, 2009).

Many of the countermeasures described in previous sections of this chapter apply not only to adults, but to teenagers as well. However, there are some countermeasures to reduce drinking and alcohol-related crashes that are directed specifically to those under 21.

Since 1987, minimum-drinking-age laws in all States prohibit youth under 21 from purchasing alcohol or consuming it in public. These laws influence all youth impaired-driving strategies. For people 21 and older, drinking is legal but driving while impaired by alcohol is not. With a BAC limit of .08, drivers know they should not drive after drinking “too much,” but are faced with mixed messages at low levels of alcohol, because lower BAC’s are not illegal *per se*. The message for those under 21 is unambiguous: they should not be drinking at all, and certainly should not be driving after drinking.

Zero-tolerance laws in all States reinforce this message by setting a maximum BAC limit of .02 or less for drivers under 21. This effectively prohibits driving after drinking *any* amount of alcohol. Many policies and programs reinforcing the no-drinking message are directed primarily at youth (beer keg registration) or take place in schools or youth organizations (Students Against Destructive Decisions clubs, alcohol-free prom and graduation parties). Youth receive education and information about alcohol and alcohol-impaired driving in schools and colleges and through media directed to youth.

The minimum-drinking-age laws and the no-drinking message for youth mean that youth impaired-driving activities must work hand-in-hand with activities to control youth drinking. With the exception of zero-tolerance law enforcement, all the countermeasures discussed below require cooperative activities between traditional highway safety organizations, such as law enforcement and motor vehicle departments, and community, health, and educational organizations with a broader social agenda than traffic safety.

6.1 Minimum Drinking Age 21 Laws

Effectiveness: ★ ★ ★ ★ ★	Use: High	Cost: Low	Time: Low
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The minimum legal drinking age (MDA) has been 21 in all States since 1987. There is strong evidence that MDA-21 laws reduced drinking, driving after drinking, and alcohol-related crashes and injuries among youth (Hingson et al., 2004; McCartt, Hellinga, & Kirley, 2010; Shults et al., 2001). In fact, MDA-21 laws reduced youth drinking and driving more than youth drinking alone (using the measurements of self-reporting and testing of drinking drivers in fatal crashes). Drinking and driving has become less socially acceptable among youth, and more youth have separated their drinking from their driving (Hedlund et al., 2001).

The specific laws implementing MDA 21 for alcohol vendors, adults, and youth differ substantially from State to State. See Alcohol Epidemiology Program (2000) and Century Council (2005) for State-by-State summaries of some of the key provisions.

MDA-21 law enforcement is very limited in many communities (Hedlund et al., 2001). Enforcement can take several forms, as summarized by Stewart (1999):

- Actions directed at alcohol vendors: compliance checks to verify that vendors will not sell to youth.
- Actions directed at youth: “use-and-lose” laws that confiscate the driver’s license of an underage drinker, “Cops in Shops” directed at underage alcohol purchasers, law enforcement “party patrols” using party dispersal techniques, and penalties for using false identification.
- Actions directed at adults: beer keg registration laws, enforcement of laws prohibiting purchasing alcohol for youth, shoulder tap operations, and programs to limit parties where parents provide alcohol to youth.

While these enforcement strategies have been used frequently, few have been evaluated. Four strategies with some research evidence are discussed below, followed by a program and a discussion of comprehensive, multi-strategy community programs.

Alcohol vendor compliance checks: In a compliance check or “sting,” law enforcement officers watch as underage people attempt to purchase alcohol and cite the vendor for an MDA-21 violation if a sale is made. Vendors can include on-premise retailers (e.g., bars and restaurants) or off-premise outlets (e.g., convenience stores or liquor stores). Several studies document that well-publicized and vigorous compliance checks reduce alcohol sales to youth; for example, a review of eight high quality studies found that compliance checks reduced sales to underage people by an average of 42% (Elder et al., 2007). Compliance checks require strong community support, education for alcohol vendors on their responsibilities under MDA 21, and publicity to underage youth. They require staff time from traffic or alcohol beverage control staff. See NCHRP (2005, Strategy A3) for a full discussion.

“Use and lose” laws: These laws allow confiscation of the driver’s license or postpone licensure for a period of time for youth who violate a State’s MDA-21 law. In the only study to date, Ulmer et al. (2001) investigated “use and lose” law implementation and effects in

Missouri and Pennsylvania. Missouri suspended the driver's licenses of most youth arrested for DWI but rarely suspended the licenses of youth who violated the MDA-21 law by drinking but not driving. Pennsylvania, in contrast, applied the "use and lose" law to violations of the MDA-21 both for youth arrested while driving and youth arrested while not driving. Pennsylvania's "use and lose" license suspensions appeared to reduce subsequent traffic violations and crashes. "Use and lose" laws can be implemented quickly and inexpensively once enacted. To be effective, they should be publicized extensively. As of 2006, 29 States have "use and lose" laws and another 10 States and the District of Columbia have "use and lose" authority that may be applied in varying circumstances (NHTSA, 2006c).

Keg registration laws: These laws link beer keg purchasers to an identification number on the keg, which provides a method of identifying adults who supply beer to parties attended by youth. As of 2000, 12 States and the District of Columbia had keg registration laws (Alcohol Epidemiology Program, 2000). In the only study on the effectiveness of these laws, keg registration was shown to be associated with reduced traffic fatality rates in 97 United States communities (Cohen, Mason, & Scribner, 2001). However, the authors could not conclude that key registration *caused* the lower fatality rates.

Media campaigns: Ohio has conducted a statewide media campaign, *Parents Who Host Lose the Most*, since 2000. The campaign informs parents and youth about Ohio's underage drinking laws and attempts to discourage parents from providing alcohol to underage drinkers at parties. Telephone surveys in 2006 showed that about 55% of parents and youth had heard messages about underage drinking (Applied Research Center, 2008). About two-thirds of those who had heard a message said that it prompted a conversation between parents and their teenagers about drinking. In comparison with surveys conducted in 2001, there was a 42% decrease among youth who reported knowing of parents who host parties where alcohol is served to teens.

Underage Drinking Tipline: In 2006 Kansas launched a statewide underage drinking tipline, 866-MustB21. The toll-free tipline operates 24 hours a day, seven days a week, for citizens to report parties involving underage drinking, plans to purchase alcohol for underage people, and willingness of retailers to sell alcohol to underage people. The effect of the tipline has not been evaluated. Nebraska introduced a statewide underage drinking tipline in 2009, using the same phone number as Kansas.

Comprehensive community programs: Several comprehensive community initiatives have reduced youth drinking and alcohol-related problems (Hingson et al., 2004; Shults et al., 2009). These initiatives typically bring together several community government departments, such as schools, health, and law enforcement, with alcohol sellers, parents, youth, and citizen organizations. They may include school-based programs, law enforcement, media, and other intervention strategies. They require strong leadership and organization. They may take many months to plan and implement. Costs depend on the activities included. A recent example is a campaign conducted in Huntington, West Virginia, that included checkpoints to look for violations of the MDA-21 law, checks of alcohol outlets to reduce sales to minors, and publicity for program activities. Roadside surveys conducted before and during the program showed a 93% drop in 16- to 20-year-old drivers having BACs greater than .05 (IIHS, 2008).

6.2 Zero-Tolerance Law Enforcement

Effectiveness: ★ ★ ★	Use: Unknown	Cost: Medium	Time: Short
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Zero-tolerance laws set a maximum BAC of .02 or less for drivers under 21. Violators have their driver's licenses suspended or revoked. There is strong evidence that zero-tolerance laws reduce alcohol-related crashes and injuries (Jones & Lacey, 2001; NCHRP, 2005, Strategy B3; Shults et al., 2001). Fell, Fisher, Voas, Blackman, and Tippetts (2009) estimate that zero-tolerance laws save 159 lives each year.

However, zero-tolerance laws often are not actively enforced or publicized (Hedlund et al., 2001; Jones & Lacey, 2001). Studies have found that young drivers are not arrested in proportion to their involvement in alcohol-related crashes (Hingson, Assailly, & Williams, 2004). One exception is the State of Washington, where a study found that arrests for alcohol violations among 16- to 20-year-old drivers increased by about 50% after the zero-tolerance law went into effect (McCartt, Blackman, & Voas, 2007). Enforcement may be greater in Washington because the law allows officers to request a test for alcohol based on suspicion of either a DWI or zero-tolerance offense. In other States where drivers can only be tested if DWI is suspected, zero-tolerance laws may be more difficult to enforce.

Use: Zero-tolerance laws have been in effect in all States since 1998. The degree to which zero-tolerance laws are enforced in States is unknown.

Effectiveness: An early study in Maryland found that alcohol-involved crashes for drivers under age 21 dropped by 21% in six counties after the zero-tolerance law was implemented. After the law was publicized extensively, these crashes dropped by an additional 30% (Blomberg, 1992). No other studies have examined the effect of increasing enforcement and publicity for an existing zero-tolerance law. Lacey, Jones, and Wiliszowski (2000) documented how zero-tolerance laws are administered and enforced in four States. Highly publicized enforcement has proven effective in increasing compliance with many traffic safety laws and reducing crashes and injuries: see for example checkpoints (Chapter 1, Section 2.1) and seat belt use mobilizations (Chapter 2, Section 2.1).

Costs: Zero-tolerance laws can be enforced on regular patrol or on special patrols directed at times and areas when young drinking drivers may be present. Enforcement will require moderate costs for appropriate training, publicity, and perhaps equipment (see Other Issues).

Time to implement: Enforcement programs can be implemented within three or four months, as soon as appropriate training, publicity, and equipment are in place.

Other issues:

- **Zero-tolerance-law provisions:** Zero-tolerance laws are far easier to enforce if the offense is an administrative rather than criminal violation, and if law enforcement officers can use PBTs at the roadside to determine if the law has been violated and to seize the driver's license if it has (Jones and Lacey, 2001). Some State laws require the same probable cause as for a standard DWI arrest, or even require a full DWI arrest,

before a BAC test for a zero-tolerance-law violation can be administered. In these States, the zero-tolerance law is not enforced independently of the standard DWI law, and in fact young drivers may not be aware of the zero-tolerance law (Hingson et al., 2004).

- **PBT and PAS:** Preliminary breath test devices (PBTs) are important to effective and efficient enforcement in States that allow PBT use for zero-tolerance laws. A passive alcohol sensor (PAS) can help officers detect violators who have consumed alcohol. See Chapter 1, Sections 2.3 and 2.4.
- **Holding juveniles in custody:** A complication of enforcing zero-tolerance laws is deciding how and where to hold young offenders once they are taken into custody. NHTSA helped produce an implementation guide for developing a juvenile holdover program (NHTSA, 2001).

6.3 Youth Programs

Effectiveness: ★ ★	Use: High	Cost: Varies	Time: Medium
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States and communities have conducted extensive youth drinking-and-driving-prevention programs over the past 25 years. These programs seek to motivate youth not to drink, not to drink and drive, and not to ride with a driver who has been drinking. Although some programs use scare tactics, many employ positive messages and methods: providing positive role models that discourage alcohol use, promoting positive norms that do not involve alcohol, and encouraging youth activities that do not involve or lead to alcohol use.

The best-known youth program is SADD, founded in 1981 as Students Against Driving Drunk, then renamed Students Against Destructive Decisions. SADD currently has an estimated 10,000 chapters in the United States, with a total of 350,000 active student members (SADD, 2010). Some States conducted similar activities under different names, such as Students Taking a New Direction (STAND) in Colorado and Stopping Automobile Fatalities Through Youth Efforts (SAFTYE) in Washington State. One specific activity, operated either by a youth program or independently, is Project Graduation, which provides alcohol-free prom and graduation parties for high school students. See Hedlund et al. (2001) for brief examples of State programs.

A more recent type of approach focuses on “social norms” or “normative feedback.” Social norms programs are based on studies showing that students often overestimate alcohol use among their peers. By providing students with accurate information about drinking, social norms programs reduce the pressure that light- or non-drinkers feel to drink, and help heavier drinkers realize that their drinking is atypical (Perkins 2002, 2003). Although many social norms programs focus on alcohol or other substance use, a few have addressed drinking and driving. Examples of social norms programs can be found at the National Social Norms Institute (www.socialnorms.org).

Use: Youth programs of some type are conducted in most, if not all, States.

Effectiveness: CDC’s systematic review found there was insufficient evidence to determine the effectiveness of youth programs (Elder et al., 2005). Two studies have attempted to evaluate SADD’s activities and effects. One study, in two schools, found that neither school implemented the model SADD program well and found no evidence of effects on any drinking and driving measure. The second study, in six schools, found that SADD affected drinking and driving attitudes as well as self-reported drinking and driving (Hedlund et al., 2001).

One study has examined the long-term effects of a social norms program on drinking and driving. Breath samples were taken from students at a large public university as they returned home late at night. Following the social norms program, there was a marginally significant decrease in drivers who registered a positive BAC, from 15.3% to 10.8%. Among drivers who had been drinking, self-reported number of drinks consumed and measured BACs decreased, as did the number of drinking-drivers who reported having five or more drinks at one sitting on the night of the survey (Goodwin, 2004).

Costs: Youth program costs can vary substantially depending on the size and nature of the individual activities. States have spent substantial funds, both Federal and non-Federal, on youth drinking-and-driving programs. These funds have been used for a variety of youth education, enforcement, and program activities.

Time to implement: With model programs available and organizations such as SADD and MADD available for assistance, youth programs can be started easily in 6 months.

6.4 School Education Programs

Effectiveness: ★	Use: Unknown	Cost: Low	Time: Long
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Elementary and secondary schools often include education on alcohol, impaired driving, and traffic safety as regular topics in health and driver education courses.

Use: Health education is a standard course for most students, but the coverage of impaired-driving issues is not known. Driver education is an elective course in some schools and is not offered in others. Commercial instructors offer driver education courses in many communities. In each, the coverage of impaired-driving issues is not known.

Effectiveness: Evaluations generally have found that prevention curricula have weak and inconsistent effects on alcohol use (Stewart, 1999). CDC’s systematic review found that education programs are effective in reducing riding with a drinking driver. There was insufficient evidence to determine the programs’ effectiveness in reducing drinking and driving (Elder et al., 2005).

Costs: Many education programs or course units are available. They must compete with other pressing educational needs for space in a crowded school curriculum.

Time to implement: School education programs require at least a year to plan, schedule, acquire material, and train teaching staff.

7. Drugged Driving

The impairing effects of alcohol and the dangers of drinking and driving are well-documented. By contrast, there is considerably less research investigating the potentially impairing effects of drugs on drivers. Compton, Vegega, and Smither (2009) and Stewart (2006) summarize some of the challenges in studying, measuring, and creating countermeasures to address drugged driving:

- There is a wide range of drugs, both licit and illicit, that can potentially impair driving. Moreover, the list of drugs in common usage is constantly changing.
- Although the relationship between BAC and driving impairment is clear and well-documented, the relationship between blood levels of drugs and driving impairment has not been established for drugs other than alcohol.
- Alcohol can be measured reliably through breath tests, but other types of drugs can only be measured through more intrusive tests of bodily fluids such as blood, urine, or saliva.
- Alcohol leaves the body in a predictable pattern, whereas other drugs are eliminated at many rates; hence, timing is critical when conducting a drug test. In addition, blood levels of certain drugs can accumulate with repeated administrations and be detected well after impairment has ceased.
- It is not unusual for drivers to take more than one impairing drug at the same time or to combine drugs with alcohol. Although individual drugs, taken at normal doses, may not impair driving, drug effects may be synergistic when taken together and substantially increase the risk of a crash.

Despite these challenges, a growing body of research suggests that many illicit, prescription, and over-the-counter drugs may impair a driver's ability to operate a vehicle (for reviews, see Couper & Logan, 2004; Jones, Shinar, & Walsh, 2003, and Kelly, Darke, & Ross, 2004). Much of this research has involved laboratory or experimental studies using driving simulators, although some epidemiological studies have examined the effect of drugs on crash prevalence and risk. See Compton et al. (2009) for a discussion of this research.

In most cases, the research investigating the effect of drugs on driving has had variable results. Several studies suggest that a benzodiazepine user is at increased risk of being involved in a crash (Movig et al., 2004; Rapoport et al., 2009), although some studies have not found these results. The findings for marijuana also have been inconclusive. Generally, the risk appears highest when marijuana has been used recently, and especially when marijuana is combined with alcohol (Beirness & Simpson, 2006; Sewell, Poling, & Sofuoglu, 2009). The relationship between antihistamines and motor vehicle crashes is also ambiguous, although less so than for other drugs (Moskowitz & Wilkinson, 2004). A small connection has been found between first-generation antihistamines and crashes, but second-generation antihistamines appear to cause less sedation. Fewer studies have examined the crash risks associated with stimulants (e.g., amphetamines and cocaine) and other types of drugs.

Compton et al. (2009) describe four basic issues that must be addressed to better understand the extent of the problem of drug-impaired driving:

- What drugs impair driving ability?
- What drug dose levels are associated with impaired driving?

- How frequently are impairing drugs being used by drivers?
- What drugs are associated with higher crash rates?

In sum, there are still sizeable gaps in our understanding of the effects of drugs on driving. In their review of drug-impaired driving, Jones et al. (2003) concluded: “The role of drugs as a causal factor in traffic crashes involving drug-positive drivers is still not understood.... Current research does not enable one to predict with confidence whether a driver testing positive for a drug, even at some measured level of concentration, was actually impaired by that drug at the time of crash” (p. 96). Perhaps the one consistent finding across studies is the risk of driver impairment increases substantially when drugs are combined with alcohol.

Similar to alcohol-impaired driving, drugged driving is primarily addressed through a combination of laws, enforcement, and education. Relatively few countermeasures have been developed to address drugged driving, and there has been little evaluation of drugged-driving countermeasures. Much more research is needed to better understand the nature and degree of traffic safety risk posed by drugs, as well as the effectiveness of potential countermeasures to address this issue.

7.1 Enforcement of Drugged Driving

Effectiveness: ★ ★ ★	Use: Unknown	Cost: Medium	Time: Short
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Enforcement of drugged driving laws can be difficult. Typically, drugged driving is only investigated when a driver is obviously impaired but the driver's BAC is zero (or low). If a driver has a BAC over the legal limit, there is often no reason to probe for drugs since in many States drugged driving carries no additional penalties.

Although several devices are available that allow officers to screen suspects for illegal drug use at point-of-contact, none have been proven to be accurate and reliable (Compton et al., 2009). Instead, a number of law enforcement agencies employ drug recognition experts (DREs) to assist in investigating potential drug-impaired driving cases. DREs use a standardized procedure to observe a suspect's appearance, behavior, vital signs, and performance on psychophysical and physiological tests to determine whether and what type of drug or drug category may have been used. If drug intoxication is suspected, a blood or urine sample is collected and submitted to a laboratory for confirmation.

Use: As of December 2010, 48 States and the District of Columbia had Drug Evaluation and Classification (DEC) programs, which are designed to train officers to become DREs (GHS, 2010c). These programs have prepared nearly 1,000 instructors and trained more than 6,000 officers (Compton & Berning, 2009).

There are no data on how frequently drugged driving is enforced. One study examining DEC programs in 5 States found only about 2% of all impaired driving suspects were evaluated by a DRE (Preusser, Ulmer, & Preusser, 1992). This suggests drugged driving arrests are not as common in comparison to arrests for alcohol-impaired driving. However, the DEC program has grown since 1992 and this research needs to be updated.

Effectiveness: Several studies have shown that DRE judgments of drug impairment are corroborated by toxicological analysis in 85% or more of cases (NHTSA, 1996). However, one experimental laboratory study found that DREs' ability to distinguish between impaired and non-impaired individuals was moderate to poor for several types of drugs, including marijuana, codeine, and amphetamines (Shinar, Schechtman, & Compton, 2000). The study found that DREs tended to rely on just one or two "pivotal" cues to identify specific drug impairment. To date, there have been no studies examining the effectiveness of enforcement in reducing drugged driving or crashes.

Costs: As with other enforcement strategies, the primary costs are for law enforcement time and training. The time to conduct a DRE evaluation can be 2 to 3 hours.

Time to implement: Drugged driving enforcement can be integrated into other enforcement activities within three months; however, time will be needed to train DREs in detecting drug impairment. DRE training consists of 9 days of classroom instruction, and DRE candidates are also required to perform a number of supervised field evaluations in order to become certified (Compton et al., 2009).

7.2 Drugged Driving Laws

Effectiveness: ★	Use: Medium [†]	Cost: Unknown	Time: Short
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[†]Use for drug *per se* laws

Although most States have laws that prohibit the use of impairing drugs by drivers, there is a great deal of variability in how States approach this issue. In some States, impairment-based statutes stipulate that prosecution must prove the driver was impaired (for example, by driving recklessly or erratically). Other States have *per se* laws in which it is illegal to operate a motor vehicle if there is any detectable level of a prohibited drug in a driver’s system. Hence, a positive drug test is sufficient for conviction. This is equivalent to “zero tolerance.”

NHTSA’s Report to Congress includes a model drugged driving law (Compton et al., 2009). Because the relationship between blood levels of drugs and driving impairment has not been established for drugs other than alcohol, the model law does not include a *per se* provision. However, NHTSA recommends States include enhanced penalties for drivers who are under the influence of multiple drugs (including alcohol). In addition, NHTSA recommends State statutes provide separate and distinct sanctions for alcohol-impaired driving and drugged driving (Compton et al., 2009).

Use: As of July 2010, 18 States have *per se* laws that forbid the presence of any prohibited drug while a driver is in control of a vehicle (GHSA, 2010c). Much more information about the drugged driving laws in each State can be found in Walsh (2009).

Effectiveness: To date, there have been no evaluations of the effect of drugged driving laws on the prevalence of drug-impaired driving or crashes.

Costs: The costs of drugged driving laws will depend on the number of offenders detected and the penalties applied to them.

Time to implement: Drugged driving laws can be implemented as soon as appropriate legislation is enacted, although time will be needed to train law enforcement officers, prosecutors, and judges about the new legislation and to inform the general public.

7.3 Education Regarding Medications

Effectiveness: ★	Use: Unknown	Cost: Unknown	Time: Long
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Some medications prescribed by a doctor can pose a risk for drivers. It is important that physicians, pharmacists, and patients receive information about the potential risk of motor vehicle crashes associated with certain medications. Perhaps the simplest way to achieve this would be through clear warning labels on packages. France uses a warning label system that has four categories:

- 0. No warning.
- I. Be careful: Read the patient leaflet carefully before driving.
- II. Be very careful: Seek advice from a physician or pharmacist before driving.
- III. Danger – Do not drive: Seek medical advice before driving again.

Entire classes of drugs may be classified in a particular category. For example, all hypnotic drugs are classified as category III. Any labeling scheme would need to be systematic. Presently in the United States, labeling is inconsistent and dependent on the individual pharmacy/pharmacist.

The International Council on Alcohol, Drugs, and Traffic Safety (ICADTS) has developed a categorization system for medicinal drugs that can affect driving performance (ICADTS, 2007). The list was intended for physicians and pharmacists so they could better identify medications that could impair driving skills and look for safer alternatives when possible. A number of other organizations also have developed classification systems for potentially impairing medications.

The effects of medications on driving are a particular concern with older drivers. LeRoy and Morse (2008) examined the association between multiple medication use and motor vehicle crashes among people 50 and older. The study found a large percentage of older people (64%) take medications that can potentially impair driving, and those taking three or more impairing medications were 87% more likely to be involved in a crash.

For recent reviews on medications and road safety, see de Gier (2006) and Vandrevalla, Helman, Turner, and Stone (2010).

Use and Effectiveness: There is little information available on how frequently this countermeasure is used in the United States, or how effective it has been in raising awareness, increasing knowledge, or changing behavior. NHTSA has worked with Walgreens, the country's largest drugstore chain, to develop a curriculum for pharmacists on medication-impaired driving. The curriculum includes modules that cover potentially driver-impairing prescription drugs, laws relating to medication use and DUI, and the role of pharmacists in counseling patients regarding medications and driving risk. A pilot test with 640 pharmacists showed the curriculum was effective in increasing pharmacists' knowledge of medication-related impaired driving (Lococo & Tyree, 2007).

Costs: Targeted education to physicians and pharmacists (through drug categorization systems) and to drivers (through warning labels) would be needed. The former would likely be the most costly.

Time to implement: Targeted communications could require a year or more to plan, produce, and distribute.

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2. Seat Belt Use and Child Restraints

Overview

Correctly using a child restraint for a young child or wearing a seat belt by older children and adults is the single most effective way to save lives and reduce injuries in crashes. Research has found that lap and shoulder combination seat belts, when used, reduce the risk of fatal injury to front-seat passenger car occupants by 45% and the risk of moderate-to-critical injury by 50% (NHTSA, 2001). For light-truck occupants, seat belts reduce the risk of fatal injury by 60% and moderate-to-critical injury by 65% (NHTSA, 2009a).

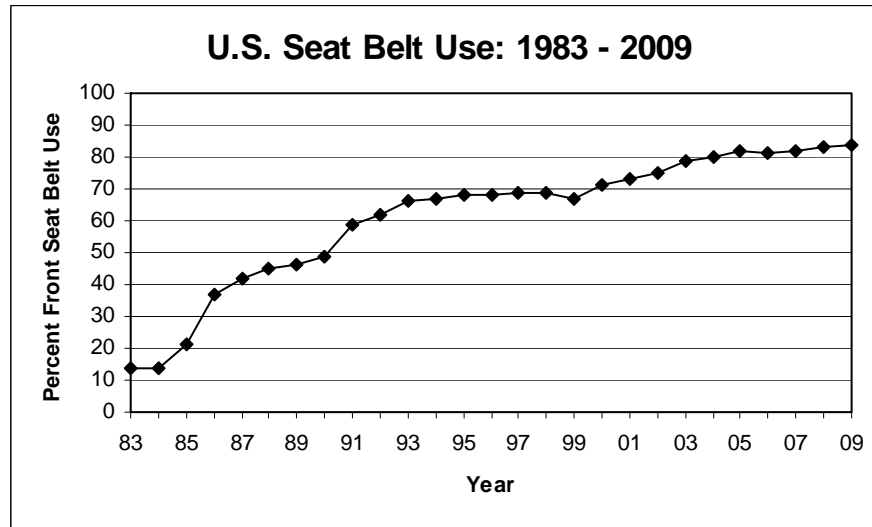
NHTSA estimates that correctly used child restraints are even more effective than seat belts in reducing fatalities. Child restraints reduce fatalities by 71% for infants younger than 1 year old and by 54% for children 1 to 4 years old in passenger cars. In light trucks, the fatality reductions are 58% for infants and 59% for children 1 to 4 years old (NHTSA, 1996). In addition, research conducted by the Partners for Child Passenger Safety (PCPS) Program at the Children's Hospital of Philadelphia found that belt-positioning booster seats reduce the risk of injury to children 4 to 8 in crashes by 45% when compared to the effectiveness of seat belts alone (Arbogast, Jermakian, Kallan & Durbin, 2009).

The challenge is to convince all passenger vehicle occupants to buckle up. Current data show that:

For adult drivers and passengers:

- Seat belt use nationwide was 85% in 2010 (NHTSA, 2010a);
- In 2009, belt use was greater than or equal to 90% in 17 States and Territories (Michigan, Hawaii, Oregon, Washington, California, Maryland, Iowa, District of Columbia, Texas, New Jersey, Indiana, Puerto Rico, Illinois, Nevada, Minnesota, New Mexico, and Alabama) (NHTSA, 2010a); but
- In 2009, belt use was less than 70% in 2 States and a Territory (New Hampshire and Wyoming, plus American Samoa) (NHTSA, 2010a).

See NHTSA's most recent reports (NHTSA, 2009a, 2010a) for the latest national and State data.

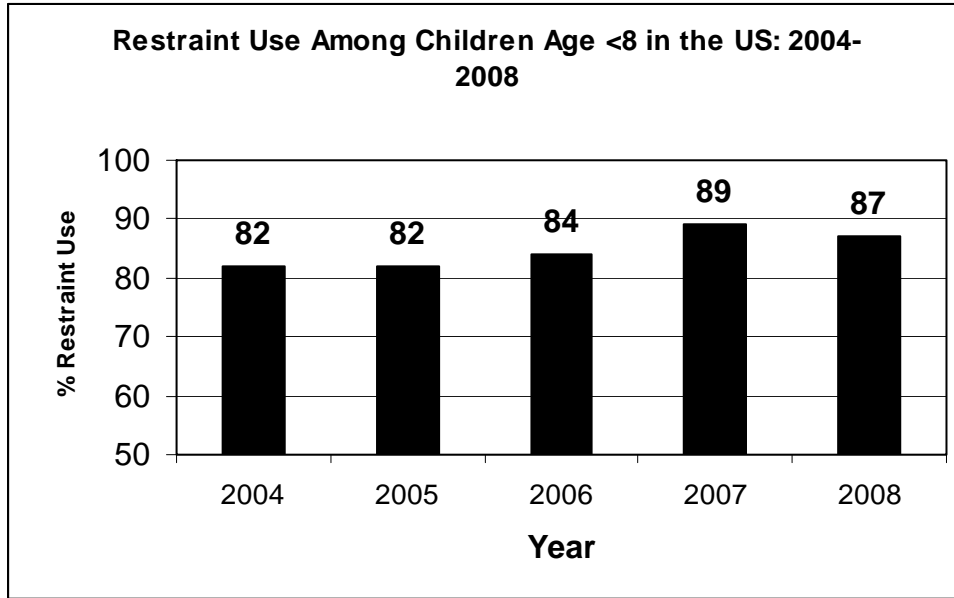


Source: NHTSA, National Occupant Protection Use Survey (NOPUS)

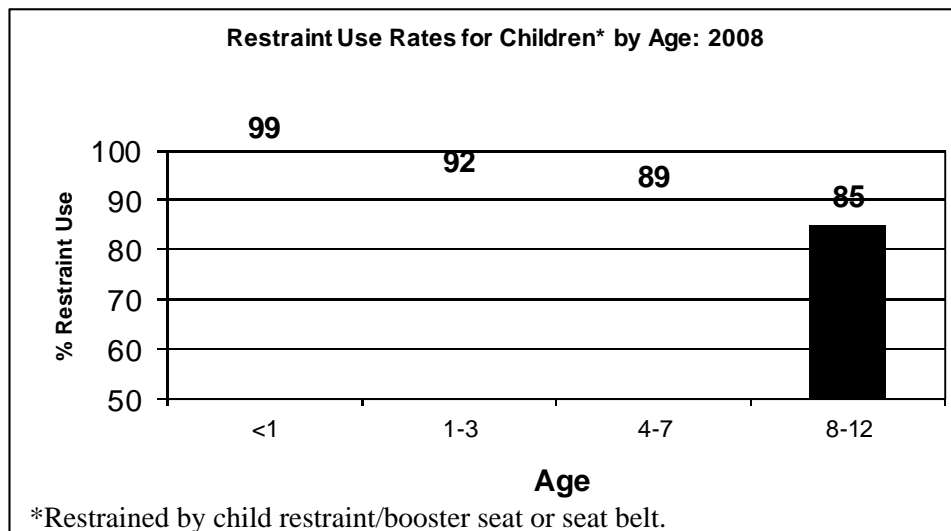
For child passengers:

- The restraint use for all children less than 8 years old was 87% in 2008 compared to 89% in 2007 (NHTSA, 2009b).
- In 2008, restraint use for children less than 12 years old was as follows: children less than age 1, 99%; children 1 to 3 years old, 92%; children 4 to 7 years old, 89%; and children 8 to 12 years old, 85% (NHTSA, 2009b). The restraint use for all age groups increased from their 2007 levels, other than for the 1- to 3-year-olds, which declined from 96% as reported by NHTSA (Ye & Pickrell, 2008).
- In 2008, 454 children under age 8 were killed as passengers in motor vehicle crashes (NHTSA, 2009a). Between 1975 and 2008, the motor vehicle fatality rate for children under age 5 dropped from 4.50 to 1.45 per 100,000 population (NHTSA, 2009c). Among children ages 5 to 9, the fatality rate decreased from 2.71 to 1.43 during that same time period.
- The National Survey of the Use of Booster Seats (NSUBS) found that in 2008:
 - About 21% of children who were under age 1 or less than 20 pounds were not in rear-facing child restraints as recommended by NHTSA, the American Academy of Pediatrics (AAP, 2002), and many other national organizations. Most of these children had been prematurely switched to front-facing restraints.
 - 61% of children who were 20 to 40 pounds were in either a rear-facing or forward-facing child restraint. Some of these 20- to 40-pound children may have been in booster seats with weight limits as low as 30 pounds.
 - NHTSA recommends that once children outgrow their forward-facing seats (usually at around age 4 and 40 pounds), they should ride in booster seats until they are at least eight years old or 4' 9" tall. However, the 2008 NSUBS found that 51% of the children who were 37 to 53 inches tall were in a child restraint or booster, 38% were in a seat belt, and 11% were unrestrained. Furthermore, only 14% of the children who were 54 to 56 inches tall were in a child restraint or booster, 70% were in a seat belt, and 15% were unrestrained. (NHTSA, 2009d).

- In 2003, the overall measure of “critical” child restraint misuse - misuse that could reasonably be expected to result in serious injury or death to the child - was found to be 73% with the most common critical misuses being loose harness straps securing the child to the child restraint and loose seat belt used to install the child restraint in the vehicle (Decina & Lococo, 2004).



Source: NHTSA, Child Restraint Use in 2008 - Overall Results



Source: NHTSA, The National Survey of the Use of Booster Seats 2008

Seat Belts for Adults – Trends and Laws

Trends. All new passenger cars had some form of seat belts beginning in 1964, shoulder belts in 1968, and integrated lap and shoulder belts in 1974 (ACTS, 2001). Few occupants wore the belts: surveys in various locations recorded belt use of about 10%. The first widespread survey, taken in 19 cities in 1982, observed 11% belt use for drivers and front-seat passengers (Williams & Wells, 2004). This survey became the benchmark for tracking belt use nationwide. The chart titled “U.S. Seat Belt Use: 1983 - 2008” in the section above shows the best available estimate of national belt use annually since 1983.

New York enacted the first belt use law in 1984. Other States soon followed. In a typical State, belt use rose quickly to about 50% shortly after the State’s belt law went into effect. However, during the year following the effective date of the law, the seat belt use rate usually decreased slightly, by about 4 percentage points on average (Nichols, 2002).

High-visibility, short-duration belt law enforcement programs, often called STEPs (Selective Traffic Enforcement Programs), “STEP waves,” or “blitzes,” were demonstrated in individual communities in the late 1980s. North Carolina’s *Click It or Ticket* program took this model statewide beginning in 1993 and raised the use rate above 80% (Williams & Wells, 2004). Statewide, multi-State, and national enforcement programs increased through the 1990s under different names and sponsors. These enforcement programs typically raised belt use by 13 to 26 percentage points, with greater gains where belt use was lower (Dinh-Zarr et al., 2001; Nichols, 2002). Belt use often decreased by about 6 percentage points after the enforcement program ended.

The *Click It or Ticket* model expanded nationwide in 2003 (Solomon, Compton, & Preusser, 2004). Programs have used extensive paid advertising as part of their communications and outreach strategies and have included strategies designed specifically to increase seat belt use among low-belt-use groups such as pickup truck drivers (Nichols, Tison, Solomon, Ledingham, Preusser, & Siegler, 2009), teens (Fell et al., 2005) and rural residents (Nichols, Tison, Solomon, Ledingham, & Preusser, 2009). The national belt use rate reached 84% in 2009 (NHTSA, 2010a). More recent research found that belt use, measured as observed or self-reported belt use or belt use in fatalities, increased nationwide and in almost all States during the 2000 – 2006 time period when these mobilizations were in operation and concluded that the *Click It or Ticket* mobilizations conducted during these years were an important factor in these increases in seat belt use (Tison & Williams, 2010).

Recent research has focused on the contrasts between daytime and nighttime crashes in terms of fatality rates and restraint use. According to 2005 FARS data, almost two-thirds (64%) of people killed at nighttime did not use restraints. In contrast, the percentage of fatally injured passenger vehicle occupants during daytime crashes who were unrestrained was just under one-half (47%) (Varghese & Shankar, 2007). Furthermore, according to FARS data for the 10-year period from 1998 to 2007, nighttime seat belt use was on average 18 percentage points lower than daytime belt use (Tison, Williams, & Chaudhary, 2010). Strategies to increase restraint use among nighttime drivers are currently being developed, implemented, and evaluated.

For more information on the history of belt systems, belt use laws, enforcement programs, and belt use trends, see ACTS (2001), Solomon et al. (2004), Milano, McInturff, and Nichols (2004), NCHRP (2004), NHTSA (2001, 2003b), Williams and Wells (2004), and Hedlund, Gilbert, Ledingham, and Preusser (2008).

Belt use laws. As of August 2010, all States except New Hampshire require adult passenger vehicle occupants to wear seat belts. The laws in 31 States plus the District of Columbia permit law enforcement officers to stop vehicles based solely on observed belt law violations. These are called standard or primary enforcement laws. The remaining 18 States have secondary enforcement laws that allow nonusers to be cited only after they first have been stopped for some other traffic violation (IIHS, 2010). In 2010, minimum fines in primary law States ranged from \$10 to \$200 with a fine of \$25 or more in all but 8 States. Minimum fines in secondary law States ranged from \$10 to \$75 with a fine of \$25 or less in all but 4 States (IIHS, 2010). Some laws cover only front-seat occupants or allow other exemptions.

Child Restraints and Seat Belts for Children – Trends and Laws

Trends. The first Federal standard for child restraints, FMVSS 213, went into effect in 1971 but did not require restraint systems intended for infants and small children to be dynamically tested. FMVSS 213 was amended such that, beginning in 1981, child restraints were required to be dynamically tested in a simulated 30 mph crash into a barrier, and has been amended several times since then to address issues of potential misuse of the child restraints, to require more stringent head excursion requirements, to accommodate larger and heavier children, and, since 2002, to be equipped with LATCH (Lower Anchors and Tethers for Children) attachments.

Child restraints are specially designed for the anatomies of infants and small children. Child restraints hold children in place and prevent them from being ejected from the vehicle or hitting the vehicle interior, and they do so while not loading dangerous levels of crash forces on vulnerable parts of a child's body. In the 1970s, child restraints were purchased and used by only a few parents. For instance, only 5% of the children younger than 6 years old in North Carolina crashes were restrained in any manner in 1978 (Hall, 1985).

During the 1970s, the medical community, governmental agencies and consumer/advocacy groups conducted widespread public awareness campaigns educating the public that children need to be protected in cars by restraints designed specifically for them. These educational and public awareness campaigns achieved only a modicum of success. Restraint use for children up to 4 years old was estimated to be only 15% in 1979 when Tennessee was the only State to have a child restraint law. Between 1978 and 1985, every State passed laws requiring safety seats for young child passengers. The public has supported the laws and generally understands why they are needed. By 1984, close to half of the child passenger population up to age 4 were riding in child restraints (Kahane, 1986).

One of the issues identified when these laws were being considered was the costs associated with obtaining child restraints. Many State and local organizations initiated programs to make child restraints available at low or no cost to parents through child restraint loan or rental programs

(Orr, Hall, Woodward, & Desper, 1987). Continuing educational and distribution programs, and especially the implementation and enforcement of child passenger safety laws, increased the levels of child restraint use to 80% for children up to age 4 in 1987 (Partyka, 1988). By 2008, child restraint use was over 90% (99% for age less than 1, 92% for ages 1 to 3), although rates drop markedly among children in successive age groups (NHTSA, 2009b).

The misuse of child restraints - that is, when the child restraint was not being used according to the manufacturer's instructions - is an issue that has been a concern for many years. Kahane (1986) found that the misuse of child restraints can reduce their effectiveness and that in 1984, the overall effectiveness of child restraints in use was reduced to 46% when misuse was taken into consideration. Observational surveys conducted at Hardees restaurants in 1984 measured the overall misuse of child restraints at 65% (Cynecki & Goryl, 1984). More recently, the overall measure of "critical" child restraint misuse - misuse that could reasonably be expected to result in serious injury or death to the child - was found to be 73% (Decina & Lococo, 2004).

Many programs have been implemented to provide parents and other caregivers with "hands-on" assistance with the installation and use of child restraints in an effort to combat widespread misuse. The NHTSA Standardized Child Passenger Safety Training Course, complemented by a national certification process, was developed and implemented in 1998 to train safety professionals and other interested parties in the fundamentals of child passenger safety. Individuals who successfully completed the course would then educate the public in using child restraint systems properly. The course consists of classroom instruction, "hands-on" exercises, and knowledge and skills assessments, and is typically spread across three or four days (Womack, De La Zerda, Block, & Guzzetta, 2005). According to the Safe Kids Worldwide CPS Certification program, there were 33,973 certified CPS technicians and instructors as of July 2010 (Safe Kids Worldwide, 2010).

Child passenger safety (CPS) inspection stations, sometimes called "fitting stations," are places or events where parents and caregivers can receive assistance from certified CPS technicians, and are popular services provided by a variety of local CPS programs. Guidebooks are available on how local programs can set up and operate a mobile CPS clinic or permanent inspection station (Hall, 1987; NHTSA 2003a).

Also in reaction to the high levels of child restraint misuse and incompatibility issues between seat belts and child restraints, a concept of standardized child restraint installation, initially called ISOFIX, was completed as an international standard in 1999 (Weber, 2000). The intent of ISOFIX, later renamed as LATCH (Lower Anchors and Tethers for Children) as implemented in the United States, is to provide a simpler way to install child restraints using special attachments that fasten to lower anchors built into the vehicle. In addition, LATCH consists of ready-to-use top tether anchors and tether straps on child restraints to hold forward-facing child restraints more securely in place.

In a LATCH use and misuse study (Decina, Lococo, & Doyle, 2006), 61% of child restraints installed in LATCH-equipped vehicles and installed with the lower attachments were correctly and securely installed. In the most recent national study before the LATCH study, less than 50%

of child restraints installed with seat belts were correctly and securely installed (Decina & Lococo, 2004).

As was noted above, high-visibility short-duration belt law enforcement programs, such as *Click It or Ticket*, have proven to be the most effective countermeasure to date for increasing seat belt use. There is concern, however, that law enforcement officers are reluctant to enforce child restraint laws due to a number of factors including a lack of commitment by their departments to enforce CPS laws and a lack of knowledge on the part of officers on the subject of child restraints (Decina, Temple, & Dorer, 1994; Decina, Lococo, Ashburn, Hall, & Rose, 2008; NHTSA, 1990). More recent research demonstrates that effective approaches for enforcing child restraint laws — in particular booster seat laws — are possible, but they depend on top management support and enforcement methods that are dedicated to booster seat and other child restraint laws (Decina, Hall, & Lococo, 2010).

Child passenger safety laws. In 1978, Tennessee became the first State to put a child passenger safety law into effect. Between 1978 and 1985, every State and the District of Columbia passed laws requiring safety seats for young child passengers (Kahane, 1986). State child restraint laws vary in their definitions of which children must be restrained, type of restraint, and the vehicle positions for restraint use. In some States, children as young as 5 may be restrained using the adult seat belt, while other State laws require children up to age 9 or 80 pounds or 57 inches tall to be restrained in a child safety seat or booster seat. Ninety percent of the States have booster seat provisions for children who have outgrown their child safety seats, but there are exemptions and limited coverage to many of these laws (Decina et al., 2010).

In general, child restraint laws require children to travel in child restraint devices that meet Federal standards (FMVSS 213) until they reach a certain age and/or weight and/or height. In addition, some State laws require older children to use adult seat belts. The age at which children are permitted to be restrained by a seat belt differs among the States. As noted by IIHS (2010), young children are usually covered by child restraint laws, while older children and adults are covered by seat belt laws. Enforcement and fines differ under belt use and child restraint laws. Enforcement is primary for all child restraint laws, except in Montana. In addition, enforcement is secondary for children required to be in seat belts and/or booster seats in Nebraska, Ohio, and Pennsylvania.

Strategies to Increase Child Restraint Use and Seat Belt Use for Adults and Older Children

This chapter addresses child restraint use for infants and young children as well as seat belt use by adults and older children. Younger children require rear-facing, forward-facing, or booster seats appropriate to their size and weight and are covered by restraint use laws different than those for adults in all States. Many issues and strategies for increasing child occupant protection are quite different from those raised by adult belt use. Therefore, countermeasures in this chapter are organized by type and occupant age:

- Adults
- Pre-teens and Teenagers in Seat Belts, and

- Infants and Children in Child Restraints/Booster Seats.

The most effective basic strategy for achieving and maintaining high belt use is highly publicized high-visibility enforcement of strong occupant restraint use laws. As referenced above, this strategy's effectiveness has been documented repeatedly in the United States and abroad. The strategy's three components – laws, enforcement, and publicity – cannot be separated: effectiveness decreases if anyone is weak or lacking (Nichols & Ledingham, 2008; Tison & Williams, 2010). The sections in this chapter discuss each component's key features. Some communications and outreach and incentive programs directed to well-defined and limited audiences such as schools, businesses, and communities have been moderately successful and also are discussed in this chapter. NCHRP (2004) discusses several of these strategies and provides links to additional information.

Seat belt and child restraint use may also be affected by vehicle design features such as the comfort and convenience of belt systems, and by lights, buzzers or gear shift interlocks to remind occupants to buckle up (NHTSA, 2003b; Van Houten, Malenfant, Reagan, Sifrit, & Compton, 2009). These vehicular countermeasures are not included in this guide because SHSOs have little or no authority or responsibility for them.

Resources

The agencies and organizations listed below can provide more information on seat belt use and child passenger safety, and links to numerous other resources.

Seat Belts and Child Passenger Safety

- National Highway Traffic Safety Administration:
 - Occupant Protection - www.nhtsa.gov/Driving+Safety/Occupant+Protection
 - Child Safety - www.nhtsa.gov/Safety/CPS
 - Research and Evaluation - <http://www.nhtsa.gov/Driving+Safety/Research+&+Evaluation>
 - Behavioral Safety Research Reports - ntlsearch.bts.gov/repository/ntlc/nhtsa/index.shtm
- Insurance Institute for Highway Safety:
 - Safety Belt Use - www.iihs.org/research/topics/belt_use.html
 - Children - www.iihs.org/research/topics/children.html
- National Safety Council:
 - Seat Belts - www.nsc.org/safety_road/DriverSafety/Pages/SeatBelts.aspx
 - Child Safety Seats & Boosters - www.nsc.org/safety_road/DriverSafety/Pages/ChildPassengerSafety.aspx
- Centers for Disease Control and Prevention, Injury Prevention & Control: Motor Vehicle Safety: www.cdc.gov/Motorvehiclesafety/index.html
- AAA
 - Safety Belts - www.aaapublicaffairs.com/Main/Default.asp?CategoryID=3&SubCategoryID=4&ContentID=339

- Child Passenger Safety -
www.aaapublicaffairs.com/Main/Default.asp?CategoryID=7&SubCategoryID=47
- AAA Foundation for Traffic Safety: www.aaafoundation.org
- Governors Highway Safety Association:
www.ghsa.org/html/issues/occupantprotection.html

Child Passenger Safety

- American Academy of Pediatrics: www.aap.org/healthtopics/carseatsafety.cfm
- Automotive Safety Program, Riley Hospital for Children: www.preventinjury.org
- Center for Injury Research and Prevention, The Children's Hospital of Philadelphia -
www.research.chop.edu/programs/injury/
- Safe Ride News Publications: www.saferidenews.com
- SafetyBeltSafe U.S.A.: www.carseat.org

Key terms

- Primary enforcement: laws that permit child passenger safety law and seat belt use law violators to be stopped and cited by a law enforcement officer independently of any other traffic behavior.
- Secondary enforcement: laws that permit child passenger safety law and seat belt use law violators to be cited only after they have been stopped for some other traffic violation.

Countermeasures That Work

Countermeasures to increase seat belt use are listed below and discussed individually in this chapter. The table is intended to give a rough estimate of each countermeasure's effectiveness, use, cost, and time required for implementation. The terms used are described below. Effectiveness, cost, and time to implement can vary substantially from State to State and community to community. Costs for many countermeasures are difficult to measure, so the summary terms are very approximate. See each countermeasure discussion for more information on each item.

Countermeasures Targeting Adults

1. Seat Belt Use Laws

Countermeasure	Effectiveness	Use	Cost	Time
1.1 State primary enforcement belt use laws	★ ★ ★ ★ ★	Medium	Low	Short
1.2 Local primary enforcement belt use laws	★ ★ ★ ★	Low	Low	Short
1.3 Increased belt use law penalties	★ ★ ★	Low	Low	Short
1.4 Coverage: seating position, vehicles, ages	★	Medium	Low	Short

2. Seat Belt Law Enforcement

Countermeasure	Effectiveness	Use	Cost	Time
2.1 Short high-visibility belt law enforcement	★ ★ ★ ★ ★	Medium [†]	High	Medium
2.2 Combined enforcement, nighttime	★ ★ ★ ★	Unknown	High	Medium
2.3 Sustained enforcement	★ ★ ★	Unknown	Varies	Varies

[†] Used in many jurisdictions but often only once or twice each year

3. Communications and Outreach

Countermeasure	Effectiveness	Use	Cost	Time
3.1 Supporting enforcement	★ ★ ★ ★ ★	Medium	Varies	Medium
3.2 Strategies for low-belt-use groups	★ ★ ★ ★ [†]	Unknown	Unknown	Medium

[†] ★ ★ For stand-alone programs not supporting enforcement

4. Other Strategies

Countermeasure	Effectiveness	Use	Cost	Time
4.1 Incentive programs	★ ★ ★ ★ ★ [†]	Low	Varies	Medium
4.2 Employer programs	★ ★ ★ ★ ★ [†]	Unknown	Varies	Varies

[†] In low-belt-use settings with no belt use law

Countermeasures Targeting Pre-teens and Teenage Occupants

5. Restraint Use Laws

Countermeasure	Effectiveness	Use	Cost	Time
5.1 Coverage: seating position, vehicles, ages	★★★★★	Medium	Low	Short

6. Communications and Outreach

Countermeasure	Effectiveness	Use	Cost	Time
6.1 Strategies for older children	★★★	Unknown	Varies	Medium

7. Other Strategies

Countermeasure	Effectiveness	Use	Cost	Time
7.1 School programs	★★★	Unknown	Varies	Varies

Countermeasures Targeting Infants and Children in Child Restraints and Booster Seats

8. Child Restraint/Booster Seat Use Laws

Countermeasure	Effectiveness	Use	Cost	Time
8.1 Implement child restraint use laws	★★★★★	High	Low	Short
8.2 Coverage: seating position, vehicles, ages	★★★★★	High	Low	Short

9. Child Restraint/Booster Seat Law Enforcement

Countermeasure	Effectiveness	Use	Cost	Time
9.1 Short high-visibility CR law enforcement	★★★★★	Medium [†]	High	Medium

[†] Used in many jurisdictions but often only once or twice each year

10. Communications and Outreach

Countermeasure	Effectiveness	Use	Cost	Time
10.1 Supporting enforcement	★★★★★	Medium	Varies	Medium
10.2 Strategies for Booster Seat Use	★★★ [†]	Unknown	Varies	Medium

[†] For stand-alone programs not supporting enforcement

11. Other Strategies

Countermeasure	Effectiveness	Use	Cost	Time
11.1 CR distribution programs	★ ★	High	Medium	Short
11.2 Inspection stations	★ ★	High	Medium	Short

Effectiveness:

- ★ ★ ★ ★ ★ - Demonstrated to be effective by several high-quality evaluations with consistent results
- ★ ★ ★ ★ - Demonstrated to be effective in certain situations
- ★ ★ ★ - Likely to be effective based on balance of evidence from high-quality evaluations or other sources
- ★ ★ - Effectiveness still undetermined; different methods of implementing this countermeasure produce different results
- ★ - Limited or no high-quality evaluation evidence

Effectiveness is measured by increases in observed occupant restraint use and decreases in motor vehicle occupant crash injuries. See individual countermeasure descriptions for information on effectiveness size and how effectiveness is measured.

Use:

- High: more than two-thirds of the States, or a substantial majority of communities
- Medium: between one-third and two-thirds of States or communities
- Low: fewer than one-third of the States or communities
- Unknown: data not available

Cost to implement:

- High: requires extensive new facilities, staff, equipment, or publicity, or makes heavy demands on current resources
- Medium: requires some additional staff time, equipment, and/or facilities
- Low: can be implemented with current staff, perhaps with training; limited costs for equipment or facilities

These estimates do not include the costs of enacting legislation or establishing policies.

Time to implement:

- Long: more than one year
- Medium: more than three months but less than one year
- Short: three months or less

These estimates do not include the time required to enact legislation or establish policies.

Countermeasures Targeting Adults

1. Seat Belt Use Laws

1.1 State Primary Enforcement Belt Use Laws

Effectiveness: ★ ★ ★ ★ ★	Use: Medium	Cost: Low	Time: Short
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Primary enforcement belt use laws permit seat belt use law violators to be stopped and cited independently of any other traffic behavior. Secondary enforcement laws allow violators to be cited only after they first have been stopped for some other traffic violation.

Use: As of July 2010, 31 States and the District of Columbia had primary belt use laws, 18 States had secondary enforcement laws, and New Hampshire had no belt use law applicable to adults (IIHS, 2010). Some of the primary laws are secondary for drivers and passengers older than a specified age.

Effectiveness: In 2009, belt use averaged 88% in the 30 States with primary belt laws at that time and the District of Columbia and averaged 77% in those with weaker enforcement laws (NHTSA, 2010a). Studies of 5 States that changed their belt use laws from secondary to primary enforcement found that belt use increased from 12 to 18 percentage points where all passenger vehicles were covered by the law and 8 percentage points in one State where pickup trucks were excluded (Nichols, 2002). The Center for Disease Control and Prevention’s systematic review of 13 high-quality studies (Shults, Nichols, Dinh-Zarr, Sleet, & Elder, 2004) found that primary laws increase belt use by about 14 percentage points and reduce occupant fatalities by about 8% compared to secondary laws. In another study, Farmer and Williams (2005) found that passenger vehicle driver death rates dropped by 7% when States changed from secondary to primary enforcement. On average, States that pass primary seat belt laws can expect to increase seat belt use by eight percentage points. Depending on the level of high-visibility enforcement that they employ, however, far greater results are possible.

Recent research (Masten, 2007) has provided strong support that changing from secondary to primary enforcement seat belt laws increases occupant seat belt use during the nighttime hours as well as the daytime hours when most observational surveys of seat belt use are conducted.

Hedlund et al. (2008) studied the effects of primary law changes on seat belt use and occupant fatalities in Michigan, New Jersey, Washington, Delaware, Illinois, and Tennessee. Strong evidence was found in the FARS data for all 6 States that primary seat belt laws increase seat belt use. Furthermore, statistically significant decreases in the number of front-seat passenger vehicle occupant fatalities were found in Michigan and Washington and the decrease in New Jersey was marginally significant. The lack of significant effects on fatalities in Illinois and Tennessee, as well as a marginal increase in Delaware, was attributed in part to the short amount of time since the implementation of the primary provisions in these States as well as the small number of fatalities in Delaware.

Chaudhary, Tison, and Casanova (2010) evaluated the effects of Maine's change from secondary to primary enforcement of their seat belt law. Observational surveys conducted over an 18-month period after this change went into effect in 2007, measured increases in seat belt use from 77% to 84% during the daytime and from 69% to 81% at night.

Costs: Once legislation has been enacted to upgrade a secondary law to primary, the costs are to publicize the change and enforce the new law. Publicity costs to inform the public of the law change should be low because the media will cover the law change extensively. Law enforcement can adapt its secondary law enforcement strategies for use under the primary law or may be able to use new strategies permitted by the primary law. States wishing to increase enforcement and publicity to magnify the effect of the law change will incur additional costs: see Chapter 2, Section 2.1.

Time to implement: A primary belt use law can be implemented as soon as the law is enacted unless it has a delayed effective date.

Other issues:

- **Opposition to primary belt laws:** In most States there is substantial opposition to changing a secondary law to a primary belt use law. Opponents claim that primary laws impinge on individual rights and provide opportunities for law enforcement to harass minority groups. Studies in several States have found that minority groups were ticketed at similar or lower rates than others after a primary law was implemented (Shults et al., 2004). When Michigan changed from a secondary to a primary law, harassment complaints were very uncommon both before and after the law change. The proportion of seat belt use citations issued to minority groups decreased under the primary law. In a telephone survey, the vast majority of people who actually received seat belt citations did not feel that they were singled out on the basis of race, age, or gender. However, some minorities and young drivers reported perceptions of harassment (Eby, Kostyniuk, Molnar, Vivoda, & Miller, 2004).
- **Effect on low-belt-use groups:** Studies in States that changed their law from secondary to primary show that belt use increased across a broad range of drivers and passengers. In some States, belt use increased more for low-belt-use groups, including Hispanics, African-Americans, and drinking drivers, than for all occupants (Shults et al., 2004).

1.2 Local Primary Enforcement Belt Use Laws and Ordinances

Effectiveness: ★ ★ ★ ★	Use: Low	Cost: Low	Time: Short
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In some States with secondary enforcement belt use laws, individual communities have enacted and enforced community-wide primary laws or ordinances. These laws differ from statewide laws only in that they are enacted, publicized, and enforced locally.

Use: No data is available on how many communities have primary laws.

Effectiveness: Prior to 2010, there had been no formal studies of local primary belt laws published, but the available evidence suggests that they increase belt use (see also NCHRP, 2004, strategy A3). In Illinois, the statewide primary belt use law was enacted in 2003. From 1997 to 2002, Illinois Department of Transportation data show that average belt use was higher in communities with local primary belt use laws. In the annual statewide belt use surveys over these 6 years, average belt use in the 39 sites with local laws was 5.6 percentage points higher than the statewide belt use rate (Nassirpour, 2005). Local ordinances occasionally may lead to State laws, as was the case in Illinois, since a large portion of the population is already covered by a primary law.

St. Louis County, Missouri, implemented a primary seat belt use ordinance in March 2007. Following implementation of this ordinance, the St. Louis County Police Department conducted an intense high-visibility enforcement campaign, accompanied by publicity in the form of variable message boards and permanent road signs, along an 8-mile corridor on State Highway 21. Observational surveys were conducted along the Highway 21 corridor and a control site prior to the start of the enforcement and immediately after its conclusion. The observational surveys measured an increase in belt use from 83% to 88% along the Highway 21 corridor and a small, 59% to 57% decrease in belt use along the control corridor (Nichols, Solomon, Chaffe, & Preusser, 2010).

Costs: As with a statewide law, the costs are for publicity and enforcement. Both must be directed to the community itself.

Time to implement: As with a statewide law, a local law can be implemented as soon as it is enacted. The law’s debate and passage likely will generate initial publicity.

Other issues: See the discussion under Chapter 2, Section 1.1, Primary Enforcement Belt Use Laws.

1.3 Increased Belt Use Law Penalties: Fines and Driver’s License Points

Effectiveness: ★ ★ ★	Use: Low	Cost: Low	Time: Short
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Penalties for most belt use law violations are low. As of August 2010, a violation resulted in a typical fine of \$25 or less in all but 13 States (IIHS, 2010). Low fines may not convince nonusers to buckle up. They also may send a message that belt use laws are not taken seriously.

Most States penalize serious traffic law violations by assessing demerit points against a driver’s license. Drivers lose their licenses if they accumulate more than a specified number of points within a specified period of time. In a national survey in 2000, drivers who were not regular belt users considered license points the most effective way to increase their belt use. License points were considered more effective than increased fines or increased enforcement, in both primary and secondary law States (ACTS, 2001).

Use: As of August 2010, 9 primary law States and 4 secondary law States had maximum fines of \$30 or more. As of March 2009, 3 jurisdictions, the District of Columbia, Georgia, and New Mexico, assessed driver’s license points for all seat belt law violations (Decina, Hall, & Lococo, 2010).

Effectiveness: Houston and Richardson (2006) studied the effects of belt law type (primary or secondary), fine level, and coverage (front seat only or front and rear seats) using belt use data from 1991 to 2001. They found that primary belt laws and higher fines increase belt use.

Evidence from 2005 is mixed. In primary law States, belt use averaged 4.1 percentage points higher in the 7 States with fines of \$30 or more compared to the 15 States with fines of \$25 or less (89.3% compared to 85.2%). In secondary law States, the 2 States with fines of \$30 or more averaged lower belt use than the 26 States at \$25 or less: 74.3% compared to 77.1% (Glassbrenner, 2005b). The laws may be publicized and enforced more vigorously in primary law States with higher fines, and the enforcement and publicity may account for some or all of the differences in usage rates.

In a national survey in 2000, 42% of drivers who did not use belts regularly said they would definitely be more likely to wear belts if the fine were increased. Another 25% of these drivers said they would probably be more likely to wear their belts (ACTS, 2001). Surveys in North Carolina also found that some nonusers would buckle up if the fine were doubled to \$50 (Williams & Wells, 2004).

The effect of driver’s license points on belt use has not been evaluated. The evidence from 2005 sheds little light on the effectiveness of points. All three jurisdictions with points had primary laws. Belt use averaged 86.1% in the three jurisdictions with points and 86.6% in the remaining primary law States (Glassbrenner, 2005b).

In the 2000 national survey, 49% of drivers who were not regular belt users said they would definitely be more likely to wear their seat belts if violators were assessed driver’s license points. Another 27% of these drivers said they would probably be more likely to wear their belts

(ACTS, 2001). In a North Carolina survey, 62% of nonusers said they always would wear their belts if violations led to driver's license points (Williams & Wells, 2004).

Costs: The direct costs associated with increasing fine levels or assessing driver's license points are minimal.

Time to implement: Both measures can be implemented as soon as they are publicized and appropriate changes are made to the motor vehicle records systems.

Other issues:

- **Balance:** If penalties are excessively low, then they may have little effect. If they are excessively high, then law enforcement officers may be reluctant to issue citations and judges may be reluctant to impose them. States should choose penalty levels that strike an appropriate balance.
- **Penalty levels are part of a system:** Penalty levels are part of the complete system of well-publicized enforcement of strong belt use laws. Appropriate penalty levels help make strong laws. But without effective enforcement, judicial support, and good publicity, increased penalties may have little effect.

1.4 Belt Use Law Coverage: Seating Positions, Vehicles, Ages

Effectiveness: ★	Use: Medium	Cost: Low	Time: Short
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Belt use laws do not cover adult rear seat passengers in 24 States (IIHS, 2010). Most States’ laws exempt some vehicles, such as those designed for more than 10 passengers, taxis, postal delivery vehicles, farm vehicles, pickup trucks, or vehicles not required to have seat belts (Glassbrenner, 2005b).

Most State belt use laws cover passengers over a specified age and are designed to work in combination with child passenger safety laws covering younger passengers. Some States exempt passengers for specified medical or physical reasons (Glassbrenner, 2005b). Many States make belt use mandatory under their Graduated Driver Licensing laws for beginning drivers (see Chapter 6, Section 1.5).

A good belt use law should be comprehensive, covering all seating positions equipped with a seat belt in all passenger vehicles (ACTS, 2001; National Committee on Uniform Traffic Laws and Ordinances [NCUTLO], 2004; NHTSA, 2003b). Such a law sends a clear and consistent message to the public.

Use: In many States, belt use laws exempt adult passengers in some seating positions or in some passenger vehicles (Glassbrenner, 2005b).

Effectiveness: Since belt use surveys observe only front seat occupants, there is no direct survey evidence on whether belt laws that include rear seat adult passengers affect belt use. In NHTSA’s 2007 national Motor Vehicle Occupant Safety Survey, rear-seat passengers who thought they were covered by their State’s law reported higher belt use than those who did not: 69% “always use belts” compared to 48% (Boyle & Lampkin, 2008, p. 123).

In general, belt use is lower in pickup trucks than in other passenger vehicles: in 2009, belt use nationwide was 74% in pickup trucks compared to 86% in cars and 87% in vans and SUVs (NHTSA, 2009e). However, there are no available State-level data on whether pickup truck belt use is affected by a pickup truck or farm vehicle belt use law exemption.

Costs: The costs of expanding a belt use law to include all seating positions in all passenger vehicles are minimal.

Time to implement: Expanded belt use law coverage can be implemented as soon as the law is enacted and publicized.

2. Seat Belt Law Enforcement

2.1 Short-Term, High-Visibility Belt Law Enforcement

Effectiveness: ★ ★ ★ ★ ★	Use: Medium	Cost: High	Time: Medium
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[†] Used in many jurisdictions but often only once or twice each year

The most common high-visibility belt law enforcement method consists of short (typically lasting for two weeks), intense, highly publicized periods of increased belt law enforcement, frequently using checkpoints (in States where checkpoints are permitted), saturation patrols, or enforcement zones. These periods sometimes are called STEP waves (Selective Traffic Enforcement Programs) or blitzes. The method was developed in Canada in the 1980s (Boase, Jonah, & Dawson, 2004) and demonstrated in several United States communities (Williams & Wells, 2004). It was implemented statewide in North Carolina in 1993 using the *Click It or Ticket* slogan (Reinfurt, 2004), and subsequently adopted in other States under different names and sponsors (Solomon et al., 2004). NHTSA's *Click It or Ticket* high-visibility enforcement model is described in detail in Solomon, Chaudhary, and Cosgrove (2003) and Solomon, Chaffe, and Cosgrove (2007).

Use: Most States currently conduct short-term, high-visibility belt law enforcement programs in May of each year as part of national seat belt mobilizations (Solomon et al., 2004; Solomon, Chaffe, et al., 2007). In previous years, two mobilizations were conducted each year, in May and November. NHTSA has supported these campaigns. Approximately 10,000 law enforcement agencies took part in the May 2007 campaign (Solomon, Preusser, Tison, & Chaudhary, 2009). See Milano et al. (2004) for a detailed account of the history and evolution of the national campaigns.

Effectiveness: CDC's systematic review of 15 high-quality studies (Dinh-Zarr et al., 2001; Shults et al., 2004) found that short-term, high-visibility enforcement programs increased belt use by about 16 percentage points, with greater gains when pre-program belt use was lower. CDC noted that many of the studies were conducted when belt use rates were considerably lower than at present, so that new programs likely will not have as large an effect. Belt use often dropped by about 6 percentage points after the enforcement program ended. Short-term, high-visibility enforcement programs thus typically have a ratchet effect: belt use increases during and immediately after the program and then decreases somewhat, but remains at a level higher than the pre-program belt use.

Between 2002 and 2005, NHTSA evaluated the effects *Click It or Ticket* campaigns on belt use in the States. In 2002, belt use increased by 8.6 percentage points across 10 States that used paid advertising extensively in their campaigns. Belt use increased by 2.7 percentage points across 4 States that used limited paid advertising and increased by 0.5 percentage points across 4 States that used no paid advertising (Solomon, Ulmer & Preusser, 2002).

The 2003 campaign used extensive paid advertising: about \$8 million nationally and \$16 million in individual States (Solomon et al., 2003, Technical Summary). The advertising strongly supported the campaign with clear enforcement images and messages. Nationally, belt use

following the 2003 campaign was 79% compared to 75% at the same time in 2002 (Glassbrenner, 2005a). Twenty-eight States conducted small belt use surveys immediately before the May 2003 campaign. Across these States, belt use was 75.2% in 2002, 72.8% before the 2003 campaign and 78.5% immediately after the campaign. These results show the typical ratchet effect, with belt use dropping gradually after the 2002 campaign and then rising rapidly immediately after the 2003 campaign to a higher level than after the previous campaign (Solomon et al., 2003, Chapter IV).

The 2004 campaign increased paid advertising to about \$12 million nationally and \$20 million in the States (Solomon, Chaffe, et al., 2007). As in 2003, the advertising strongly supported enforcement activities. Belt use nationally reached 80% following the campaign (Glassbrenner, 2005a). Across the 50 States and the District of Columbia, belt use increased in 42 jurisdictions compared to the same time in 2003. When averaged across all 51 jurisdictions, belt use increased by 2.4 percentage points (Solomon, Chaffe, et al., 2007).

For the 2005 campaign, paid media valued at \$9.7 million nationally and \$22 million in States delivered a strong enforcement related message. Overall, seat belt use rates improved in 2005 in a majority of States (35 of 47). The level of improvement was slightly higher among primary law States compared to secondary law States (+2.0 versus +1.2, median point change). Among 22 primary law States, 18 showed an increase while among 25 secondary enforcement States, 17 showed an increase (Solomon, Gilbert, et al., 2007). Nationally, the seat belt use increased to 82% in 2005. Activities were similar in 2006, with approximately \$12 million in national paid advertising and \$20 million in the States that year (Tison et al., 2008). National *Click It or Ticket* activities in 2007 were again similar and observed seat belt use remained at 82% through 2007. As of 2007, 12 States had achieved seat belt use rates of 90% or higher (Solomon, Preusser, et al., 2009).

Hedlund et al. (2008) compared 16 States with high seat belt rates and 15 States with low seat belt rates. The single most important difference between the two groups was the level of enforcement, rather than demographic characteristics or the amount spent on media. High-belt-use States issued twice as many citations per capita during their *Click It or Ticket* campaigns as low-belt-use States.

Costs: High-visibility enforcement campaigns are expensive. They require extensive time from State highway safety office and media staff and often from consultants to develop, produce, and distribute publicity and time from law enforcement officers to conduct the enforcement. Paid advertising increases a campaign's effectiveness, as discussed above, but can be quite expensive. Averaged across all States, paid advertising costs were about \$125,000 per State for the 2002 campaign and over \$400,000 in 2004 (Solomon, Chaffe, et al. 2007).

Time to implement: A high-visibility enforcement program requires 4 to 6 months to plan and implement.

Other issues:

- **Effects in primary and secondary belt law States:** High-visibility enforcement campaigns are effective in both primary and secondary law States. NHTSA's 2003

evaluation found that belt use increased by 4.6 percentage points across the primary law States and by 6.6 percentage points across the secondary law States; the primary law States had higher use rates before the campaigns (Solomon et al., 2003; see also Nichols, 2002). The 2004 evaluation found that the campaign increased belt use in 25 secondary jurisdictions by an average of 3.7 percentage points. Belt use decreased in the remaining 5 jurisdictions by an average of 2.3 percentage points (Solomon, Chaffe, et al., 2007).

- **Effects on low-belt-use groups:** CDC's systematic review observed that short-term, high-visibility enforcement campaigns increased belt use more among traditionally lower-belt-use groups, including young drivers, rural drivers, males, African-Americans, and Hispanics, than among higher-belt-use drivers such as older drivers, suburban drivers, females, and Caucasians (Shults et al., 2004). NHTSA's Region 5 implemented a Rural Demonstration Program (RDP) prior to the May 2005 Click It or Ticket (CIOT) mobilization. The goal of the RDP was to evaluate strategies for increasing seat belt usage in rural areas. Paid media was used to notify rural residents that seat belt laws were being enforced. Active enforcement was included during the initial phase in three of the six Region 5 States (Illinois, Indiana, Ohio), but only the paid media component was implemented in the remaining three States (Minnesota, Michigan, Wisconsin). During the RDP phase, States that had intensified enforcement had significant increases in usage in their rural targeted areas. All six Region 5 States intensified enforcement during the CIOT mobilization, but States that had intensified enforcement during RDP showed substantially greater overall statewide gains during the CIOT phase than did the States that had not intensified enforcement during the Rural Demonstration Program (Nichols, Ledingham, & Preusser, 2007).

2.2 Combined Enforcement, Nighttime

Effectiveness: ★ ★ ★ ★	Use: Unknown	Cost: High	Time: Medium
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Short-term, high-visibility belt law enforcement programs (Chapter 2, Section 2.1) require substantial funding and law enforcement resources, so they can be difficult to sustain over a period of several years (Nichols, 2002). These programs also have been conducted almost exclusively during the daylight hours, and the limited available data suggest that belt use is lower at night (Chaudhary, Alonge, & Preusser, 2005; Hedlund et al., 2004). Continual enforcement (Chapter 2, Section 2.3), in which belt law violations are enforced as routine part of regular traffic patrol, is one way to address these issues.

A second way is to retain the short-term, high-intensity enforcement model but include other traffic safety issues such as impaired driving (DWI) and excessive speed, especially since the same drivers tend to drink, speed, and not buckle up. In particular, combined DWI and belt law checkpoints, saturation patrols, or enforcement zone operations could be conducted at night, when belt use is lower, DWI higher, and crash risk greater than during the day.

Another way to increase belt use at night is to use new night-vision technology for nighttime enforcement. The first demonstration of this strategy took place in 2004 in Reading, Pennsylvania (Chaudhary et al., 2005).

Use: There is no available information on how frequently the multifocused high-visibility enforcement strategy is used. One demonstration of a nighttime program was conducted in 2004 (Chaudhary et al., 2005) and another demonstration program involving three communities was conducted in 2007 (Solomon, Chaffe, & Preusser, 2009).

Effectiveness: The one study of combined high-visibility enforcement, in three demonstration sites, produced “encouraging but inconclusive” overall results (Jones, Joks, Lacey, Wiliszowski, & Marchetti, 1995; Jones & Lacey, 2001). Each site targeted belt use, speeding, and alcohol-impaired driving (DWI). One site maintained the planned high-intensity enforcement directed at all three behaviors and saw reduced DWI and speeding while maintaining a high belt use rate. A second site conducted only high-visibility DWI enforcement, which had an effect only on DWI. The third site failed to conduct high-visibility enforcement of any type and saw no effect.

A 2004 nighttime high-visibility belt enforcement program in Reading, Pennsylvania, increased nighttime front-seat-occupant belt use by 6 percentage points, from 50% to 56%. Daytime belt use increased by 3 percentage points, from 56% to 59% (Chaudhary et al., 2005). As previously noted, strategies are being developed to increase restraint use among nighttime drivers, but evaluations documenting the effectiveness of these programs have not been completed at this time.

A 2007 evaluation of three high-visibility enforcement demonstration programs designed to improve nighttime seat belt use in three communities — two in North Carolina with a primary seat belt law and one in West Virginia with a secondary law — concluded that nighttime high-

visibility seat belt law enforcement programs can be effective for increasing nighttime belt use. Furthermore, roadside breath tests used to collect BAC measures in one North Carolina community indicated that the program decreased drinking and driving (Solomon, Chaffe, et al., 2009).

Costs: The costs of combined high-visibility enforcement programs are similar to and probably somewhat greater than the costs of programs directed exclusively at belt law violators (Chapter 2, Section 2.1). Publicity must be directed at different offenses in turn, and law enforcement officers must have the training and equipment to address different offenses. Nighttime programs may entail somewhat higher costs if new night-vision technology is used.

Time to implement: As with primary belt law short-term, high-visibility enforcement programs, combined or nighttime programs require 4 to 6 months to plan and implement.

2.3 Sustained Enforcement

Effectiveness: ★ ★ ★	Use: Unknown	Cost: Varies	Time: Varies
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Some jurisdictions, including California, Oregon, and Washington, enforce their belt use laws vigorously as part of customary traffic enforcement activities.

Use: The extent of vigorous sustained belt law enforcement, with or without extensive publicity, is unknown.

Effectiveness: There are few studies of the effectiveness of sustained enforcement (Hedlund, Preusser, & Shults, 2004). California, Oregon, and Washington, States that are reported to use sustained enforcement, have recorded statewide belt use well above national belt use rates since 2002 (California: 91 to 95%; Oregon: 88 to 97%; Washington: 93 to 96%) (NHTSA, 2010a).

Nichols and Ledingham (2008) conducted a review of the impact of enforcement, as well as legislation and sanctions, on seat belt use over the past two decades and concluded that sustained enforcement is as effective as “blitz” enforcement (short-term, high-visibility enforcement) and is not usually associated with abrupt drops in belt use after program completion.

Costs: Sustained enforcement may require funds for publicity. As with short-term, high-visibility enforcement programs, publicity costs will depend on the mix of earned and paid media. Paid media can be expensive.

Time to implement: Sustained enforcement by law enforcement officers can be implemented immediately. Extensive publicity will take three or four months to plan and implement.

3. Communications and Outreach

3.1 Communications and Outreach Supporting Enforcement

Effectiveness: ★ ★ ★ ★ ★	Use: Medium	Cost: Varies	Time: Medium
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Effective, high-visibility communications and outreach are an essential part of successful seat belt law high-visibility enforcement programs (Solomon et al., 2003). Paid advertising can be a critical part of the media strategy. Paid advertising brings with it the ability to control message content, timing, placement, and repetition (Milano et al., 2004).

Use: All high-visibility enforcement programs include communications and outreach strategies that use some combination of earned media (news stories) and paid advertising. Communications and outreach can be conducted at local, State, regional, or national levels.

Effectiveness: As discussed in Section 2.1, the May 2002 *Click It or Ticket* campaign evaluation demonstrated the effect of different media strategies. Belt use increased by 8.6 percentage points across 10 States that used paid advertising extensively in their campaigns. Belt use increased by 2.7 percentage points across 4 States that used limited paid advertising and increased by only 0.5 percentage points across 4 States that used no paid advertising (Solomon et al., 2002). Milano et al. (2004) summarize an extensive amount of information from national telephone surveys conducted in conjunction with each national campaign from 1997 through 2003.

Costs: As discussed in Chapter 2, Section 2.1, paid advertising can be quite expensive. In the average State, paid advertising costs were about \$125,000 for the 2002 campaign and over \$400,000 in 2004 (Solomon, Chaffe, et al., 2007).

Time to implement: An effective media campaign requires 4 to 6 months to plan and implement.

3.2 Communications and Outreach Strategies for Low-Belt-Use Groups

Effectiveness: ★ ★ ★ ★ †	Use: Unknown	Cost: Varies	Time: Medium
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† ★ ★ For stand-alone programs not supporting enforcement

With belt use at 84% nationally and 70% or higher in 48 States and the District of Columbia, the large majority of drivers and passengers use their belts on every trip. The challenge is to reach the minority who still do not buckle up regularly.

Observations and telephone surveys show who these nonusers are. NHTSA’s 2009 national observation survey found lower use for males (81%) than females (86%), lower use for occupants age 16 to 24 (81%) than those 25 to 69 (84%), lower use for rural occupants (81%) compared to urban (83%) and suburban (86%) occupants, and lower use for passengers (82%) than for drivers (85%) (NHTSA, 2009e). Belt use is lower for pickup truck occupants (74%) than passenger car occupants (86%) (NHTSA, 2009e). NHTSA’s 2007 national telephone survey found the same patterns, with males, young drivers, rural drivers, and pickup truck drivers reporting lower belt use (Boyle & Lampkin, 2008, p. iv). In a 2002 observation survey in Michigan, Vivoda, Eby, and Kostyniuk (2004) found significantly lower belt use among front seat occupants identified as Black (76%) compared to those identified as White (82%) or Other (84%).

Most nonusers do wear belts some of the time, or at least say they do. In NHTSA’s 2007 national telephone survey, only 1% of drivers said they never used their belts and another 1% said they rarely used them (Boyle & Lampkin, 2008). Backseat passengers are more frequently unbelted: 11% said they never use belts and another 6% said they rarely use them, while only 58% reported wearing belts all the time (Boyle & Lampkin, 2008). The most frequent reasons given by drivers for not wearing a belt were that they: were only driving a short distance (59%), forgot (52%), were in a rush (39%), or they found the belt uncomfortable (35%) (Boyle & Lampkin, 2008).

In the 1960s and 1970s, during the period of low belt use before belt use laws were enacted, communications and outreach campaigns did not increase belt use (ACTS, 2001). More recently, many communications efforts that do not carry an enforcement message have been used in attempts to raise the belt use of low-belt-use groups but few have been evaluated.

North Dakota’s “Pick Up the Habit for Someone You Love” campaign in 2003 provides the best-documented example of a successful communications and outreach program not directly connected to enforcement. It was directed at male pickup drivers, whose pre-program belt use was 20 percentage-points lower than the statewide 63% rate. A survey of these drivers identified effective message goals (*choose* and *remember* to buckle up), message strategies (motivation through loved ones, sometimes using humor), and message placement (combining paid and earned radio and television, posters, and public relations events). The program increased observed belt use of male pickup drivers by 7 percentage points at a total cost of \$295,000 (North Dakota DOT, 2004).

High-visibility enforcement programs generally have been effective in increasing belt use among these lower-use groups (see Chapter 2, Section 2.1; Shults et al., 2004). Their publicity messages and placement can be directed at specific lower-belt-use groups.

The five States of NHTSA's Region 6 conducted a two-week "Buckle Up in Your Truck" paid advertising campaign immediately before their May 2004 *Click It or Ticket* campaign. The truck campaign's message complemented the *Click It or Ticket* message by focusing on the dangers of riding unrestrained in a truck and stressing the usefulness of belts in rollover crashes. The campaign spent nearly \$600,000 for paid advertising in the five States. Surveys at the end of the campaign, before any enforcement-based *Click It or Ticket* publicity, showed that belt use increased in pickup trucks by about 2 percentage points. Belt use in pickup trucks increased by another 6 percentage points after the *Click It or Ticket* publicity (Solomon, Chaffe, et al., 2007).

In a follow-up study, an intensive campaign using the same "Buckle Up in Your Truck" message was conducted in Amarillo, Texas, in November 2004. The campaign used paid advertising emphasizing belt law enforcement as well as earned media featuring local law enforcement officers. Belt use in pickup trucks increased by 12 percentage points in Amarillo and belt use in cars increased by 8 percentage points. At the same time, belt use in a comparison community increased by 5 percentage points for pickup truck occupants and by 4 percentage points for car occupants (Solomon, Chaffe, et al., 2007).

Iowa, Kansas, Missouri, and Nebraska (in NHTSA's Region 7) implemented a similar "Buckle Up in Your Truck" (BUIYT) program in May 2006 and 2007. BUIYT sought to increase seat belt use among pickup truck occupants by making such occupants aware of the dangers of riding unbuckled and awareness of ongoing enforcement efforts. Following this BUIYT phase, these States also conducted statewide CIOT campaigns that included additional paid media and enforcement directed at occupants of all vehicle types. An evaluation of the BUIYT found that the program did increase the awareness of "buckle up in trucks" messages, but in terms of observed seat belt use the CIOT created the greatest change in use among occupants of pickup trucks (Nichols, Tison, Solomon, Ledingham, Preusser, & Siegler, 2009).

Demonstration programs conducted in Kentucky, Mississippi, North Dakota, and Wyoming during the 2004–2007 period sought to increase seat belt use through a variety of innovative approaches. The primary method employed by Mississippi, North Dakota, and Wyoming was to target low-belt-use counties for additional enforcement and publicity focused on the enforcement. The seat belt laws in Kentucky and Mississippi were also upgraded from secondary to primary enforcement during the times their demonstration programs were in effect. All 4 States achieved significant statewide increases in belt use above baseline belt use rates (Blomberg, Thomas, & Cleven, 2009).

Use: Communications and outreach campaigns directed at low-belt-use groups probably are quite common, but no summary is available.

Effectiveness: Demonstrated to be effective for targeted programs that support, and are supported by, enforcement. Uncertain effectiveness for stand-alone programs not supported by enforcement. The North Dakota and Amarillo campaigns are well-documented and successful

examples of programs that target low-belt-use groups. They used all the characteristics of effective communications and outreach campaigns: good target audience research, effective and creative message development, and good message placement using both paid and earned media. The overall South Central Region campaign produced only modest gains, but Kentucky (67% to 76% statewide), Mississippi (58% to 65% in targeted counties), North Dakota (66% to 80% in targeted counties), and Wyoming (55% to 70% in targeted counties) were able to achieve significant increases in seat belt use through their programs (Blomberg et al., 2009).

Costs: As with enforcement-related communications and outreach, costs vary depending on program quality and delivery. Paid advertising can be expensive.

Time to implement: A good media campaign will require 4 to 6 months to plan and implement.

4. Other Strategies

4.1 Incentive Programs

Effectiveness: ★ ★ ★ ★ ★ †	Use: Low	Cost: Varies	Time: Medium
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† In low-belt-use settings with no belt use law

Incentive programs use rewards of some sort as an inducement to wear seat belts. Incentive programs have been implemented by employers, in schools, and across entire communities. Rewards have included cash, coupons for merchandise or food, T-shirts or other promotional items, and raffle tickets for valuable prizes. Rewards typically have been given to people observed to be wearing their belts but sometimes have been given for a pledge to buckle up. Incentive programs usually are accompanied by seat belt communications and outreach and may also be combined with seat belt use policies (Nichols, 2002).

Hagenzieker, Bijleveld, and Davidse (1997) summarized 34 incentive program evaluations published between 1978 and 1992. Almost all (95%) programs were conducted in the United States. Almost all (83%) were conducted when no belt use law was in effect, so that pre-program belt use was low. No incentive program evaluations appear to have been conducted since 1992 (Hagenzieker et al., 1997; Nichols, 2002).

Use: Incentive programs were popular before belt use laws were implemented but most appear to have been discontinued. There are no data on the number of incentive programs operating currently.

Effectiveness: In the situations studied – low baseline belt use and no belt use law in effect – incentive programs raised belt use immediately by 12 percentage points on average. As with enforcement programs, belt use subsequently decreased somewhat, so that the average long-term belt use increase was 9 percentage points (Hagenzieker et al., 1997; Nichols, 2002). In general, the effects were greater when baseline belt use was lower and when the target population was more confined: elementary school programs had the greatest impact, followed by employers, colleges, and finally entire communities.

Costs: Incentive program costs will depend on the size of the target audience, the nature of the incentives, and the nature and amount of publicity required. Sponsors can be sought to donate incentive rewards or otherwise offset program costs.

Time to implement: An incentive program should take 4 to 6 months to plan and implement.

Other issues:

- **Incentive programs in high-belt-use settings:** As noted above, there is little or no information on incentive programs in a setting with a belt use law and high baseline belt use. No incentive program evaluations appear to have been conducted since 1992.

4.2 Employer Programs

Effectiveness: ★ ★ ★ ★ ★ †	Use: Unknown	Cost: Varies	Time: Varies
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† In low-belt-use settings with no belt use law

Employers, schools, and similar institutions provide well-defined and somewhat controlled audiences for seat belt use programs. Education and other communications strategies can be tailored to a specific audience. Seat belt use policies can be implemented and enforced in certain settings. Incentive programs can be conducted (Chapter 2, Section 4.1).

Little information is available on what employer and school programs have been conducted recently and how effective they have been. The few high-quality published studies were conducted more than 15 years ago, in a low-belt-use environment (Nichols, 2002).

Use: There are no data on the number of employer and school programs operating currently.

Effectiveness: Employer and school programs in a low-belt-use environment with no belt use law have increased belt use substantially: by an average of 24 percentage points in five corporate programs and by 6 to 28 percentage points in several school programs (Nichols, 2002).

Costs: Program costs will depend on the size of the target audience and the components of the program.

Time to implement: Employer and school policies can be implemented immediately. Complete programs will require at least four months to plan and implement. School programs may require a full year.

Other issues:

- **Employer and school programs in high-belt-use settings:** As noted above, there is little information on employer and school programs in a setting with a belt use law and high baseline belt use. No evaluations appear to have been conducted since 1994.

Countermeasures Targeting Pre-Teens and Teenage Occupants

5. Restraint Use Laws

5.1 Coverage by Restraint Use Laws: Seating Position, Vehicles, Ages

Effectiveness: ★ ★ ★ ★ ★	Use: Medium	Cost: Low	Time: Short
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Child restraint/seat belt use laws do not cover all children under 16 in 5 States. Adult seat belt use laws do not cover rear-seat passengers in 24 States (IIHS, 2010).

Good occupant restraint use laws for a State – that is, the combination of child restraint and seat belt laws – should be comprehensive, covering all seating positions equipped with a seat belt in all passenger vehicles (ACTS, 2001; NCUTLO, 2004; NHTSA, 2003b, NHTSA, 2006). Such a law sends a clear and consistent message to the public.

Countermeasures that may affect teen seat belt use through graduated driver licensing and driver training are covered in Chapter 6, Sections 1 and 2.

Use: In many States, occupant restraint use laws exempt adult passengers in some seating positions or in some passenger vehicles (Glassbrenner, 2005b; Decina et. al., 2008; IIHS, 2010).

Effectiveness: A number of research studies (Fell et. al., 2005; Guerin & MacKinnon, 1985; Margolis, Bracken, & Stewart, 1996) have found that restraint use levels among children and teens covered by restraint use laws are higher than those not covered, and that injury levels among children covered by child passenger safety laws are lower than children not covered.

Costs: The costs of expanding a restraint use law to include all seating positions in all passenger vehicles are minimal.

Time to implement: Expanded restraint use law coverage can be implemented as soon as the law is enacted and publicized.

6. Communications and Outreach

6.1 Communications and Outreach Strategies for Older Children

Effectiveness: ★ ★ ★	Use: Unknown	Cost: Varies	Time: Medium
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As noted by Kuhn and Lam (2008a; 2008b), there is not a great deal of information on the factors influencing restraint use for children 8 to 15 years old. The few available studies have tended to focus on changing nonuse behaviors without investigating attitudinal or motivational factors that might be useful in developing additional strategies.

Use: There is beginning to be more of an emphasis on developing and implementing programs targeting children ages 8 to 15. NHTSA is developing material and resources for States and programs interested in targeting this age group and some pilot programs have been implemented and evaluated that can be used as resources for program development. One extensive resource available is the report titled “Increasing Seat Belt Use Among 8- to 15-Year-Olds: Volumes I and II” (Kuhn & Lam, 2008a, 2008b).

Effectiveness: The few studies that have been conducted have produced encouraging but inconclusive results. The Automotive Coalition for Traffic Safety launched two pilot programs in 2005 targeting 8- to 15-year-olds, sometimes called “tweens.” These brief school and community-based interventions targeted both children and their parents. The programs were evaluated by pre- and post-intervention surveys of tweens and parents, as well as observational surveys in one site. Both programs were successful in changing knowledge and attitudes of the parents and children, but limited observations did not show significant changes in belt use among the targeted children (Jennings, Merzer, & Mitchell, 2006).

Costs: Program costs will depend on the size of the target audience and the components of the program.

Time to implement: Complete programs will require at least four months to plan and implement. School programs may require a full year.

7. Other Strategies

7.1 School Programs

Effectiveness: ★ ★ ★	Use: Unknown	Cost: Varies	Time: Varies
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Schools provide well-defined and somewhat controlled audiences for seat belt use programs. Education and other communications strategies can be tailored to a specific audience.

Some information is available on school programs that have been conducted and how effective they have been. Williams, Wells and Ferguson (1997) conducted a pilot program to increase restraint use and rear seating position among elementary schools and day care centers. The programs, held in conjunction with an ongoing statewide *Click It or Ticket* program, included letters and pamphlets sent to parents, proper restraint use demonstrations, assemblies emphasizing proper restraint use (at the schools), and enforcement checkpoints. A few high-quality published studies were conducted more than 15 years ago, in a low-belt-use environment (Nichols, 2002).

Use: There are no data on the number of school programs operating currently.

Effectiveness: School programs have been shown to increase belt use substantially: by 6 to 28 percentage points (Nichols, 2002). Williams et al. (1997) found that, although only slight increases occurred in the percentage of children in rear seats, gains can be achieved in proper restraint use. Proper use increased substantially at elementary schools (36% to 64%; 49% to 71%) with smaller increases at the daycare centers (71% to 76%; 60% to 75%). The researchers concluded also that enforcement is a key ingredient of programs even among school age children.

Costs: Program costs will depend on the size of the target audience and the components of the program.

Time to implement: School policies can be implemented immediately. Complete programs will require at least four months to plan and implement and may require a full year.

Countermeasures Targeting Infants and Children in Child Restraints and Booster Seats

8. Child Restraint/Booster Seat Use Laws

8.1 Enactment of Child Restraint Use Laws

Effectiveness: ★ ★ ★ ★ ★	Use: High	Cost: Low	Time: Short
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Child restraint laws require children traveling in motor vehicles to be restrained in child restraints appropriate for the child’s age and size. Legislation also specifies the children to whom the law applies by age, height, weight, or a combination of these factors, and who is legally responsible for restraining the children in the vehicle.

Use: Beginning with Tennessee, every State between 1978 and 1985 passed laws requiring safety seats for young child passengers. With few exceptions, child restraint laws are primary enforcement laws.

Effectiveness: Many studies have examined the effectiveness of child restraint laws in increasing child restraint use and decreasing crash-related injuries. Houston, Richardson, and Neeley (2001) evaluated the effectiveness of State child restraint laws in the United States by conducting a time series analysis for all 50 States for the period 1975 to 1994, and found that child restraint laws significantly reduced fatality rates among children up to 5 years old. A similar reduction in the fatality rate of an older age cohort (6 to 11 years old and not typically covered by these laws) was not found. Zaza, Sleet, Thompson, Sosin, and Bolen (2001) conducted a systematic review of evidence of effectiveness for five interventions, including child restraint laws, to increase child safety seat use. Establishment of child restraint laws was one of the interventions found to be effective.

Costs: Once legislation has been enacted, the only costs are to publicize and enforce the law.

Time to implement: As soon as the law is enacted.

8.2 Coverage: Seating Position, Vehicles, Ages

Effectiveness: ★ ★ ★ ★ ★	Use: High	Cost: Low	Time: Short
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Strong occupant restraint use laws for a State – that is, the combination of child restraint and seat belt laws – should be comprehensive, covering all seating positions equipped with a seat belt in all passenger vehicles (ACTS, 2001; NCUTLO, 2006; NHTSA, 2003b, NHTSA, 2006). Such a law sends a clear and consistent message to the public. NHTSA and various partners have encouraged States to expand their child restraint laws to include “booster” provisions; that is, to not allow children to be restrained by a seat belt alone until they are big enough for the lap and shoulder belts to fit and continue to do so.

Use: As of March 2009, 45 States and the District of Columbia had enacted booster seat provisions that require child restraint/booster seat use for children 5 and older or heavier than 40 pounds (Decina et al., 2010). However, a wide variation in age, height, and weight requirements exists between the laws of the various States.

Effectiveness: Research conducted by Arbogast et al. (2009) found that transitioning children from child restraints with harnesses to belt-positioning booster seats instead of vehicle seat belts provides significant safety benefits for children at least through age 8, and that belt-positioning booster seats lower the risk of injury to children in crashes by 45% compared to the use of vehicle seat belts alone. A number of studies evaluated the effect of booster provisions in States’ laws on booster seat use (Gunn, Phillippi, & Cooper, 2007). Observational surveys conducted in Washington State before their booster seat law was expanded found that only 21 % of children between the ages 4 and 8 were using booster seats (Ebel, Koepsell, Bennett, & Rivara, 2003). Following a new law requiring booster seats for children weighing between 40 and 60 pounds or younger than 6 years old, observational surveys in Washington State found close to half of children 4 to 8 years old in a booster seat (Stehr & Lovrich, 2003).

Costs: The costs of expanding a restraint use law to include all seating positions in all passenger vehicles are minimal.

Time to implement: Expanded restraint use law coverage can be implemented as soon as the law is enacted and publicized.

9. Child Restraint/Booster Seat Law Enforcement

9.1 Short-Term High-Visibility Child Restraint/Booster Law Enforcement

Effectiveness: ★ ★ ★ ★ ★	Use: Medium [†]	Cost: High	Time: Medium
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[†] Used in many jurisdictions but often only once or twice each year

As noted in Section 2.1, the most common high-visibility belt law enforcement method consists of short (typically lasting for two weeks), intense, highly publicized periods of increased belt law enforcement, frequently using checkpoints (in States where checkpoints are permitted), saturation patrols, or enforcement zones. These periods sometimes are called STEP waves (Selective Traffic Enforcement Programs) or blitzes but are now primarily conducted under NHTSA’s *Click It or Ticket* high-visibility enforcement program. NHTSA typically includes child restraint and booster seat use and enforcement as a part of their *Click It or Ticket* campaigns.

More recently, NHTSA evaluated the implementation of State booster seat requirements, and examined the most effective strategies that law enforcement agencies can use to enforce booster seat laws (Decina et al., 2010).

Use: Most States currently conduct short-term, high-visibility belt law enforcement programs in May of each year as part of national seat belt mobilizations (Solomon et al., 2004; Solomon, Chaffe, et al., 2007).

Effectiveness: Pilot programs conducted in 1989 in eight communities demonstrated the potential effectiveness of child passenger safety law enforcement (NHTSA, 1990). The enforcement efforts increased the correct use of child restraints in the demonstration sites; the use of seat belts by older children also increased. In their systematic review of evidence of effectiveness for child restraint interventions, Zaza et al. (2001) determined that community-wide information plus enhanced enforcement campaigns were effective in increasing child restraint use. One study evaluated the effects of Tennessee’s “booster” provisions that added new requirements for 4- to 8-year-olds in 2005 (Gunn et al., 2007). Pre- and post-law observational survey data revealed a significant increase in booster seat use among 4- to 8-year-olds from 29% to 39%. Decina et al. (2008) reported that an observational study conducted to evaluate a demonstration program found a 9-percentage-point increase in the use of child restraints, including booster seats, for children age 4 to 8 following enactment of an enhanced child restraint law (booster seat law) in Wisconsin.

Costs: As noted under Section 2.1, high-visibility enforcement campaigns are expensive. They require extensive time from State highway safety offices, time from law enforcement officers to conduct the enforcement, and time from media staff and often from consultants to develop, produce, and distribute publicity. Paid advertising increases a campaign’s effectiveness, as discussed earlier, but can be quite expensive.

Time to implement: A high-visibility enforcement program requires 4 to 6 months to plan and implement.

Other issues:

- **Barriers to enhanced enforcement programs:** Decina et al. (2008) concluded that barriers to enhanced enforcement programs, especially as related to booster seats, include: parent/caregiver ignorance of child restraint laws; low perception of risk to child passengers; lack of knowledge about the safety benefits of booster seats among the public; lack of knowledge about the safety benefits of booster seats among law enforcement officers and members of the courts; low threat of being ticketed for violations; and lack of commitment to child passenger safety by law enforcement top management.
- **Strategies to enhance enforcement programs:** NHTSA (1990) suggests that in order to maximize child restraint enforcement efforts, certain activities should be part of the overall program. These are: media coverage of enforcement and public information activities by the local press and radio and television stations; training of law enforcement officers in the benefits of child passenger protection and methods of effective law enforcement; information activities targeted to target audiences; information activities coinciding with community events; child restraint distribution programs; and public service announcements and other media coverage. Decina et al. (2010) found that most effective approaches for enforcing booster seat laws depend on top management support to enforce these laws, having resources to support dedicated booster seat law enforcement programs, and enforcement methods that are dedicated to booster seat and other child restraint laws.

10. Communications and Outreach

10.1 Communications and Outreach Supporting Enforcement

Effectiveness: ★ ★ ★ ★ ★	Use: Medium	Cost: Varies	Time: Medium
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As noted in Section 3.1, effective, high-visibility communications and outreach are an essential part of successful seat belt law high-visibility enforcement programs (Solomon et al., 2003). Paid advertising can be a critical part of the media strategy. Paid advertising brings with it the ability to control message content, timing, placement, and repetition (Milano et al., 2004).

Use: As noted in Section 3.1, all high-visibility enforcement programs include communications and outreach strategies that use some combination of earned media (news stories) and paid advertising. Communications and outreach can be conducted at local, State, regional, or national levels.

Effectiveness: Zaza et al. (2001) conducted a systematic review of evidence of effectiveness for five interventions, including child restraint laws, to increase child safety seat use. Changes in the use of child safety seats or injury rates were the outcome measures evaluated to determine the success of each intervention. One of the four interventions found to be effective was community-wide information plus enhanced enforcement campaigns. Education only programs aimed at parents, young children, healthcare personnel or law enforcement personnel did not have enough evidence for effectiveness to be proven.

Costs: As discussed in Chapter 2, Section 2.1, paid advertising can be quite expensive.

Time to implement: An effective media campaign requires 4 to 6 months to plan and implement.

10.2 Communications and Outreach Strategies for Booster Seat Use

Effectiveness: ★ ★ [†]	Use: Unknown	Cost: Varies	Time: Medium
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[†] For stand-alone programs not supporting enforcement

In 2008, restraint use for children 12 and younger was as follows: children less than age 1, 99%; children 1 to 3 years old, 92%; children 4 to 7 years old, 89%; and children 8 to 12 years old, 85% (NHTSA, 2009b). However, the National Survey of the Use of Booster Seats (NSUBS) found low booster seat use in 2009 among children who need them to assure proper seat belt fit. Fifty-one percent (51%) of the children who were 37 to 53 inches tall were either unrestrained or using a seat belt rather than a CR or booster. Of the children who were 54 to 56 inches tall, 93% were either unrestrained or using a seat belt (NHTSA, 2010b).

Use: Communications and outreach campaigns directed at booster seat age children are probably quite common, but no summary is available.

Effectiveness: Uncertain, but as noted above, 41% of children who should be in booster seats are not (NHTSA, 2010b). Will, Sabo, and Porter (2009) note that parents and 2care givers of booster-seat-aged children are difficult reach with effective messages. They also note that many booster-seat programs are unsuccessful because they are too informational in nature, but that applying messages of high-threat consequences (without gore) to booster seat interventions is promising.

Costs: As with enforcement-related communications and outreach, costs vary depending on program quality and delivery.

Time to implement: A good educational campaign will require 4 to 6 months to plan and implement.

11. Other Strategies

11.1 Child Restraint Distribution Programs

Effectiveness: ★ ★	Use: High	Cost: Medium	Time: Short
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One of the issues that was identified when child passenger safety laws were being considered was the costs associated with obtaining child restraints. Because of this, many State and local organizations initiated programs to make child restraints available at low or no cost to parents through child restraint loan or rental programs (Orr et al., 1987; Zaza et al., 2001). Continuing educational and distribution programs, and especially the implementation and enforcement of child passenger safety laws, increased the levels of child restraint use to 80% for children up to 4 in 1987 (Partyka, 1988), to over 90% (99% for age less than 1, 92% for ages 1 to 3) in 2008 (NHTSA, 2009b).

Use: There is no estimate of the number of child restraint distribution programs operating throughout the United States, but they are common components of State and local child passenger safety programs.

Effectiveness: Louis and Lewis (1997) conducted a project to increase toddler car seat use in low-income minority families. Families in the program were divided into two study groups with both groups receiving free child restraints. One group also received education regarding child restraint use. The results of the study indicated that distributing child restraints resulted in increased long-term use among a low-use population. Zaza et al., (2001) conducted a systematic review of evidence of effectiveness for five interventions, including child restraint laws, to increase child safety seat use. One of the four interventions found to be effective was child restraint distribution plus education programs.

Costs: Program costs will depend on the size of the target audience and the components of the program.

Time to implement: Complete programs typically require several months to plan and implement.

Other issues: When implementing a program, one of the primary issues to decide is whether the child restraints are to be given away, or whether the parents/caregivers receiving the restraints will be required to purchase them (at a low cost or modest fee, depending on ability to pay). Also, program planners must decide whether parents should be required to attend a child passenger safety educational session, as is considered essential by many in the public health community to ensure proper and continuous use.

11.2 Inspection Stations

Effectiveness: ★ ★	Use: High	Cost: Medium	Time: Short
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The misuse of child restraints is an issue that has been a concern for many years. A number of programs have been implemented to provide parents and other caregivers with “hands-on” assistance with the installation and use of child restraints in an effort to combat widespread misuse. Child passenger safety (CPS) inspection stations, sometimes called “fitting stations” are places or events where parents and caregivers can receive this assistance from certified CPS technicians and are popular services provided by a variety of local CPS programs. Guidebooks on how local programs can set up and operate a mobile CPS clinic or permanent inspection station are available from NHTSA (NHTSA, 2003a).

Use: Child restraint inspection stations have become common components of State and local child passenger safety programs. There are over 4,000 inspection stations listed on NHTSA’s Web site.

Effectiveness: One study conducted to evaluate child restraint inspection programs looked at Safe Kids events held at car dealerships, hospitals, retail outlets and other community locations (to provide as much local exposure as possible). The objective of the study was to measure parent confidence levels, skill development and safe behavior over a six-week interval using checklists and a matching behavioral survey. Results showed that within the 6-week time period, the child passenger safety checkup events successfully and positively changed parents’ behavior and increased their knowledge: children arriving at event 2 were restrained more safely and more appropriately than they were at event 1 (Dukehart, Walker, Lococo, Decina, & Staplin, 2007).

Another study evaluated whether a “hands-on” educational intervention makes a difference in whether or not parents correctly use their child restraints. All study participants received a free car seat and education, but the experimental group also received a hands-on demonstration of correct installation and use of the child restraint in their own vehicles. Parents who received this demonstration were also required to demonstrate in return that they could correctly install the restraint. Follow-up observations found that the intervention group was four times more likely to correctly use their child restraints than did the control group (Tessier, 2010).

Costs: Program costs will depend on the size of the target audience, the components of the program, and the level of services offered.

Time to implement: Complete programs typically require several months to plan and implement.

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3. Aggressive Driving and Speeding

Overview

Characteristics and problem size: aggressive driving. Aggressive driving is generally understood to mean driving actions that markedly exceed the norms of safe driving behavior and that directly affect other road users by placing them in unnecessary danger. Aggressive driving may also involve driver anger, attempts to gain an advantage over other drivers, and deliberate violations and deviations from normal traffic speeds (NCHRP, 2003a). It has proven challenging to arrive at a consensus for a theoretical definition of aggressive driving, and hence to come up with a working definition. Not every moving violation is considered aggressive driving. However, multiple violations that encroach on others' safe space, such as driving much faster than prevailing speeds, following too closely, making unsafe lane changes, and running red lights, either on one occasion or over a period of time, may indicate a pattern of aggressive driving. Although some States have passed laws criminalizing aggressive driving, it should not be confused with road rage, an intentional assault by a driver or passenger with a motor vehicle or a weapon that occurs on the roadway or is precipitated by an incident on the roadway.

Causes of aggressive driving can include both personal and environmental triggers. A predisposal to immature and "selfish" driving that frequently puts others at risk might be the norm for a small proportion of drivers, while others may be provoked to drive aggressively at least occasionally by exceptional congestion, work zone delays, poorly timed traffic signals, being late, and other frustrating conditions. Other drivers' actions are also sources of irritation for "reactive" style drivers. More than half of drivers in one study reported that they would react aggressively, particularly to being impeded, but also to others' reckless driving or actions perceived as directly hostile (Björklund, 2008). Other life stressors may also contribute to aggressive driving. A recent paper suggests that soldiers who have been recently deployed to a combat zone may be more prone to taking risks, losing their temper, and retaliating while driving than other soldiers (Sarkar, 2009). The perceived rise in aggressive driving is therefore likely to be related, at least in part, to increasingly crowded roadways, longer commute times, increases in trips and complexity of personal schedules, and other sources of stress. But, driving actions are ultimately under individual drivers' control. Behavioral countermeasures must reinforce and help teach such control.

Aggressive driving actions are perceived to be common, although they are difficult to measure accurately. In NHTSA's 2002 survey of speeding and unsafe driving behaviors, 40% of drivers reported that they sometimes enter an intersection "just as the light turned from yellow to red," and 11% said they often did this. In the same survey, 10% reported sometimes cutting in front of another driver, and 2% said they often did this (NHTSA, 2004). About one-third (34%) of drivers reported that they feel threatened by other drivers at least several times monthly (NHTSA, 2004). NHTSA estimated that two-thirds of traffic fatalities involve behaviors commonly associated with aggressive driving such as speeding, red-light running, and improper lane changes (NHTSA, 2001a). The AAA Foundation for Traffic Safety has estimated that 56% of fatal crashes involved one or more driver actions typically associated with aggressive driving, the most common being excessive speed (AAA Foundation for Traffic Safety, 2009).

Characteristics and problem size: speeding. The legal definitions of speeding include exceeding the posted speed limit or driving too fast for existing conditions. Speeding becomes aggressive driving when a vehicle's speed substantially exceeds the prevailing travel speeds of other vehicles. Speeding is a more clearly defined problem than aggressive driving, and strategies to reduce speeding (and other serious traffic law violations) may provide a means to address the problem of aggressive driving.

Speeding is legally defined by municipalities and States in terms of a "basic speed rule" and statutory maximum speed limits. Although the wording of the basic speed rule varies, it usually requires drivers to drive at a reasonable and prudent rate for roadway conditions. This is open to the officer's judgment, but is frequently related to weather, surface conditions, congestion, or other roadway conditions. Statutory speed limits set maximum limits for different types of roads, and generally apply to all roads of that type even when the limits are not posted. These limits can be superseded by limits posted for specific roadway segments usually determined on the basis of an engineering study. Special Report 254 of the Transportation Research Board summarizes much of the past research regarding the effects of speed on crashes and best practices for setting speed limits and managing speeds (TRB, 1998). Aarts and van Schagen (2006) provide a more recent review of studies of the effects of speed and speeding on crash risk.

Speeding is the most frequently cited aggressive-driving infraction, and has been incorporated into most aggressive driving laws as one of the violations required to invoke an aggressive driving offense. Speeding is common. About three-quarters of all drivers in NHTSA's 2002 national survey reported that they exceeded the posted speed limit on various types of roads. Specifically, 78% of drivers reported speeding on interstates, 83% on non-interstate multilane roads, 78% on two-lane roads, and 73% on city streets during the past month. One-fourth to one-third of drivers reported speeding on the various types of roads on the day of the interview (NHTSA, 2004). In addition, one-third (34%) of all drivers reported that they drive, at least some of the time, 10 or more miles per hour faster than most other vehicles (NHTSA, 2004).

Approximately two-thirds (68%) of drivers felt that other speeding drivers pose a major threat to their personal safety (NHTSA, 2004). NHTSA reports that speeding, as determined by the investigating officer, was a contributing factor in 31% of fatal crashes in 2009 resulting in 10,591 lives lost (NHTSA, 2010a). The percentage of speeding-related fatal crashes has changed little over the years. In-depth investigations found speeding to be a causal factor in 19% of a sample of serious crashes in 1996-1997, second only to driver distraction/inattention (Hendricks, Fell, & Freedman, 2001; Hendricks, Freedman, Zador, & Fell, 2001).

Speeding can be dangerous on all types of roads. In 2009, 50% of the speed-related traffic fatalities occurred on roads posted at 50 mph or less and 24% occurred on roads posted at 35 mph or less (NHTSA, 2010b, Table 121). Young males tend to be most involved in fatal speed-related crashes (NHTSA, 2010a).

Strategies to Reduce Aggressive Driving and Speeding

Aggressive driving, speeding, and red-light running all involve traffic law violations. Therefore, deterrence through traffic law enforcement is the basic behavioral strategy that has been used to control them. This strategy involves the same components used to deter alcohol-impaired driving

or seat belt nonuse: highly publicized and highly visible enforcement of practical, sound, and broadly accepted laws. In particular, speed limits should be set carefully and rationally, taking into account the road segment's design speed, vulnerable users, traffic operations, and environmental conditions; if not, many drivers may lose respect for and exceed the speed limit. Additionally, the NCHRP Guide for Addressing Aggressive-Driving Collisions (NCHRP, 2003a) suggests that successful anti-aggressive driving programs place an emphasis on enforcing all traffic laws. Such a strategy increases respect for all laws and the public's expectation that laws should be obeyed.

Aggressive driving enforcement can be conducted through regular traffic patrols; sustainable levels of widespread, randomized but well-targeted enforcement (Newstead, Cameron & Leggett, 2001); intense, highly publicized enforcement periods; and automated speed or red-light enforcement. The sections in this chapter discuss relevant laws and sanctions, special enforcement techniques, and publicity. General communications and outreach campaigns urging tolerant and non-aggressive driving behavior have also been used in attempts to reduce aggressive driving and speeding.

Environmental and vehicular measures also can be effective. As examples, traffic calming measures can reduce speeds, especially on local roads (TRB, 1998). A variety of measures to reduce congestion, such as mass-transit or ride-sharing, can diminish driver frustration that leads to aggressive driving (Shinar & Compton, 2004). Well-coordinated traffic signals can improve traffic flow and reduce red-light running. Advance warnings of congestion or delays and well-designed and managed work zones may also decrease unexpected frustration. Intelligent Transportation System technologies (e.g., real-time transit information, variable speed limits, variable message signs, and traffic control warning devices and other systems that provide motorists with information and respond to changing traffic and environmental conditions) also hold promise for improving mobility and safety by mitigating causes of delay and hazardous conditions. Adequately designed turn bays and entrance and exit ramps can reduce improper merging and driving on the shoulder (NCHRP, 2003a, Strategy B1). Company policies, backed up with speed monitors and logs or even speed regulators, can reduce commercial vehicle speeding. These environmental and vehicular strategies are not included in this guide because State Highway Safety Offices (SHSOs) have little or no direct authority or responsibility for them. However, managing traffic operations in general and speeds in particular requires cooperative efforts between State Departments of Transportation (DOTs) and SHSOs. SHSOs are encouraged to act cooperatively with State DOTs to identify their aggressive driving and speeding problems and to adopt comprehensive plans and programs to address them. For example, targeted enforcement requires agencies that maintain crash data, such as DOTs, join with researchers who analyze the data, and with law enforcement agencies to identify and target enforcement to areas and times where aggressive driving crashes are highly represented (Strategy 4.1, A.1). See NCHRP (2003a) for more examples of cooperative strategies.

The same cooperative methods can be useful in addressing local aggressive driving or speeding concerns, for example, in a neighborhood or on a road segment or corridor. Working together, State and community traffic engineers, law enforcement, safety officials, community leaders, and concerned citizens can develop comprehensive plans and programs.

The Department of Transportation's 2005 Speed Management Strategic Initiative (U.S. DOT, 2005) contains a comprehensive set of engineering, enforcement, and education strategies to reduce speeding-related fatalities and injuries. The Department of Transportation, together with GHSA and several national organizations sponsored a National Forum on Speeding in June 2005. The forum's invited presentations documented speed-related issues and summarized speed management practices in Australia, Canada, and the Netherlands. The presentations are available at www.nhtsa.dot.gov/people/injury/enforce/Speed_Forum_Presentations/. The forum report (NHTSA, 2005) presents an action agenda.

A key component of the Speed Management Strategic Initiative has been to emphasize the interdisciplinary nature of effective speed management, whereby engineering, enforcement, and the judiciary are all critical components. Law enforcement officers can only rigorously enforce speed limits when engineering and the judiciary provide infrastructure support. Engineering is required to set reasonable and enforceable speed limits, and to re-engineer problematic roadway segments. If the judiciary does not follow-through by supporting tickets levied by officers, regard for the limits as meaningful and credible acquired through rigorous enforcement is undermined. Victoria, Australia implemented a comprehensive effort to reduce speed that combined review and adjustment of speed limits, covert and overt forms of enforcement, a media campaign, penalty restructuring, and other efforts. An evaluation found these combined elements reduced injury crashes by 10% and fatal crashes by 27% (D'Elia, Newstead & Cameron, 2007).

Efforts to address dangerous speeding and aggressive driving could also benefit from better understanding of the motivations and choices of drivers who are willing to accept increased risks not only for themselves, but for other drivers as well. More comprehensive, or at least different, measures may be needed to address certain types of offenders, including flagrant and repeat offenders, than are generally employed. For example, as part of a comprehensive road safety strategy the United Kingdom has embarked upon an ambitious research program known as High UnSafe Speed Accident Reduction (HUSSAR) to understand the psychological and human factors reasons for speeding and other dangerous driver behaviors so that educational and enforcement programs may better target barriers to speed compliance (Fuller et al., 2008a; Fuller et al., 2008b; Stradling et al., 2008). There may be lessons available for the United States as a whole, and for States and communities resulting from these and similar efforts to better-understand the psychology of driving, and to treat driver behavioral problems accordingly, including those involving an anti-social component such as in aggressive driving and flagrant speeding.

Resources

As mentioned in the introduction, this document is restricted to behavioral countermeasures that are typically under the direct authority of SHSOs. But a comprehensive, multifaceted approach that incorporates assessing and addressing engineering and environmental issues as well as enforcement, legislative, and program evaluation needs is essential to most effectively reduce speeding-related crashes and injuries.

For example an updated version of an expert system (USLimits2) was developed for NCHRP project 3-67 to assist with evaluating and setting reasonable speed limits in the United States

(Srinivasan, Parker, Harkey, Tharpe, & Sumner, 2006). The tool is available here:
<http://www2.uslimits.org/>

Other resources and links include:

- National Highway Traffic Safety Administration
 - Aggressive Driving – www.nhtsa.gov/Aggressive
 - Enforcement and Justice Services - www.nhtsa.gov/Driving+Safety/Enforcement+&+Justice+Services
 - Research and Evaluation - www.nhtsa.gov/Driving+Safety/Research+&+Evaluation
 - Behavioral Safety Research Reports - ntlsearch.bts.gov/repository/ntlc/nhtsa/index.shtm
- FHWA Safety Office, Speed Management Safety page and links safety.fhwa.dot.gov/speedmgt/
 - AASHTO Strategic Highway Safety Plan, including the NCHRP Report 500 series guides on reducing crashes safety.transportation.org/guides.aspx
 - NCHRP Report 504, Design Speed, Operating Speed, and Posted Speed Practices NATIONAL onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_504.pdf
 - Transportation Research Information Services (TRIS) database – bibliographic database of transportation-related research tris.trb.org

Countermeasures That Work

Countermeasures to reduce aggressive driving and speeding are listed below and discussed individually in this chapter. The table is intended to give a rough estimate of each countermeasure’s effectiveness, use, cost, and time required for implementation. The terms used are described below. Effectiveness, cost, and time to implement can vary substantially from State to State and community to community. Costs for many countermeasures are difficult to measure, so the summary terms are very approximate. See each countermeasure discussion for more information.

1. Laws

Countermeasure	Effectiveness	Use	Cost	Time
1.1 Speed limits	★★★★★ [†]	High	Low	Short
1.2 Aggressive driving laws	★	Low	Low	Short

[†] When enforced and obeyed

2. Enforcement

Countermeasure	Effectiveness	Use	Cost	Time
2.1 Automated enforcement	★★★★★	Medium	High [†]	Medium
2.2 High-visibility enforcement	★★	Low ^{††}	High	Medium
2.3 Other enforcement methods	★★	Unknown	Varies	Varies

[†] Can be covered by income from citations

^{††} For aggressive driving, but use of short-term, high-visibility enforcement campaigns for speeding is more widespread

3. Penalties and Adjudication

Countermeasure	Effectiveness	Use	Cost	Time
3.1 Penalty types and levels	★★	High	Varies	Low
3.2 Diversion and plea agreements	★	Unknown	Varies	Varies

4. Communications and Outreach

Countermeasure	Effectiveness	Use	Cost	Time
4.1 Public Information supporting enforcement	★★★	Medium	Varies	Medium

Effectiveness:

★★★★★ - Demonstrated to be effective by several high-quality evaluations with consistent results

★★★★ - Demonstrated to be effective in certain situations

- ★ ★ ★ - Likely to be effective based on balance of evidence from high-quality evaluations or other sources
- ★ ★ - Effectiveness still undetermined; different methods of implementing this countermeasure produce different results
- ★ - Limited or no high-quality evaluation evidence

Effectiveness is measured by reductions in crashes or injuries unless noted otherwise. See individual countermeasure descriptions for information on effectiveness size and how effectiveness is measured.

Use:

- High: more than two-thirds of the States, or a substantial majority of communities
- Medium: between one-third and two-thirds of States or communities
- Low: fewer than one-third of the States or communities
- Unknown: data not available

Cost to implement:

- High: requires extensive new facilities, staff, or equipment, or makes heavy demands on current resources
- Medium: requires some additional staff time, equipment, and/or facilities
- Low: can be implemented with current staff, perhaps with training; limited costs for equipment or facilities

These estimates do not include the costs of enacting legislation or establishing policies.

Time to implement:

- Long: more than one year
- Medium: more than three months but less than one year
- Short: three months or less

These estimates do not include the time required to enact legislation or establish policies.

1. Laws

1.1 Speed Limits

Effectiveness: ★ ★ ★ ★ ★ †	Use: High	Cost: Low	Time: Short
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† When enforced and obeyed

Speed limits are only one part of the system that attempts to control driving speeds. Without broad public acceptance and active enforcement they have little effect. With public acceptance and enforcement, lower speed limits can reduce travel speeds and casualties.

Speed limits are set both by legislation and by administrative action. General speed limits apply to all roads in a class, such as rural interstates or local streets. They are set by State, municipal, or even at times by Federal law based on tradeoffs between safety, travel efficiency, and community concerns, taking into account the design characteristics of each road class. Speed zones apply to road segments where the general speed limit is thought to be inappropriate. Speed limits in these zones usually are set by administrative action based on the road segment’s free-flowing travel speeds, crash experience, road and land use conditions, and other factors (TRB, 1998).

The effects of maximum speed limits on speeds, crashes, and casualties have been studied extensively over the past 30 years. In 1974 the 55 mph National Maximum Speed Limit (NMSL) was enacted to conserve fuel. Travel decreased, speeds decreased on roads where the speed limit was lowered to 55 mph, and total traffic fatalities decreased by 9,100 from 1973. The slower and more uniform speeds due to the 55 mph limit are judged to have saved between 3,000 and 5,000 lives in 1974 (TRB, 1984). As fuel became plentiful again, travel increased and compliance with the 55 mph limit decreased markedly (TRB, 1984). In 1987 Congress allowed States to raise speed limits to 65 mph on rural interstate highways. States that raised their limits generally saw increases of about 4 mph in average speeds and 85th percentile speeds and statistically significant increases in traffic fatalities on these roads (TRB, 1998). In 1995, Congress repealed the NMSL and returned full authority to set speed limits back to the States. Again, increased speed limits produced modest increases in both average and 85th percentile speeds as well as increases in traffic fatalities (TRB, 1998; for the most recent analysis, see TRB, 2006). Speed limit increases from 75 to 80 mph on rural Texas interstates in 2006 also resulted in increased speeds relative to a comparison highway with no increase in limit (Retting & Cheung, 2008). For summaries of each State’s maximum speed limits see the Governors Highway Safety Association (GHSA, 2010c) and the Insurance Institute for Highway Safety (IIHS, 2010c) Web sites. NHTSA (2007) provides a publication with each State’s complete speed limit laws.

Few studies have examined the effects of speed limit changes on lower-speed roads. Earlier studies found little effect on driving speeds or crash rates when speed limits were raised to near the 85th percentile travel speed or lowered to near the 35th percentile speed, either on rural roads or on urban and suburban arterials (TRB, 1998, p. 6). A more recent study found that crashes increased by 20 to 30% when speed limits were increased from 50 to 70 kph (31 to 43 mph) or from 70 to 80 kph (43 to 50 mph) on 19 urban road segments in Hong Kong (Wong, Sze, Lo, Hung, & Loo, 2005).

Use: A speed limit is in effect on all road segments in all States.

Effectiveness: Lower maximum speed limits definitely reduce crashes and casualties when the limits are obeyed. The same holds true on any road: if a lower speed limit is obeyed, then crashes and casualties will drop. But lower speed limits by themselves may not reduce travel speeds.

Costs: The immediate costs of changing speed limits are for new signage and for publicizing the new limit. Enforcing the new limit may involve substantial costs.

Time to implement: Speed limit changes can be implemented quickly, as soon as signage is in place and the new limits are publicized.

Other issues:

- **Public acceptance, roadway characteristics, enforcement, and publicity:** Speed limit changes may not by themselves affect speeding, whether defined either as average travel speed or as the proportion of drivers traveling substantially faster than the average speed. Speed limits can reduce speeding if most drivers believe that the limits are reasonable and if the threat of enforcement is great enough to affect the few drivers who would not comply voluntarily. It is generally very difficult to enforce and obtain general compliance with a lower speed limit on a roadway designed for higher speeds (TRB, 1998). Thus, speed limits must be considered as part of a system including broad public acceptance, roadway characteristics, active enforcement, and publicity (TRB, 1998).
- **Rational speed limits:** Speed limits on many road segments are frequently not obeyed, and average travel speeds on these segments substantially exceed the speed limit. One strategy that has been proposed to increase overall safety is to carefully set and enforce credible speed limits for homogeneous road segments. Once rational speed limits are established, aggressive enforcement is used to enforce close to the actual limit. The goal of this strategy is to increase the public's overall acceptance of speed limits while reducing the number of people driving at speeds considerably higher than the limit. Emerging evidence suggests that drivers' perceptions of safe speed are in fact influenced by their expectation of what speed above the limit would trigger a ticket. Therefore lower tolerances would help to increase the perception of the risk of exceeding limits by even small amounts (Mannering, 2009).
- **Variable speed limits:** Speed limits that may adjust to adverse or changing environmental conditions are also considered by FHWA to have promise in restoring credibility of speed limits on some highways. Whether this promise will hold up, however, is uncertain. As of 2007, six metropolitan areas were employing enforceable, variable speed limits on freeways (posted on changeable message signs) (RITA, 2007). Effects on safety have not, as yet, been established. Automated speed enforcement could be linked to variable limits.

1.2 Aggressive Driving and Other Laws

Effectiveness: ★	Use: Low	Cost: Low	Time: Short
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Aggressive driving actions are covered by specific traffic laws, such as the laws regarding speeding, improper lane changes, and following too closely, or by general laws, such as those that target reckless driving. Most existing reckless driving statutes carry relatively minor penalties and may be difficult to prosecute according to NHTSA (NHTSA, 2001a). Aggressive drivers, as distinct from aggressive driving, often can be identified as those who violate traffic laws repeatedly or whose violations lead to crashes producing serious injury or death. Therefore, the primary traffic law strategy to address aggressive driving is to assure that more severe penalties are available for repeat offenders and for violations causing death or serious injuries. Existing statutes, including reckless driving laws, may be strengthened or aggressive driving laws may be enacted.

NHTSA’s 1999 Symposium on Aggressive Driving and the Law (NHTSA, 2001a) recommended that States implement laws targeting aggressive drivers by providing for:

- enhanced penalties for repeat offenders, including increased driver’s license points, license suspension or revocation, higher fines, and jail or probation; and
- felony charges for violations resulting in serious injury or death.

NHTSA also developed a model statute that defines aggressive driving as three moving violations in a single driving incident and a number of States have adopted similar laws; however, aggressive driving violations may be difficult to enforce and prosecute (Flango & Keith, 2004). The NCHRP Aggressive Driving Guide also suggests a strategy of applying increased sanctions and treatment for repeat offenders and serious offenses (NCHRP, 2003a, Strategy A3).

Use: In general, States provide for increased penalties for repeat offenders and for violations with serious consequences. Thirteen States have aggressive driving laws (GHSA, 2010a). Among these, Florida’s is a "defining statute" only; there is no aggressive driving charge, but there is a notation on the citation that aggressive driving was involved. Pennsylvania passed a resolution to discourage aggressive driving, but there is no enforceable offense.

Effectiveness: There are no studies of the effects of aggressive driving laws in general or of increased penalties in particular on aggressive driving and related crashes. See Chapter 3, Section 3.1 for a discussion of the effects of driver improvement actions in general.

Costs: The only immediate costs of the recommended law changes are to publicize the new or altered laws. Additional costs may result as drivers are sentenced to more costly sanctions.

Time to implement: Law changes can be implemented quickly, as soon as they are publicized.

Other issues:

- **Public acceptance, enforcement, and publicity:** Law changes by themselves cannot reduce aggressive driving. Traffic laws in general and aggressive driving laws in

particular are essential to, but only a part of, a system that includes broad public acceptance, active enforcement, effective adjudication, and publicity (NHTSA, 2001a.).

- **Record-keeping:** Information on prior convictions of offenders must be up-to-date and available to prosecutors and court officials so that repeat and flagrant violators may be prosecuted in keeping with the strategy to increase sanctions for these offenders. Providing the technology and ability for patrol officers to obtain up-to-date driver history information at the time of traffic stops is another strategy recommended to deal with drivers with suspended or revoked licenses who continue to violate traffic laws (NCHRP, 2003b).

2. Enforcement

2.1 Automated Enforcement

Effectiveness: ★ ★ ★ ★ ★	Use: Medium	Cost: High [†]	Time: Medium
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[†] Can be covered by income from citations

Automated enforcement is used in some jurisdictions to reduce red-light running and speeding. At intersections with traffic lights, automated cameras take photographs of vehicles entering the intersection on a red light. Citations are sent to the vehicle’s registered owner. FHWA’s Red-Light Camera Systems Operational Guidelines (FHWA, 2005) provides information on red-light camera program costs, effectiveness, implementation, and other issues. Maccubbin, Staples, and Salwin (2001) provide more detailed information on programs operating in 2001. Speed cameras, also called photo radar or automated speed enforcement, operate similarly, recording a vehicle’s speed using radar or other instrumentation and taking a photograph of the vehicle when it exceeds a threshold limit. NHTSA and FHWA have released speed camera enforcement program and operational guides with information on problem identification and program planning, communications strategies, obtaining community and other stakeholder support, processing of violations, and program evaluation (NHTSA, 2008; U.S. DOT, 2008).

Use: Red-light cameras are used extensively in other industrialized countries and were first employed in the United States in 1993 (NCSRLR, 2002). According to the Insurance Institute for Highway Safety, red-light cameras are used in nearly 500 United States communities in 25 States and the District of Columbia. Speed cameras have been used in 12 States and the District of Columbia (IIHS, 2010b), but not all of these programs may be active at present. Speed cameras also are used extensively in other countries (WHO, 2004). Information on States’ laws authorizing or restricting use of automated enforcement is provided by the GHSA (2010b) and by IIHS (2010a).

Effectiveness: Red-light camera effectiveness has been studied fairly extensively. Summary reviews conclude that they increase rear-end crashes, reduce side-impact crashes (the target group), and reduce overall crash severity (Aeron-Thomas & Hess, 2006; Decina, Thomas, Srinivasan, & Staplin, 2007; Maccubbin et al., 2001; McGee & Eccles, 2003; Retting, Ferguson, & Hakkert, 2003; WHO, 2004). Because there tend to be increases in lower-severity rear end crashes that somewhat offset reductions in the target group of higher-severity angle crashes, cameras were found to be more beneficial at intersections with a higher ratio of angle crashes to rear-end crashes. Intersections with high total volumes, higher entering volumes on the main road, short signal cycle lengths, protected left turn phases, and higher publicity may also increase the aggregate cost benefits of red light camera enforcement (Council, Persaud, Eccles, Lyon, & Griffith, 2005).

Speed cameras can reduce crashes substantially. Decina et al. (2007) reviewed 13 safety impact studies of automated speed enforcement internationally, including one study from a United States jurisdiction. The best-controlled studies suggest injury crash reductions are likely to be in the range of 20 to 25% at conspicuous, fixed camera sites. Covert, mobile enforcement programs also result in significant crash reductions area-wide (Thomas, Srinivasan, Decina, & Staplin, 2008). Prior reviewers also concluded that, although the quality of evidence was not high, speed

cameras and speed detection technologies are effective at reducing traffic crashes and injuries (Pilkington & Kinra, 2005; Wilson, Willis, Hendrikz, & Bellamy, 2006). Recent crash-based studies from the United States have reported positive safety benefits through crash and speed reductions from mobile camera enforcement on 14 urban arterials in Charlotte, NC (Cunningham Hummer, & Moon, 2008), and from fixed camera enforcement on an urban Arizona freeway (Shin, Washington, & van Schalkwyk, 2009).

The Shin et al. (2009) study examined effects of a fixed camera enforcement program applied to a 6.5-mile urban freeway section through Scottsdale, Arizona. The speed limit on the enforced freeway is 65 mph; the enforcement trigger was set to 76 mph. Total *target* crashes were reduced by an estimated 44 to 54%, injury crashes by 28 to 48%, and property damage only crashes by 46 to 56% during the nine month program period. (The program was temporarily suspended, then reactivated; future evaluations may elaborate on the results.) Since analyses found low speeding detection rates during peak travel times, the target crashes (speeding-related crashes) were considered to be those that occurred during non-peak flow periods (weekends, holidays, and non-peak weekdays hours). In addition to the crash reductions, average speed was decreased by about 9 mph and speed variance was also decreased around the enforced zones. An economic analysis suggested that the total estimated safety benefits were from \$16.5 to \$17.1 million per year, although other economic impacts were not considered. Another positive finding from this study was that all types of crashes appeared to be reduced, with the possible exception of rear-end crashes, for which effects were non-significant. Thus, there were no obvious trade-offs of decreases in some crash types at the expense of increases in others. The program effects should be considered short-term. There was also very limited examination of spillover effects, including the possibility of traffic or crash diversion to other routes.

Pilot project evaluations of speed camera use in the United States have also obtained promising speed reductions from fixed speed cameras on a high-speed, urban freeway in Scottsdale, Arizona (Retting, Kyrychenko, & McCartt, 2008), low-speed, school zones in Portland, Oregon (Freedman et al., 2006), and low-speed limit residential streets and school zones in Montgomery County, Maryland (Retting, Farmer, & McCartt, 2008). In the latter case, speed reductions attributed to spillover from the automated enforcement program were also observed on unenforced comparison streets (Retting et al., 2008). The percentage of speeders was also substantially reduced when police-operated photo radar enforcement vans were present in a work zone on a non-interstate highway in Portland, Oregon, but there was no carry-over when the enforcement was not present (Joerger, 2010). Given that there was no evidence of any accompanying publicity, there was, however, no reason to expect carry-over outside of the enforced periods. Crash and injury outcomes were not evaluated in these studies.

Costs: Costs will be based on equipment choices, operational and administrative characteristics of the program, and arrangements with contractors. Cameras may be purchased, leased, or installed and maintained by contractors for a negotiated fee (U.S. DOT, 2008). In 2001, red-light cameras cost about \$50,000 to \$60,000 to purchase and \$25,000 to install. Monthly operating costs were about \$5,000 (Maccubbin et al., 2001). Most jurisdictions contract with private vendors to install and maintain the cameras and use a substantial portion of the income from red-light citations to cover program costs.

Speed camera costs probably are similar. Chen (2005) provides an extensive analysis of the costs and benefits of the British Columbia, Canada speed camera program. Gains, Heydecker, Shrewsbury, and Robertson (2004) reported on costs and benefits and program factors of a cost-recovery program used in the U.K.

Time to implement: Once any necessary legislation is enacted, automated enforcement programs generally require 4 to 6 months to plan, publicize, and implement.

Other issues:

- **Laws:** Many jurisdictions using automated enforcement are in States with laws authorizing its use. Some States permit automated enforcement without a specific State law. A few States prohibit or restrict some forms of automated enforcement (GHSA, 2010b; IIHS, 2010a). See NCUTLO (2004) for a model automated enforcement law.
- **Public acceptance:** Public surveys typically show strong support for red-light cameras and somewhat weaker support for speed cameras (IIHS, 2009; NHTSA, 2004). Support appears highest in jurisdictions that have implemented red-light or speed cameras. However, efforts to institute automated enforcement often are opposed by people who believe that speed or red-light cameras intrude on individual privacy or are an inappropriate extension of law enforcement authority. They also may be opposed if they are viewed as revenue generators rather than methods for improving safety. Per citation payment arrangements to private contractors should be avoided to reduce the appearance of conflicts of interest (FHWA, 2005). Australian researchers discussed how Australia and the United Kingdom have dealt with the opponents of and controversies associated with speed cameras and expanded programs at the same time (Delaney, Diamantopoulou, & Cameron, 2003; Delaney, Ward, Cameron, & Williams, 2005).
- **Legality:** State courts have consistently supported the constitutionality of automated enforcement.
- **Covert vs. overt enforcement:** Covert, mobile speed camera enforcement programs may provide a more generalized deterrent effect and may have the added benefit that drivers are less likely to know precisely when and where cameras are operating. Drivers may therefore be less likely to adapt to cameras by taking alternate routes or speeding up after passing cameras, but data are lacking to confirm this idea (Thomas, et al., 2008). Public acceptance may be somewhat harder to gain with more covert forms of enforcement (U.S. DOT, 2008). Fixed, or signed, conspicuous mobile enforcement may also be more noticeable and achieve more rapid site-specific speed and crash reductions. However, the use of general signs in jurisdictions with automated enforcement (not at specifically enforced zones), media, and other program publicity about the need for speed enforcement may help to overcome the idea that covert enforcement is unfair, and promote the perception that enforcement is widespread, enhancing deterrence effects. Based on lessons learned abroad, a mix of conspicuous and covert forms of enforcement may be most effective. The recent operational guidelines outline other considerations of overt and covert speed enforcement and signing strategies (U.S. DOT, 2008).
- **Halo effects:** More research is needed to shed light on spillover effects (positive or negative) of automated speed enforcement programs of varying characteristics. While fixed cameras may yield more dramatic decreases in crashes at the treated sites (which, however, are often sites with high crash frequencies) than mobile enforcement, there is little reason to expect that there would be a significant positive spillover effect. In fact

some studies have detected crash migration related to conspicuous, fixed camera enforcement (Decina et al., 2007). There is also a possibility of negative spillover resulting from mobile camera enforcement, but signing and random deployment practices may reduce that possibility (Thomas, Srinivasan, et al., 2008).

2.2 High-Visibility Enforcement

Effectiveness: ★ ★	Use: Low [†]	Cost: High	Time: Medium
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[†] For aggressive driving, but use of short-term, high-visibility enforcement campaigns for speeding is more widespread

High-visibility enforcement campaigns have been used to deter aggressive driving and speeding through both specific and general deterrence. In the high-visibility enforcement model, law enforcement targets selected high-crash or high-violation geographical areas using either expanded regular patrols or designated aggressive driving patrols. This model is based on the same principles as high-visibility seat belt and alcohol-impaired-driving enforcement: to convince the public that speeding and aggressive driving actions are likely to be detected and that offenders will be arrested and punished (see Chapter 1, Alcohol-Impaired Driving, Sections 2.1 and 2.2, and Chapter 2, Seat Belt Use, Section 2.1).

In the high-visibility enforcement model, officers focus on drivers who commit common aggressive driving actions such as speeding, following too closely, and running red lights. Enforcement is publicized widely. The strategy is very similar to saturation patrols directed at alcohol-impaired drivers (Chapter 1, Section 2.2). Because speeding and aggressive driving are moving violations, officers cannot use checkpoints. Rather, they must observe driving behavior on the road.

Use: No data are available on the number of jurisdictions operating high-visibility aggressive driving enforcement campaigns, but it is likely that they are not common. NCHRP (2003a, Strategy A1) provides a few examples of aggressive driving enforcement programs.

Effectiveness: Some effectiveness evidence comes from NHTSA demonstrations in three communities. All three demonstrations lasted 6 months and included extensive publicity but differed in other respects. Milwaukee was the most successful. Red-light running decreased at targeted intersections. Crashes in the city dropped by 12% in targeted corridors and by 2% in comparison corridors (McCartt, Leaf, Witkowski, & Solomon, 2001). The Indianapolis demonstration was not a success. Average speeds dropped slightly. Total crashes *increased* 32% over the previous year. Crashes increased *more* in the demonstration area than in other areas, and the proportion of crashes involving aggressive driving behaviors also increased in the demonstration areas (Stuster, 2004). Tucson had mixed results. Average speeds dropped moderately. Total crashes *increased* 10% in the demonstration areas and *decreased* in comparison areas. However, the proportion of crashes involving aggressive driving behaviors decreased by 8% in the demonstration areas (Stuster, 2004).

Several studies have reported reductions in crashes or reductions in speeding or other violations attributed to both general and targeted high-visibility enforcement campaigns. Although the evidence is not conclusive, the trends are promising. These efforts have included a high-visibility enforcement campaign following review and setting of rational speed limits in Minnesota (Harder & Bloomfield, 2007), a substantial increase in general traffic enforcement in Fresno, California (Davis et al., 2006), and a neighborhood high-visibility speed enforcement campaign in Phoenix and Peoria, Arizona (Blomberg & Clevon, 2006). Publicity measures for the latter included both street and yard signs, educational material and active participation of

neighborhood groups. Speed reductions were greatest in neighborhoods where new vertical traffic calming measures were also installed. No particular publicity measures were noted for the Fresno campaign, but it is likely that the increase from 20 to 84 traffic patrol officers, the addition of 20 new police motorcycles and radar guns, and more than 3-fold increase in citations in two years generated substantial publicity. The Minnesota campaign, which used speeding and crash histories to help target enforcement, effectively reduced mean speeds and especially excessive speeding (speeds of 70 mph and more). Downward crash trends were also promising though not conclusive. Extensive radio publicity supplemented by earned media was used in the Minnesota campaign, but it was unclear if these efforts were successful at reaching a wider audience. The project evaluators recommended that the program be continued both to evaluate the long-term effects, and in an effort to change the culture of speeding (Harder & Bloomfield, 2007).

High-visibility model programs to target specific aggressive driving actions around large trucks have also recently been undertaken in several States. The program, known as TACT (Ticketing Aggressive Cars and Trucks) is modeled on the *Click It or Ticket* belt use campaigns. An evaluation found promising results in reducing the number of targeted violations as the program was implemented in Washington State; effects on crashes or injuries were not determined (Nerup et al., 2006; Thomas, Blomberg, Peck, Cosgrove, & Salzberg, 2008).

Taken together, the evaluation evidence suggests that high-visibility, aggressive driving enforcement campaigns have promise, but success is far from guaranteed.

Costs: As with alcohol-impaired driving and seat belt use enforcement campaigns, the main costs are for law enforcement time and for publicity. The Minnesota Speed Management Program cost approximately \$3 million, with \$2.5 million for increased enforcement, \$350 thousand for paid media (primarily radio), and \$150 thousand for data collection and evaluation. The Minnesota DOT and State Patrol also made significant in-kind contributions toward project management, sign installation, speed detection equipment, engineering reviews, and fuel & vehicle costs (Harder & Bloomfield, 2007). The Milwaukee demonstration received a \$650,000 grant and the other two demonstrations each received a \$200,000 grant.

Time to implement: High-visibility enforcement campaigns may require 4 to 6 months to plan, publicize, and implement.

2.3 Other Enforcement Methods

Effectiveness: ★ ★	Use: Unknown	Cost: Varies	Time: Varies
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Many traffic enforcement operations help to deter speeding and aggressive driving as well as other traffic offenses. In addition to high-visibility enforcement campaigns (Chapter 3, Section 2.2) and automated enforcement (Section 2.1), a number of new technologies have been recommended to address speeding and aggressive driving (NHTSA, 2001a). Law enforcement agencies around the country have also conducted innovative and effective aggressive driving enforcement programs (NHTSA, 2000).

New technology: Improved technology may help in several ways.

- In-car video equipment in patrol cars allows law enforcement to record aggressive driving actions and can enhance the ability to prosecute and convict offenders (NHTSA, 2001a).
- Laser speed measuring equipment can provide more accurate and reliable evidence of speeding (NHTSA, 2001a).
- Unstaffed speed display devices, also known as speed trailers, can show drivers that they are speeding and may encourage some drivers to slow down, but effects may last only as long as the devices are in place (Donnell & Cruzado, 2008). They may also suggest to drivers that speeds are being monitored or enforcement is nearby. Signs that provided either an implication that speeds were being monitored or a social norms message (average speed at the site; your speed) were effective at reducing speeds in a 50 km/h zone although not as much as in earlier studies (Wrapson, Harre, & Murrell, 2006). Other studies have shown that speed trailers can be effective in reducing speeds in work zones (Brewer, Pesti, & Schneider, 2006; Mattox, Sarasua, Ogle, Eckenrode, & Dunning, 2007) and school zones (Lee, Lee, Choi, & Oh, 2006). Automated speed display monitors also provide a method to collect location-specific travel speed data.
- Both in-vehicle driver warning systems as well as traditional cruise control are widely available technologies that may be well-accepted by drivers to help govern their own speeds and have begun to be evaluated in Europe (Sivak et al., 2007; Young & Regan, 2007).
- Lease cars in the Netherlands were equipped with technology that continuously monitored and displayed whether drivers were allowing a safe following distance and complying with the speed limit. Rewards were given by the lease company for good driving behavior over a 16 week period. Drivers were about 20% more likely to drive within posted speed limits and 25% more likely to maintain adequate following distances when receiving feedback and rewards (Mazureck & van Hattem, 2006). In contrast, a study of the effects of in-vehicle warning and monitoring systems was disappointing with respect to speed control by young teens (Farmer, Kirley, and McCartt, 2010). Even with parental notification (immediate or delayed) and with or without in-vehicle alerts, there was either no reduction in instances of teens exceeding the limit by more than 10 mph or initial declining trends reversed after a few weeks.
- Drone radar - A study of the use of this technology in work zones suggests that it may be effective at reducing overall speed of the traffic stream, with particularly large speed

reductions among vehicles equipped with radar detectors (Eckenrode, Sarasua, Mattox, Ogle, & Chowdhury, 2007).

Many jurisdictions use some of these new technologies. Each has costs for new equipment, maintenance, and training. Each can be implemented quickly as soon as equipment is purchased and training completed.

Other enforcement programs: NHTSA's *Aggressive Driving Enforcement: Strategies for Implementing Best Practices* (NHTSA, 2000) provides brief descriptions of 12 aggressive driving enforcement programs from around the country. See NHTSA's *Aggressive Driving Programs* (NHTSA, 2001b) for additional examples.

- The Albuquerque, New Mexico, Safe Streets program used saturation patrols in four high-crash and high-crime areas. On freeways they observed speeding and aggressive driving from a "cherry picker" platform and radioed to patrol officers.
- The Arizona Department of Public Safety's Operation Chill used both marked and unmarked patrol vehicles backed up with an extensive publicity campaign.
- The Colorado State Patrol ADAPT (Aggressive Drivers Are Public Threats) campaign used unmarked patrol vehicles, motorcycles, airplanes, and motorist calls to *277 to detect aggressive drivers. The campaign was publicized extensively.
- The Maryland State Police used a special ADVANCE (Aggressive Driving Video and Non-Contact Enforcement) vehicle equipped with lasers to determine a vehicle's range and speed and a computer system to record video images of the vehicle.
- The Massachusetts State Police 3D Program, (Dangerous Drunk and Drugged Driving) used unmarked patrol vehicles as well as unmarked or nontraditional vehicles, equipped with in-car video cameras and radar units, and emergency lights, working in cooperation with two or more marked patrol vehicles.
- The Milwaukee, Wisconsin, Police Department used an "angel patrol" (for those drivers who "drive faster than their guardian angel can fly"), a "flasher patrol" for those drivers who do not use their turn signals when turning or switching lanes, and a "basket patrol" for the drivers who like to weave in and out of traffic. See Chapter 3, Section 2.2 for evaluation data.
- The Ohio State Highway Patrol's Operation TRIAD (Targeting Reckless, Intimidating, and Aggressive Drivers) used a large, fixed-wing aviation division and local highway patrol officers to target aggressive driving.
- The Oklahoma City Police Department's RAAID (Reduction of Accidents and Aggressive and Inconsiderate Drivers) used dedicated law enforcement teams to target 10 high-crash areas.
- The Pennsylvania State Police used two programs. Operation Centipede stationed 8 to 10 officers one to two miles apart along a roadway, in both marked and unmarked vehicles. TAG-D (Ticket the Aggressive Driver) used saturation patrols with marked and unmarked law enforcement vehicles, a vehicle that appears disabled, radar, fixed-wing aircraft, and pursuit vehicles.
- The Richardson, Texas, Police Department used a downstream light system to reduce red-light running. A white light on the back of a traffic light was activated when the light turned red. Officers across the intersection or downstream from the traffic light could then tell when the light turned red and wait for the red-light runners to reach them.

- The St. Petersburg, Florida, Police Department's "Where's Jockers?" program featured Patrol Officer Mike Jockers, equipped with a radar gun and hand-held radio, sitting in unexpected places to observe aggressive driving and call ahead to marked patrol vehicles. Locations included on lawn mowers and bus benches, and in road construction vehicles.
- The greater Washington, DC, area multi-agency Smooth Operator program used shared publicity and coordinated enforcement waves with marked and unmarked patrol vehicles as well as nontraditional vehicles.

3. Penalties and Adjudication

3.1 Penalty Types and Levels

Effectiveness: ★ ★ [†]	Use: High	Cost: Varies	Time: Low
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[†] For general traffic offenses

Penalty types and levels for speeding and the various traffic offenses included under aggressive driving are part of each State’s overall driver control system. Penalties typically are low for first offenses that do not produce serious crashes and casualties and include small fines and perhaps a few demerit points assessed against the driver’s license. When violations cause a crash producing serious injury or death, the offense may carry criminal charges and sanctions may be more severe. As discussed in Chapter 3, Section 1.2, NHTSA’s Aggressive Driving Symposium and NCHRP’s Aggressive Driving Guide recommend enhanced penalties for repeat aggressive driving offenders and felony charges for offenses resulting in serious injury or death (NCHRP, 2003a, Strategy A3; NHTSA, 2001a).

States use the demerit point system in an attempt to prevent drivers from committing repeated traffic offenses. As drivers accumulate demerit points, States use various actions and penalties such as warning letters, educational brochures, group counseling meetings, individual counseling, administrative hearings, and driver’s license suspension or revocation (Masten & Peck, 2004). Penalty levels and types for speeding and aggressive driving offenses should be considered within the context of a State’s overall driver control and problem driver remediation system.

Use: Each State has a system of penalties for traffic offenses. Each system includes more severe penalties for significant individual offenses, such as those producing serious injury or death, and for repeated offenses, often determined through accumulated driver’s license demerit points.

Effectiveness: Generally, for penalties to be effective, perceived risk of getting caught must be high. Evidence is mixed about effectiveness of varying severity of penalties. Masten and Peck (2004) reviewed the effectiveness evidence for different driver improvement and driver control actions, including penalty levels and types, from 35 high-quality studies of 106 individual actions and penalties. They found that, taken together, all actions and penalties reduced subsequent crashes by 6% and violations by 8%. Even simple warning letters have some effect on both violations and crashes. The effect increased as the “obtrusiveness” of the action increased, with license suspension or revocation the most effective by far. The authors noted that the threat of license suspension probably is responsible for the effectiveness of the weaker actions such as warning letters. Educational brochures by themselves had no effect. Finally, administrative penalties imposed by the driver licensing agency were more effective than penalties imposed by the courts.

In Norway, Elvik and Christensen (2007) reported that there was a weak tendency for speeding violations to decrease near camera-enforced sites in response to increasing fixed penalties over time. There was no general effect of increasing fixed penalties over the road system at large, likely due to the overall low risk of detection. A study in Maryland found that various legal consequences for speeding had little impact on future citations for individual drivers

(Lawpoolsri, Li, & Braver, 2007). Drivers who received legal consequences had the same likelihood of receiving another speeding citation as drivers who escaped legal consequences. Only fines coupled with probation before judgment (PBJ) was associated with a reduced risk of receiving a subsequent speeding ticket (Lawpoolsri et al., 2007). Most evidence suggests that there is at least a population of drivers for whom penalties do not seem to have the desired deterrent effect. For example, a study from the U.K. that examined survey and conviction data found that the immediate threat of being disqualified from driving deterred those with points on their license from further speeding. However, for a subset of drivers, the threat of this sanction did not appear to affect their choice to speed (Corbett, Delmonte, Quimby, & Grayson, 2008).

Repeat offenders: Repeat speeding and aggressive driving offenders may be especially difficult to deter. Recommended methods to reach them include:

- enhanced penalties, including increased driver's license points, immediate license suspension or revocation, higher fines, and jail or probation. See Chapter 3, Sections 1.2 and 3.1, for more information.
- improved traffic record systems, to better identify repeat offenders and to allow patrol officers to immediately access a driver's complete driving record (NCHRP, 2003b; NHTSA, 2001a). There are no studies of the effects of improved record systems on repeat offenders. Costs and implementation time will vary.

Costs: Costs vary by penalty type. For example, warning letters are very cheap once a record system has been established to identify drivers who should receive letters. Individual counseling and administrative hearings may require substantial staff time. Some costs may be recovered through offender fees.

Time to implement: Most changes in penalty levels can be implemented quickly within a State's overall driver improvement system.

Other issues:

- **Public acceptance, enforcement, and publicity:** Changes in speeding and aggressive driving penalty types and levels by themselves cannot reduce speeding and aggressive driving. Traffic laws, penalty types, and penalty levels are essential to, but only a part of, a system that includes broad public acceptance, active enforcement, and publicity (NHTSA, 2001a).

3.2 Diversion and Plea Agreement Restrictions; Traffic Violator School

Effectiveness: ★	Use: Unknown	Cost: Varies	Time: Varies
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In many jurisdictions, drivers who have accumulated a specific number of demerit points on their driver’s licenses are given the option of attending Traffic Violator School in order to reduce their punishment. In most instances, if they complete Traffic Violator School, their traffic offenses are dismissed or removed from their driving record (Masten & Peck, 2004).

Negotiated plea agreements are a necessary part of an effective and efficient court system. However, plea agreements may allow offenders to have their penalties reduced or eliminated, for example if a driver is allowed to avoid a driver’s license suspension by attending Traffic Violator School.

Use: No data are available on the number of jurisdictions in which Traffic Violator School is available or the number of offenders who use Traffic Violator School to reduce their penalties. Similarly, no data are available on the use of other plea agreements for speeding or aggressive driving violations.

Effectiveness: Masten and Peck’s review (2004) included high-quality studies of over 30 group meeting programs, including Traffic Violator School. Taken together, these group meeting programs reduced subsequent crashes by 5% and violations by 8%. Masten and Peck point out that Traffic Violator School programs in California increased, rather than decreased, crashes because they allowed offenders to escape more severe penalties and start again with a clean driving record. Their review was not able to determine whether other Traffic Violator School programs that dismissed an offender’s violation had similar negative effects. These reductions or eliminations of penalties also make it difficult to use driver histories to track and provide serious sanctions to repeat violators.

Costs: Costs for establishing diversion or Traffic Violator School programs will depend on the nature of the program. Costs include developing and maintaining a tracking system, notifying offenders, and administering the Traffic Violator School. Costs for limiting or eliminating diversion programs, plea agreements, and Traffic Violator School can be determined by comparing the per-offender costs of these programs with the costs of the penalties that would otherwise be applied.

Time to implement: Diversion or Traffic Violator School programs will require at least 6 months to establish and implement. They can be modified within a few months.

Other issues:

- **Diversion and plea agreement issues in alcohol-impaired driving:** Diversion and plea agreements have been discussed and evaluated more extensively for alcohol-impaired driving offenses than for speeding and aggressive driving offenses. See Chapter 1, Section 3.2 for additional discussion.
- **Public acceptance, enforcement, and publicity:** Changes in the adjudication of speeding and aggressive driving infractions, such as limiting or eliminating diversion and plea agreements, by themselves cannot reduce speeding and aggressive driving. Traffic

laws and adjudication are essential to, but only a part of, a system that includes broad public acceptance, active enforcement, and publicity (NHTSA, 2001a).

4. Communications and Outreach

4.1 Communications and Outreach Supporting Enforcement

Effectiveness: ★ ★ ★	Use: Medium	Cost: Varies	Time: Medium
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Effective, high-visibility communications and outreach are an essential part of successful speed and aggressive-driving enforcement programs (NCHRP, 2003a; NHTSA, 2000). All of the examples discussed in Chapter 3, Sections 2.2, High-Visibility Enforcement, and 2.3, Other Enforcement Methods, used extensive communications campaigns to support their enforcement efforts. Most campaigns to date have not used paid advertising. The success of paid advertising in seat belt use campaigns (Chapter 2, Section 3.1) suggests that it is worth considering for speed and aggressive driving enforcement campaigns.

The objective should be to provide information about the program, including expected safety benefits, and to persuade motorists that detection and punishment for violations is likely. See also NCHRP (2003a, Strategy A2). Communications and outreach programs urging drivers to behave courteously or not to speed are unlikely to have any effect unless they are tied to vigorous enforcement (NCHRP, 2003a, Strategy A2).

Use: Most aggressive driving and speed enforcement programs have a communications and outreach component.

Effectiveness: Reductions in crashes in Victoria, Australia, have been attributed to a television advertising campaign that supported, but did not relate directly, to automated speed enforcement initiatives (Bobevski, Hosking, Oxley, & Cameron, 2007). Earlier evidence from Australia also suggested that paid media advertising could enhance the effectiveness of automated speed enforcement (Cameron, Cavallo, & Gilbert, 1992). The evidence from seat belt (Chapter 2, Sections 2.1, 2.2, and 3.1) and alcohol-impaired driving (Chapter 1, Sections 2.1 and 2.2) enforcement programs strongly suggests that good communications and outreach are essential to a successful enforcement program.

Costs: Good media campaigns can be expensive. See Chapter 2, Section 3.1.

Time to implement: An effective media campaign requires 4 to 6 months to plan and implement.

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4. Distracted and Drowsy Driving

Overview

Distracted driving and drowsy driving are common, though both are difficult to define, measure, and sometimes observe. Both distracted and drowsy driving result in large part from lifestyle patterns and choices: they are societal issues rather than just driving and transportation system issues. For these reasons, few behavioral highway safety countermeasures have been shown to reduce distracted or drowsy driving, although a number of new countermeasures are currently being developed and evaluated.

Recent distracted driving attention and research has concentrated on cell phones, but this is just one of many potential distractions behind the wheel. Attention and research on drowsiness has concentrated on commercial truck drivers, but the problem is far more widespread.

Problem size and characteristics: distracted driving. Distraction occurs when a driver's attention is diverted away from driving to some other activity. A distraction can be produced by something a driver sees or hears, some physical task not directly involved in driving such as eating or operating the car radio, or mental activities such as conversations on a cell phone (NHCRP, 2005, Section III).

NHTSA surveyed 4,010 drivers in spring 2002 and asked about a variety of potentially distracting behaviors (Royal, 2003). Among the behaviors that drivers reported doing on at least some trips:

- 81% talked to other passengers;
- 66% changed radio stations or looked for CDs or tapes;
- 49% ate or drank;
- 26% took incoming calls on a cell phone and 25% made outgoing calls;
- 24% dealt with children in the back seat;
- 12% read a map or directions.

A survey in 2006 of 1,201 Canadian drivers found that nearly 70% reported that distracted driving was a serious problem, up from about 40% in 2001 (Valnaar, Simpson, Mayhew, & Robertson, 2007). Nearly all (96%) respondents believed there is more distracted driving today than 5 years ago. Similarly, a AAA Foundation survey of 2,501 United States residents found that one-third (34%) of drivers reported feeling less safe today than they did 5 years ago. The most commonly cited reason for feeling less safe was the frequency of distracted driving (AAAFTS, 2009).

In 2009, 5,474 people were killed and approximately 448,000 people injured in police-reported crashes involving driver distraction (NHTSA, 2010a). NHTSA estimates that driver distraction was involved in 16% of all fatalities in 2009, up from 10% in 2005 (NHTSA, 2010a). The true role of distraction in crashes may be even higher because pre-crash distractions often leave no evidence for law enforcement officers or crash investigators to observe, and drivers are understandably reluctant to admit to being distracted following a crash. A study that monitored 100 drivers for a year using specialized instrumentation found that secondary-task distractions

such as dialing a hand-held device or eating contributed to 22% of the crashes and near-crashes that occurred during the study (Klauer, Dingus, Neale, Sudweeks, & Ramsey, 2006).

The 100-Car study also examined the risk associated with engaging in various secondary tasks compared to regular driving. In the table below, a change in risk greater than 1 represents an increase in risk due to the secondary task, while a change in risk less than 1 represents a decrease in risk. Secondary tasks were classified as “simple” if they required, at most, one button press and/or eye glance from the roadway, “moderate” if they required one to two button presses and/or eye glances, and “complex” if they required more than two button presses and/or eye glances (Klauer, Guo, Sudweeks, & Dingus, 2010).

Type of secondary task	Change in risk
<u>Complex</u> <ul style="list-style-type: none"> • Dialing a hand-held device • Locating/reaching/answering hand-held device • Operating a PDA • Viewing a PDA • Reading • Animal/object in vehicle • Reaching for moving object • Insect in vehicle • Applying makeup 	2.1
<u>Moderate</u> <ul style="list-style-type: none"> • Talking/listening to hand-held device • Hand-held device—other • Inserting/retrieving CD • Inserting/retrieving cassette • Reaching for object (not hand-held device) • Combing or fixing hair • Other personal hygiene • Eating • Looking at external object 	1.3
<u>Simple</u> <ul style="list-style-type: none"> • Adjusting radio • Adjusting other devices integral to vehicle • Talking to passenger in adjacent seat • Talking/singing: no passenger present • Drinking • Smoking • Lost in thought 	n.s.

Note: n.s. indicates no significant change in crash risk. Source: Klauer et al. (2010), Tables 10 and 14.

The risk of having a crash or near-crash risk was twice as high when drivers were engaged in a complex secondary task than when they drove normally under similar conditions. Crash risks

were also increased when drivers engaged in moderate secondary tasks. On the other hand, simple tasks, such as adjusting the radio, did not change the risk of a crash. None of the distractions listed in the table above is easily addressed. Moreover, it is important to note that many of the studies on distracted driving and its consequences were conducted prior to the proliferation of text messaging, GPS navigation systems, and other newly developed technologies. Consequently, it is possible that distraction-related crashes will escalate as the use of new technologies continues to increase.

Problem size and characteristics: drowsy driving. Three national telephone surveys, two in the United States and one in Canada, provide consistent estimates of the prevalence and key characteristics of drowsy driving. Of the 1,456 adult drivers surveyed by the National Sleep Foundation (NSF) in fall 2004, 60% reported that they had driven while feeling drowsy at least once within the past year. Further, 37% said they had “nodded off or fallen asleep” while driving a vehicle at least once in their life (NSF, 2005, p. 42). Canadian responses from 1,209 drivers were similar: 57% had driven while tired and 20% had dozed off (Beirness, Simpson, & Desmond, 2005). In NHTSA’s survey, 11% reported that they had nodded off while driving during the past year (Royal, 2003). Of those who nodded off, 66% said they had six or fewer hours of sleep the previous night. The NHTSA and Canadian surveys found that drivers under age 30 and male drivers were more likely than older drivers and female drivers to have dozed off at the wheel (Beirness et al., 2005; Royal, 2003).

The NHTSA and Canadian surveys provide additional useful information about drowsy driving. Driving while drowsy does not just occur late at night. About one-third of those drivers who admit to nodding off say the most recent incident occurred in the afternoon (noon to 6 p.m.). In addition, drowsy driving is not limited to long trips. In both surveys, nearly half of the drivers who nodded off had been driving for an hour or less (Royal, 2003; Beirness et al, 2005). About 0.7% of all drivers reported that they had been in a crash in the past five years that they attributed to their drowsy driving. That’s about one-fifth as many as reported a crash that they attributed to distracted driving (Royal, 2003).

It’s often difficult to determine whether drowsy driving contributed to a crash. Similar to distracted driving, drivers may be reluctant to admit they dozed off following a crash. NHTSA estimated in 1998 that drowsy driving results in 40,000 injuries and 1,550 deaths each year, which represented slightly less than 4% of the total traffic injuries and fatalities in the United States at that time (NHTSA, 1998). The 100-car study reported that drowsy driving contributed to 22% to 24% of the crashes and near-crashes (Klauer et al., 2006).

Strategies to Reduce Distracted and Drowsy Driving

The obvious way to reduce distracted or drowsy driving crashes is to convince or require drivers to get enough sleep and to pay attention to their driving. These are very difficult goals. Drowsy driving may result from lifestyles that include insufficient or irregular sleep (shift workers, for instance) or from medical problems – issues beyond a driver’s immediate control. Many drivers consider some distractions, such as eating or drinking, listening to the radio, or talking on a cell phone, to be important and common activities and are unlikely to give them up. Moreover, studies indicate that drivers themselves are poor judges of the performance decrements that result from distracting activities (Horrey, Lesch, & Garabet, 2008).

Behavioral strategies to reduce distracted or drowsy driving attempt to remove some of the underlying causes or to promote awareness of the risks. Currently, few studies have examined whether the standard behavioral countermeasures of laws, enforcement, and sanctions, which are used successfully for alcohol impairment, seat belt use, aggressive driving, and speeding, are effective for distracted or drowsy drivers. One exception is for young drivers: some graduated driver licensing provisions help reduce distracted and drowsy driving by limiting the number of passengers, prohibiting nighttime driving, and restricting cell phone use (see Chapter 6, Sections 1.3 to 1.5).

Distracted or drowsy driving that is related to a driver's job may be reduced through employer policies and programs. The Network of Employers for Traffic Safety (NETS), the Occupational Safety and Health Administration (OSHA), and other employer-based resources are available through distraction.gov. Drowsy driving caused by medical conditions such as sleep apnea or by drugs or medications may be addressed through policies, communications, and outreach. Similarly, communications and outreach may be useful in raising awareness of specific distraction or drowsiness issues among certain high-risk populations. However, none of these strategies has been evaluated.

This chapter discusses these behavioral strategies. It does not include the environmental, vehicular, and regulatory countermeasures mentioned below because State Highway Safety Offices do not have authority or responsibility in these areas.

Environmental strategies can address both distracted and drowsy driving. Rumble strips, both on the shoulder and the centerline, have demonstrated their effectiveness in preventing crashes caused by inattention or drowsiness. Other roadway improvements, such as wide and visible edge lines, more easily visible road signs, and better lighting at night can help drivers who are not fully alert. See National Cooperative Highway Research Program [NCHRP] (2005) for a thorough discussion and for references to other NCHRP guides.

Vehicular strategies also affect driver distraction and drowsiness. In-car televisions, vehicle location and route-finding systems, and other new technologies in vehicles may create more potential distractions (Hedlund, Simpson, & Mayhew, 2006). On the other hand, in-vehicle technology in the future may be able to detect driver distraction or drowsiness, by monitoring driver performance, and then alert drivers (Donmez, Boyle, & Lee, 2007; May & Baldwin, 2009; Papadelis et al., 2007). Such driver assistance technologies include lane departure warning, crash-imminent braking, and forward collision warning. Automobile manufacturers and NHTSA are vigorously investigating many possibilities.

Driver drowsiness is a critical issue for commercial drivers. The Federal Motor Carrier Safety Administration (FMCSA) attempts to control commercial driver drowsiness through Hours of Service regulations, driver logs and inspections (see for example FMCSA, 2008). FMCSA has an extensive drowsy driver research program focused on commercial drivers (FMCSA, 2005). Additionally, NHTSA has developed a prototype Drowsy Driver Warning System that appears promising in reducing drowsiness among drivers of heavy vehicles (Blanco et al., 2009). As with the environmental and vehicular countermeasures mentioned above, commercial driver

countermeasures are not discussed in this guide because they do not fall under SHSO jurisdiction.

Resources

The agencies and organizations listed below can provide more information on distracted and drowsy driving and links to numerous other resources.

- U.S. Department of Transportation Web site on distracted driving: www.distraction.gov
- National Highway Traffic Safety Administration:
 - Research and Evaluation - <http://www.nhtsa.gov/Driving+Safety/Research+&+Evaluation>
 - Behavioral Safety Research Reports - <http://ntlsearch.bts.gov/repository/ntlc/nhtsa/index.shtm>
- National Safety Council: www.nsc.org/safety_road/Distracted_Driving/Pages/distracted_driving.aspx
- National Conference of State Legislatures: www.ncsl.org/?tabid=18657
- National Sleep Foundation: www.sleepfoundation.org
- Insurance Institute for Highway Safety: www.iihs.org

For overviews of distracted driving prevalence, risks, legislation, research, and recommended strategies, see NCHRP (2005) and Hedlund et al. (2006). In addition, see NHTSA's *Driver Distraction: A Review of the Current State-of-Knowledge* (Ranney, 2008) and *Overview of the National Highway Traffic Safety Administration's Driver Distraction Program* (NHTSA, 2010c). For overviews on drowsy driving, see NCHRP (2005) and TIRF (2009).

Key terms

- GDL: Graduated Driver Licensing, a three-phase system for beginning drivers consisting of a learner's permit, a provisional license, and a full license. A learner's permit allows driving only while supervised by a fully licensed driver. A provisional license allows unsupervised driving under certain restrictions.
- NCSDR: National Center for Sleep Disorders Research
- NSF: National Sleep Foundation.

Countermeasures That Work

Countermeasures to reduce distracted and drowsy driving are listed below and discussed individually in this chapter. The table is intended to give a rough estimate of each countermeasure’s effectiveness, use, cost, and time required for implementation. The symbols and terms used are described below. Effectiveness, cost, and time to implement can vary substantially from State to State and community to community. Costs for many countermeasures are difficult to measure, so the summary terms are very approximate. See each countermeasure discussion for more information.

1. Laws and Enforcement

Countermeasure	Effectiveness	Use	Cost	Time
1.1 GDL requirements for beginning drivers	★ ★ ★ ★ ★ [†]	High	Low	Medium
1.2 Cell phone and text messaging laws	★ ★	Medium	Varies	Short
1.3 General drowsiness and distraction laws	★	High ^{††}	Varies	Short

[†] Effectiveness proven for nighttime and passenger restrictions

^{††} Included under reckless driving; use of explicit drowsiness and distraction laws is low

2. Communications and Outreach

Countermeasure	Effectiveness	Use	Cost	Time
2.1 Drowsy driving	★	Unknown	Medium	Medium
2.2 Distracted driving	★	High	Medium	Medium

3. Other Countermeasures

Countermeasure	Effectiveness	Use	Cost	Time
3.1 Employer programs	★	Unknown	Low	Short
3.2 Medical conditions and medications	★	Unknown	Variable	Medium

Effectiveness:

- ★ ★ ★ ★ ★ - Demonstrated to be effective by several high-quality evaluations with consistent results
- ★ ★ ★ ★ - Demonstrated to be effective in certain situations
- ★ ★ ★ - Likely to be effective based on balance of evidence from high-quality evaluations or other sources
- ★ ★ - Effectiveness still undetermined; different methods of implementing this countermeasure produce different results
- ★ - Limited or no high-quality evaluation evidence

Effectiveness is measured by reductions in crashes or injuries unless noted otherwise.

See individual countermeasure descriptions for information on effectiveness size and how effectiveness is measured.

Use:

High: more than two-thirds of the States, or a substantial majority of communities

Medium: between one-third and two-thirds of States or communities

Low: fewer than one-third of the States or communities

Unknown: data not available

Cost to implement:

High: requires extensive new facilities, staff, equipment, or publicity, or makes heavy demands on current resources

Medium: requires some additional staff time, equipment, facilities, and/or publicity

Low: can be implemented with current staff, perhaps with training; limited costs for equipment or facilities

These estimates do not include the costs of enacting legislation or establishing policies.

Time to implement:

Long: more than one year

Medium: more than three months but less than one year

Short: three months or less

These estimates do not include the time required to enact legislation or establish policies.

1. Laws and Enforcement

1.1 Graduated Driver Licensing Requirements for Beginning Drivers

Effectiveness: ★ ★ ★ ★ ★ [†]	Use: High	Cost: Low	Time: Medium
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[†] Effectiveness proven for nighttime and passenger restrictions

Graduated driver licensing (GDL) is a three-phase system for beginning drivers consisting of a learner’s permit, then a provisional license, and finally a full license. A learner’s permit allows driving only while supervised by a fully licensed driver. A provisional license allows unsupervised driving under certain restrictions. The NCHRP guide for reducing crashes involving young drivers describes the key provisions of GDL laws (NCHRP, 2007). The Insurance Institute for Highway Safety [IIHS] (2010a) and the Governors Highway Safety Association [GHSA] (2010a) summarize State GDL laws. These summaries are updated monthly. See Chapter 6, Sections 1.1 to 1.7, for a complete discussion of GDL for beginning young drivers.

During the provisional phase of GDL, driving under certain high-risk circumstances is restricted. Some of these restrictions are directly linked to drowsiness and distractions. For example, nighttime driving is typically restricted under GDL. Driving at night is more dangerous than during the day and also may pose greater risks of drowsy driving. In addition, GDL systems often include a passenger restriction. Passengers, especially teenage passengers, are a major source of distraction for young, beginning drivers. Cell phones can also distract drivers (see Chapter 4, Section 1.2), so they are often restricted under GDL.

Use: As of July 2010, all States and the District of Columbia had some GDL components in place. The laws in 48 States and the District of Columbia do not allow driving during certain nighttime hours. Laws in 43 States and the District of Columbia limit the number of passengers allowed with a driver with a provisional license (GHSA, 2010a; IIHS 2010a). Twenty-eight States and the District of Columbia prohibit the use of cell phones, both hand-held and hands-free, by drivers with learner’s permits or provisional licenses or by drivers under 18 (GHSA, 2010b; IIHS 2010b).

Effectiveness: Several studies document that nighttime and passenger GDL restrictions reduce teenage driver crashes and injuries (Hedlund & Compton, 2005; NCHRP, 2007; Williams, 2007a). The only evaluation of a GDL cell phone restriction suggests these laws may have little effect on teenage drivers’ cell phone use (Foss, Goodwin, McCartt, & Hellinga, 2009).

Costs: Publicity for GDL restriction changes can be delivered directly by the Department of Motor Vehicles to young drivers as they apply for their learner’s permits and provisional licenses, so costs will be minimal. Information about GDL restrictions can also be provided through driver education courses.

Time to implement: GDL nighttime, passenger, or cell phone restriction changes require several months to implement for drivers receiving a provisional license. They then will take one or two years before all provisionally licensed drivers are subject to the new restrictions.

1.2 Cell Phone and Text Messaging Laws

Effectiveness: ★ ★	Use: Medium	Cost: Varies	Time: Short
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Cell phones have become an essential feature of modern life. In December 2009, about 286 million Americans had cell phones, an increase of more than 100 million in 5 years (CTIA, 2010). In a survey of 2,501 United States residents conducted by the AAA Foundation, two out of three drivers (67%) admitted to talking on a phone while driving during the past 30 days, and 28% reported talking “fairly often” or “regularly” while driving (AAAFTS, 2009). NHTSA’s 2009 national observation survey found that 5% of drivers on the road at any given moment were using hand-held cell phones, (NHTSA, 2010b). NHTSA currently estimates that 9% of drivers are using some type of phone (hand-held or hands-free) in a typical daylight moment (NHTSA, 2010b).

Many studies have investigated the effects of cell phone use on driving (See Caird, Willness, Steel, & Scialfa, 2008, and McCartt, Hellinga, & Braitman, 2006, for reviews). Experiments on simulators or test tracks document that cell phone use has some effect on driving performance, most commonly slowed reaction times, but these experiments cannot measure the impact on crash risk. Cell phones can lead to inattentive blindness, where drivers may “look at” the roadway but fail to “see” potential hazards (NSC, 2010). For reasons outlined in the overview, it can be difficult to determine whether cell phones contribute to individual crashes. However, studies examining cell phone billing records have concluded drivers are four times more likely to be involved in a serious crash when using a cell phone (McEvoy et al., 2005; Redelmeier & Tibshirani, 1997). In addition, these studies and others have found that hands-free phones offer no safety advantage over hand-held phones (Caird et al., 2008; Ishigami & Klein, 2009). However, other studies show little or no risk from hands-free phones or from talking on (as opposed to dialing) a hand-held phone (Klauer et al., 2006; Olson, Hanowski, Hickman, & Bocanegra, 2009).

In recent years, there also has been a growing concern about the frequency of text messaging while driving, particularly among teenagers. To date, few studies have examined this issue. In a study of highly instrumented commercial motor vehicles, texting drivers were 23 times more likely to be involved in a crash, near-crash, or other safety-critical event compared to uneventful baseline driving (Olson et al., 2009). This is supported by experimental studies using driving simulations, which suggest that texting drivers spend up to 400 percent more time looking away from the road and are more likely to leave their lane than when not text messaging (Drews, Yazdani, Godfrey, Cooper, & Strayer, 2009; Hosking, Young, & Regan, 2009). In the AAA Foundation survey, 21% of drivers reported reading or sending a text message or e-mail while driving during the previous month (AAAFTS, 2009).

States have been very active in using legislation to address this issue. Through October 2010, 271 distracted driving bills were introduced in 43 States during the 2010 legislative sessions, most commonly concerning driver cell phone use (NCSL, 2010). This was a substantial increase from the 112 bills introduced in 33 States during 2008. Although distracted driving legislation generally falls under the jurisdiction of individual States, the Federal Government has recently directed its attention to this issue. In September 2009, and again in September 2010, the U.S. Department of Transportation convened a Distracted Driving Summit. At the 2009 meeting,

Transportation Secretary Ray LaHood announced that President Obama had issued an executive order prohibiting Federal employees from texting while driving on official government business. In addition, the Federal Motor Carrier Safety Administration enacted an interim ban prohibiting commercial vehicle drivers from texting while driving.

Use: As of July 2010, California, Connecticut, Delaware, Maryland, New Jersey, New York, Oregon, Washington, and the District of Columbia prohibit hand-held cell phone use for all drivers (GHSA, 2010b; IIHS, 2010b). With the exception of Maryland, the cell phone bans in each of these States are primary laws. In addition, several local jurisdictions such as Chicago, Illinois, and Cheyenne, Wyoming, have enacted their own restrictions on cell phones (IIHS, 2010b). At present, no State restricts *hands-free* phone use for all drivers.

A number of States have recently passed, or are currently considering, laws that would prohibit text messaging while driving. As of July 2010, 30 States and the District of Columbia prohibit text messaging for all drivers (GHSA, 2010b; IIHS, 2010b). NHTSA has prepared a sample bill to assist States in crafting new legislation to prohibit texting while driving (NHTSA, 2010d).

Effectiveness: Evaluations in New York, Connecticut, the District of Columbia, and other countries consistently show that cell phone laws reduce hand-held phone use by about 50% shortly after the laws take effect (McCartt et al., 2006). Moreover, these reductions in hand-held cell phone use are maintained three to seven years later (McCartt, Hellinga, Strouse, & Farmer, 2010). However, it is unknown whether these laws lead to increased use of hands-free devices.

The effectiveness of hand-held cell phone bans in reducing crashes is still unclear. Nikolaev, Robbins and Jacobson (2010) examined driving injuries and fatalities in 62 counties in New York State both before and after a hand-held cell phone ban took effect. Forty-six counties showed a significant decrease in injury crashes following the ban, and 10 counties showed a decrease in fatal crashes. Although encouraging, the study did not include a control group to account for other factors that may have decreased crashes. A study by the Highway Loss Data Institute investigated State-level automobile insurance collision claims in California, Connecticut, New York and the District of Columbia. When compared to neighboring States, there was no change in collision claim frequency after these jurisdictions implemented hand-held cell phone bans (HLDI, 2009). However, the data from the Highway Loss Data Institute is proprietary and an independent analysis of the data has not been conducted.

As of yet, no studies have examined the effectiveness of laws prohibiting texting while driving.

Costs: As with any law, costs are required to publicize and enforce it. A hand-held cell phone law can be enforced during regular traffic patrol because cell phone use can be observed easily, so that enforcement costs should be minimal. Paid advertising supporting highly visible law enforcement may be necessary to achieve substantial effects. Paid advertising can be expensive: for example, costs for some belt use enforcement campaigns in 2003 averaged \$500,000 per State (Chapter 2, Section 2.1; Solomon, Chaudhary, & Cosgrove, 2003).

Time to implement: A cell phone law can be implemented quickly, as soon as it is publicized.

Other issues:

- **Enforcement:** Numerous studies demonstrate that high visibility enforcement can be effective in curbing alcohol-impaired driving and increasing seat belt use among drivers (see Chapter 1, Section 2.1 and Chapter 2, Section 2.1). Recently, NHTSA has begun a high-visibility enforcement demonstration project aimed at reducing cell phone use among drivers. The message of the program is, “Phone in one hand. Ticket in the other.” Pilot programs are currently being tested in Hartford, CT and Syracuse, NY. Results from the first two waves of the program suggest hand-held cell phone use among drivers has dropped 56% in Hartford and 38% in Syracuse. Furthermore, texting while driving has declined by 68% in Hartford and 42% in Syracuse (Cosgrove, Chaudhary, & Roberts, 2010).

1.3 General Driver Drowsiness and Distraction Laws

Effectiveness: ★	Use: High [†]	Cost: Varies	Time: Short
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[†] Included under reckless driving; use of explicit drowsiness and distraction laws is low

States implicitly prohibit driving while seriously distracted or drowsy through their reckless driving laws (NCHRP, 2005, Strategy C2). These existing laws in each State allow individuals to be cited and prosecuted if they cause a crash due to distracted or drowsy driving; however, the extent to which States currently *do* pursue cases of inattentive driving is currently unknown. Only one State, New Jersey, has a law specifically targeting the issue of drowsy drivers. In 2003, New Jersey enacted “Maggie’s Law” under which drivers can be prosecuted for vehicular homicide if they have not slept in 24 hours and they cause a crash in which someone is killed (NCHRP, 2005, Strategy C2). In 2009, Maine enacted a general distracted driving law. Under the new law, a driver who is involved in a crash or who commits an infraction can be cited for distracted driving if a police officer believes that to be the underlying cause. The law defines distraction as being engaged in an activity not necessary to the operation of the vehicle and that impairs, or could impair, the ability to drive safely. Utah has a law that prohibits “careless driving,” which is defined as committing a moving violation (other than speeding) while being distracted by one or more activities unrelated to driving (GHSA, 2010b). Potentially distracting activities covered by the law include talking on a hand-held phone, searching for an item in the vehicle, or attending to personal hygiene or grooming.

No studies have evaluated whether general reckless driving laws or specific drowsy or distracted driving laws have any effect (except for cell phone laws: see Chapter 4, Section 1.2). Based on extensive experience in other traffic safety areas, it is likely that these laws will have little or no effect unless they are vigorously publicized and enforced. See Chapter 1, Sections 2.1 on alcohol-impaired driving, Chapter 2, Sections 2.1, 3.1, and 3.2 on seat belt use laws, and Chapter 3, Sections 2.2 and 4.1 on aggressive driving and speeding laws. Enforcement of drowsy or distracted driving laws is likely to be especially difficult because drowsiness and distraction often are difficult to observe, measure, and document. Nevertheless, these laws may increase the impact of communications and outreach efforts to reduce drowsy and distracted driving discussed in Chapter 4, Sections 2.1 and 2.2 (see also NCHRP, 2005, Strategy C2).

Use: New Jersey, Maine, and Utah are the only States with laws explicitly addressing drowsy driving or distractions other than cell phones (Chapter 4, Section 1.2). Other States include these conditions under their laws regarding reckless driving or similar offenses.

Effectiveness: The effects of any laws on reducing drowsy or distracted driving are unknown.

Costs: Costs are required for publicity and enforcement. Enforcement costs likely will be minimal, as most enforcement likely will be included under regular traffic patrols or combined with enforcement activities directed primarily at other offenses such as alcohol-impaired or aggressive driving.

Time to implement: A new drowsy or distracted driving law can be implemented quickly, as soon as it is publicized and law enforcement patrol officers are trained.

2. Communications and Outreach

2.1 Communications and Outreach on Drowsy Driving

Effectiveness: ★	Use: Unknown	Cost: Medium	Time: Medium
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Drowsy driving occurs because drivers don't get enough sleep. This apparently obvious statement is well-documented. In NHTSA's telephone survey, 66% of the drivers who reported they had nodded off while driving had six or fewer hours of sleep the previous night (Royal, 2003). Stutts, Wilkins, and Vaughn (1999) interviewed 467 crash-involved drowsy drivers (reported as "fatigued" or "asleep" by the investigating officer) and 529 other crash-involved drivers who were not drowsy. Half of the drowsy drivers had six or fewer hours of sleep the previous night compared to fewer than 10% of the other drivers.

States and national organizations such as the National Sleep Foundation have conducted drowsy driving communications and outreach campaigns directed to the general public (NCHRP, 2005, Strategy C1; NSF, 2004). Campaign goals usually include:

- raising awareness of the dangers of drowsy driving;
- motivating drivers to take action to reduce drowsy driving; and
- providing information on what drivers can do, either before they start out on a trip or if they become drowsy while driving.

NHTSA and NCSDR (NHTSA, 1998) identified three groups that are over-involved in drowsy driving crashes: drivers in their teens and 20s, shift workers, and people suffering from sleep apnea or narcolepsy. The joint NHTSA-NCSDR Report to Congress on drowsy driving recommended that communications and outreach on drowsy driving be directed to these groups, especially to young drivers (NHTSA, 1999). This information can be delivered in several ways. Driver education programs can include information on both drowsy and distracted driving, and the new model curriculum developed by NHTSA and the American Driver and Traffic Safety Education Association (ADTSEA) includes both. See Chapter 4, Sections 3.1 and 3.2, for additional discussion of shift workers and medical conditions, respectively.

Communications and outreach campaigns can be delivered in high schools, colleges, military training programs and bases, and other locations where there are many young drivers. NCHRP (2005, Strategy D2) provides examples. Many young drivers have part-time jobs that place them at even higher risk for drowsy driving (see Chapter 4, Section 3.1). In addition, young people are among the most likely to drive after drinking alcohol, and studies suggest that even moderate alcohol intake, when combined with drowsiness, can increase the risk of a serious crash (Horne, Barrett, & Reyner, 2006). Finally, information about the dangers of drowsy driving can be delivered through Web sites and other media with a youthful target audience.

The ultimate goal of drowsy driving communications and outreach is to change driver behavior, but they face substantial obstacles. As discussed in other chapters, communications and outreach by themselves rarely change driving behavior (Chapter 1, Section 5.2; Chapter 2, Sections 3.1 and 3.2; Chapter 3, Section 4.1; see also NCHRP, 2005, Strategy C1). To have any chance of success, stand-alone campaigns must be carefully pre-tested, communicate health information not previously known, be long-term and have substantial funding (Williams, 2007b).

An additional barrier is that drowsy driving is a byproduct of busy lifestyles that do not include enough sleep. The only truly effective method to prevent drowsy driving crashes is to get enough sleep (Nguen, Jauregui, & Dinges, 1998; NHTSA, 1998). Traffic safety messages urging enough sleep may be overwhelmed by the other demands on a driver's time that are responsible for insufficient sleep. Focus group discussions with young men and shift workers, two groups at high risk of drowsy driving, confirmed this conclusion (Nelson, Isaac, & Graham, 2001). Most shift workers and many young men understood well the risks caused by lack of sleep. Many had crashed or almost crashed after falling asleep at the wheel or had friends who had crashed. But neither their knowledge nor their crash experience changed their sleep habits. They sacrificed sleep for the demands of their work, families, and social lives. Campaigns directed to young drivers also must overcome the higher risk-taking behavior and overall immaturity of young drivers discussed in Chapter 6. No drowsy driving communications and outreach program for the general public has been evaluated (NCHRP, 2005, Strategies C1 and D2).

Use: Utah is the only State known to have conducted a drowsy driving campaign for the general public (see NCHRP, 2005, Strategy C1). NCHRP (2005, Strategy D2) gives examples of college programs.

Effectiveness: There are no studies of any campaign's effects on driver knowledge, attitudes, or behavior (NCHRP, 2005, Strategies C1 and D2).

Costs: A high-quality campaign will be expensive to develop, test, and implement.

Time to implement: A high-quality campaign will require at least 6 months to plan, produce, and distribute.

2.2 Communications and Outreach on Distracted Driving

Effectiveness: ★	Use: High	Cost: Medium	Time: Medium
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Distracted driving communications and outreach campaigns for the general public face different, but equally difficult, obstacles than drowsy driving campaigns. All drivers “know” at some level that they should be alert. However, as discussed in the Overview, distractions come in many forms. Distractions outside the car are not under the driver’s control. Many distractions inside the car also cannot be controlled easily (conversations, children), or are intentional (listening to the radio or CD player, eating). They may in fact be useful, to keep drivers alert on a long trip.

There is strong public support for communications and outreach to reduce distracted driving. For example, 80% of respondents in a Canadian survey agreed that greater awareness and education efforts are needed to alert drivers to the problem of distracted driving (Vanlaar et al., 2007). States, including California and New York, and national organizations, such as the AAA Foundation for Traffic Safety, have conducted or provided material for distracted driving communications and outreach campaigns directed to the general public (AAAFTS, 2004; NCHRP, 2005, Strategy C1). Some carry a general “pay attention” message, while others are directed at specific behaviors such as cell phone use. Recently, the U.S. Department of Transportation launched a national campaign called “Put It Down” to discourage the public from driving distracted (www.distraction.gov).

Drivers in their teens and early 20s may be easily distracted while driving (Ferguson, 2003; NCHRP, 2005, Strategy D2). GDL passenger and cell phone restrictions directly address two sources of distractions, as discussed in Chapter 4, Section 1.1. Broader communications and outreach efforts for young drivers regarding distracted driving also have been proposed. They can be combined with or complementary to information on drowsy driving and can be delivered in the same ways. See Chapter 4, Section 2.1, and NCHRP (2005, Strategy D2) for discussion.

The ultimate goal of these campaigns is to change driver behavior, but they face substantial obstacles. As discussed in other chapters, communications and outreach by themselves rarely change driving behavior (Chapter 1, Section 5.2; Chapter 2, Section 3.1; Chapter 3, Section 4.1; see also NCHRP, 2005, Strategy C1). To have any chance, stand-alone campaigns must be carefully pre-tested, communicate health information not previously known, be long-term and have substantial funding (Williams, 2007b). A broad “stay alert” message may be too general to have any impact.

Use: A recent survey by GHSA found that 41 States and the District of Columbia have implemented public information/education campaigns to address distracted driving (GHSA, 2010c). In addition, a number of States have developed distracted driving PSAs. Examples can be viewed at www.ghsa.org/html/issues/dd_psa.html.

Effectiveness: There are no studies of any campaign’s effects on driver knowledge, attitudes, or behavior (NCHRP, 2005, Strategies C1 and D2).

Costs: A high-quality campaign will be expensive to develop, test and implement.

Time to implement: A high-quality campaign will require at least 6 months to plan, produce and distribute.

3. Other Countermeasures

3.1 Employer Programs

Effectiveness: ★	Use: Unknown	Cost: Low	Time: Short
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Driver drowsiness and distractions are critical issues for commercial drivers. As discussed in the Overview, commercial driver countermeasures, including employer policies and programs to reduce commercial driver drowsiness, are not discussed in this guide because they do not fall under SHSO jurisdiction.

Shift workers are another employment group at high risk for drowsy-driving crashes. Shift workers include people who work long or irregular hours or who work at night, including many law enforcement officers (NCHRP, 2005, Strategy D6). Young male drivers with part-time jobs are at especially high risk, as they satisfy two of the three high-risk conditions identified by NHTSA and NCSDR (NHTSA, 1999): 1) shift workers, 2) young drivers, especially males, and 3) drivers with the medical conditions of sleep apnea or narcolepsy.

Another study documents the dangers for medical interns, who frequently work extended shifts of 24 hours or more. Barger et al. (2005) collected monthly reports from 2,737 interns. Interns were 2.3 times more likely to report a crash and 5.9 times more likely to report a near miss after an extended shift than a shorter shift. Each extended shift in a month increased the monthly risk of a crash during the commute from work by 16%.

NHTSA and NCSDR have produced a comprehensive workplace education program for shift workers. It includes information on sleep habits in general and drowsy driving in particular. Program material includes a video, posters, brochures for workers and their families, tip cards, a PowerPoint training session, and an administrator's guide are available at www.nhtsa.dot.gov/people/injury/drowsy_driving1/human/drowsy_driving/.

Use: The number of employers who use the NHTSA/NCSDR program, or any drowsy driving prevention material or program, is not known.

Effectiveness: The NHTSA/NCSDR program was tested by more than 20 United States companies and was well received by workers and management. It has not been evaluated further (NCHRP, 2005, Strategy D3). Gander, Marshall, Bolger, and Girling (2005) evaluated the effects of a two-hour fatigue management training class given to a group of commercial light vehicle drivers and a group of petroleum tanker drivers. For both groups, the class substantially increased the drivers' knowledge of fatigue management and the knowledge gains were retained after several months. About half the drivers in each group implemented some fatigue management strategies at home, on the job, or in both places. No other employer drowsy driving program has been evaluated.

Costs: Since a comprehensive program is available at no cost, program costs will consist only of material production and employer time for training.

Time to implement: An employer program can be implemented within three months.

3.2 Medical Conditions and Medications

Effectiveness: ★	Use: Unknown	Cost: Variable	Time: Medium
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Two medical conditions can cause drivers to fall asleep at the wheel (NCHRP, 2005, Strategy D6; NHTSA, 1998).

- Sleep apnea is a breathing disorder characterized by brief interruptions of breathing during sleep, perhaps as many as 20 to 60 per hour (NSF, 2009a). By fragmenting nighttime sleep, sleep apnea produces daytime sleepiness. NSF estimates that about 4% of men and 2% of women are affected by sleep apnea. It can be treated by physical or mechanical therapy or by surgery.
- Narcolepsy is a disorder of the central nervous system's sleep-wake mechanism that can cause narcoleptics to fall asleep suddenly at any time (NSF, 2009b). It is quite rare, affecting about one person in 2,000. It can be treated with medications.

Research shows that people with sleep apnea are up to 6 times more likely to be involved in a motor vehicle crash than those without sleep apnea (Teran-Santos, Jiminez-Gomez, & Cordero-Guevara, 1999). It has been estimated that crashes among people with sleep apnea cost approximately 16 billion dollars each year (Sassani et al., 2004). The number of crashes resulting from narcolepsy is not known.

Most cases of sleep apnea or narcolepsy are undiagnosed and untreated (NCHRP, 2005, Strategy D6; NHTSA, 1998). Indeed, falling asleep at the wheel may be one of the main ways to raise the possibility of a sleep disorder and motivate a driver to seek medical attention (NHTSA, 1998). Once treated, people with sleep apnea have crash rates that are no higher than the general population (George, 2001).

Many common prescription and over-the-counter medications can cause drowsiness. Warning labels on the medications note this and caution users against driving or other activities that could be affected by drowsiness. For more information about how medications can impair drivers, see Chapter 1, Section 7.3.

The principal countermeasures to address sleep apnea, narcolepsy, and medication effects are (NCHRP, 2005, Strategy D6):

1. Communications and outreach on sleep disorders to increase overall awareness of their symptoms, consequences, and treatment.
2. Efforts with driver licensing medical advisory boards to increase their awareness of these conditions as they review driver fitness for licensing.
3. Efforts with physicians to increase their awareness of these conditions and their potential effects on driving, to treat these conditions as appropriate, and to counsel their patients to take steps to reduce the risk of drowsy driving.

Use and Effectiveness: There is no information available on how frequently these countermeasures are used or on how effective they have been in raising awareness, increasing knowledge, or affecting behavior (NCHRP, 2005, Strategy D6).

Costs: Targeted communications and outreach to drivers (through driver licensing handbooks or flyers in license renewal material) or to physicians (through medical associations) would be relatively inexpensive. A communications and outreach campaign directed at all drivers will be expensive to develop, test and implement. See Chapter 1, Section 5.2 and Chapter 2, Sections 2.1 and 3.1, for additional discussion.

Time to implement: Either targeted or general communications and outreach activities will require at least 6 months to plan, produce, and distribute. Efforts with driver licensing medical advisory boards could be implemented quickly.

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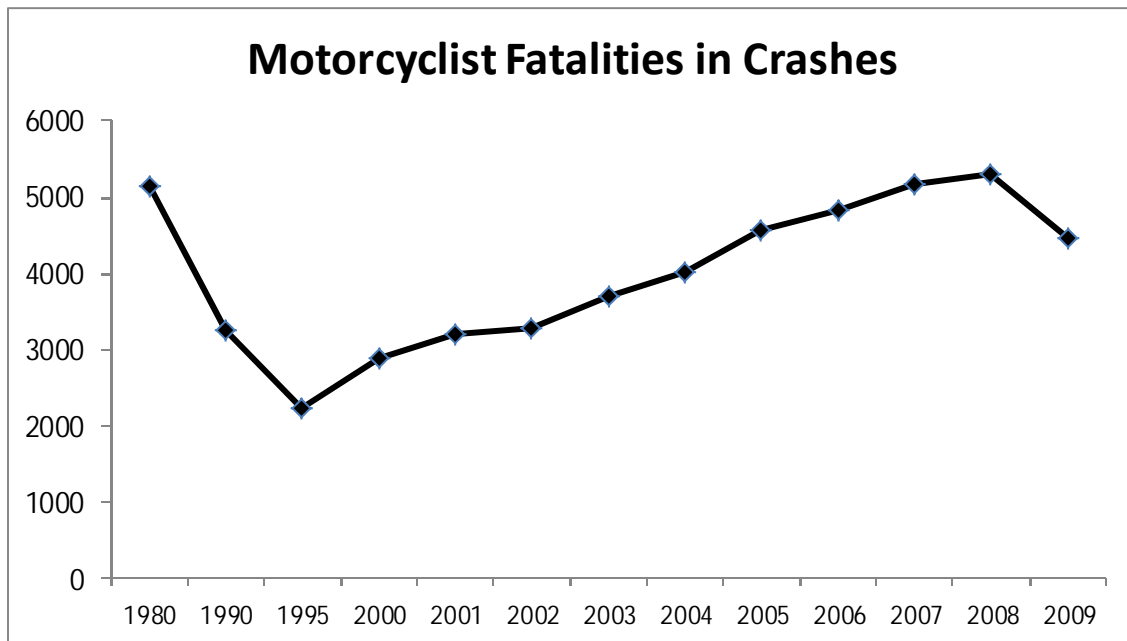
5. Motorcycle Safety

Overview

A two-wheeled motorcycle is inherently more difficult to operate than a four-wheeled passenger vehicle because it requires more physical skill. The relationship of speed and balance is also a critical consideration when riding a motorcycle, as the stability of a motorcycle is relative to speed. A motorcycle becomes more stable as speed increases, although it becomes less maneuverable. At very low speeds, the motorcycle rider must balance the motorcycle.

A motorcycle offers riders almost no protection in a crash. Crash data confirm these observations. NHTSA estimates that 80% of motorcycle crashes injure or kill a motorcyclist, while only 20% of passenger car crashes injure or kill an occupant (NHTSA, 2003).

Trends. Motorcycling has become increasingly popular over the last 10 years even as total vehicle miles traveled has declined. Not surprisingly, there has been a corresponding increase in crashes and fatalities involving motorcyclists. After drops in the 1980s and early 1990s, from 1999 to 2008, the number of motorcyclists killed in crashes increased by 114% and the number of motorcyclists injured increased by 92%. In 2008, motorcyclist fatalities increased for the 11th consecutive year to more than 5,000, a level not seen since 1980 (NHTSA 2009a). Motorcyclists accounted for 14% of all people killed and 4% of all people injured in traffic crashes in 2008 (NHTSA, 2009a). However, in 2009 motorcyclist fatalities declined by 16% and motorcyclists injured declined by 7%. Motorcyclist fatalities still accounted for 13 percent of total fatalities and 4% of total injured (NHTSA, 2010a).



Source data: Traffic Safety Facts 2009, (NHTSA, 2010a)

In the 10 year period from 1999-2007, almost half of motorcyclists injured in crashes were injured in single-vehicle crashes. Approximately two-thirds of motorcyclist injuries during this time period occurred during daylight hours, more than two-thirds occurred during the months from April to September, and slightly more than half occurred on weekdays. On average, about 85% of those injured were male and about 15% female. And about 10% of those injured were passengers (NHTSA, 2009b). These trends have remained relatively consistent over this 10 year time period, although there are year-to-year fluctuations.

One trend that is changing is an increase in fatalities and injuries among older motorcyclists. In 2009, 73% of the motorcyclists killed in crashes were age 30 or older and 54% were 40 or older. The change in only ten years is striking: in 2000, 65% were 30 or older and 41% were 40 or older (NHTSA, 2010a). Similarly, while the number of motorcyclists involved in injury crashes has increased among all age groups, injuries among motorcyclists ages 50 and older have increased at the fastest rate. Riders 50 and older were estimated to account for 21 – 22% of motorcyclists injured nationally during 2006 and 2007, compared with 11 – 15% during 1998 and 1999 (NHTSA, 2009b).

Speeding is more prevalent in fatal crashes involving motorcyclists than among other types of motor vehicle operators. Thirty-five percent of all motorcycle riders involved in fatal crashes in 2009 were speeding, compared to 21% of passenger car drivers (NHTSA, 2010a). Motorcycle riders involved in fatal crashes had worse prior driving records than other passenger vehicle drivers, including more DWI convictions, speeding convictions, and suspensions or revocations (NHTSA, 2010a, figure 1). In 2009, 30% of the motorcycle riders killed in a crash had BACs of .08 g/dL or higher (NHTSA, 2010a). Forty-four percent of fatally injured motorcyclists were not wearing a helmet (NHTSA, 2010a), although the percentage varies considerably from State-to-State. Additionally, 22% of the motorcycle riders involved in crashes in 2009 did not have a valid motorcycle operator's license (NHTSA, 2010a).

Other trends in motorcycle safety relate to the types of motorcycles being produced and purchased. While registrations of all types of motorcycles have increased between 2000 and 2005, registrations for supersport type motorcycles, which are built on a racing bike frame and reach speeds of nearly 190 mph, have climbed even faster. Supersport registrations in 2005 were 83% higher than 2000 levels. Combined registrations for all motorcycle styles were 51% higher than in 2000 (IIHS, 2007). Deaths are three to four times higher among registered supersport owners as well, but these rates do not control for other possible risk factors (IIHS, 2007; Teoh & Campbell, 2010). The more recent IIHS analysis by Teoh and Campbell of six years of data also found that fatally injured supersport style motorcycle riders were about twice as likely as standard/cruiser riders to have been speeding and half as likely to have been alcohol impaired, after accounting for rider age and gender. These results suggest that the types of risks taken may vary in association with the style of bike chosen (Teoh & Campbell, 2010). Supersport riders also tend to be younger. In 2005, the average age was 27 among those fatally injured while riding these bikes, compared to an average age of 44 for cruiser and standard motorcycles (IIHS, 2007).

Strategies to Improve Motorcycle Safety

There are various existing strategies to improve motorcycle safety. Motorcycle riders should be properly trained and licensed. They should be alert and aware of the risks they face while riding; in particular, they should not be impaired by alcohol. All motorcycle riders should wear a motorcycle helmet that meets Federal Motor Vehicle Safety Standard (FMVSS) 218 and clothing that provides both protection and visibility. These and other strategies are discussed in the National Agenda for Motorcycle Safety, NAMS (NHTSA, 2000a), a comprehensive, collaborative, and multidisciplinary blueprint for motorcycle safety. See also the NAMS Implementation Guide (NHTSA, 2006a), NHTSA's Motorcycle Safety Program Plan (NHTSA, 2006b), the U.S. DOT Action Plan to Reduce Motorcycle Fatalities (U.S. DOT, 2007), and a review of State Motorcycle Safety Program Technical Assessments that summarizes program recommendations, implementations, and barriers to implementation from nine State assessments conducted by NHTSA (Baer & Skemer, 2009).

Unfortunately, many motorcyclists do not take these straightforward precautions. The most important objectives for improving motorcycle safety are to increase helmet use, reduce alcohol-impaired motorcycle riding, increase proper licensing and increase the number of riders taking training. These objectives are all difficult to accomplish. Universal helmet laws are extremely effective in assuring that virtually all motorcycle riders use helmets, but they also are politically difficult to enact and retain. Strategies using only communications and outreach to promote helmet use, reduce impaired motorcycling, and increase licensing appear to have been no more successful with motorcycle riders than with other drivers.

Another objective is to increase other drivers' awareness of motorcyclists by increasing the visibility of motorcyclists and by educating other drivers on the importance of sharing the road with motorcycles. Daytime running lights for motorcycles improve motorcycle conspicuity. Most motorcycles on the road have headlights that turn on automatically when the engines are started (NCHRP, 2008, Strategy 11.1 D2). In addition, 24 States require daytime headlight use for all motorcycles manufactured since 1980 (MSF, 2010). Modulating headlights, which cause the headlight to move from high- to low beam rapidly, also increase motorcycle visibility (Olson, Halstead-Nussloch, & Sivak, 1979), but use of these devices has been low thus far. Intelligent transport systems including vehicle technologies such as anti-lock brakes also have the potential to enhance motorcycle safety (Bayly, Regan, & Hosking, 2006). For example, a recent study by the Insurance Institute for Highway Safety found that motorcycles with anti-lock braking systems had a 28% lower fatal crash involvement than motorcycles without anti-lock brakes (Teoh, 2010).

Resources

Many environmental factors can also affect motorcycle safety. Slippery roadway surfaces and markings, surface irregularities and debris, unpaved shoulders, and unforgiving roadway barriers all can be dangerous. These issues are not included in this guide because State Highway Safety Offices have little or no authority or responsibility for them.

See National Cooperative Highway Safety Research Report 500, Volume 22 Guide for Addressing Collisions Involving Motorcycles, for a thorough discussion of environmental and

other strategies:

www.trb.org/Publications/Public/Blurbs/A_Guide_for_Addressing_Collisions_Involving_Motor_c_160626.aspx

For a broad set of resources for State safety agencies and on-going research efforts, see:

NHTSA's Web pages:

- Motorcycles - www.nhtsa.gov/Safety/Motorcycles
- Research and Evaluation - <http://www.nhtsa.gov/Driving+Safety/Research+&+Evaluation>
- Behavioral Safety Research Reports - ntlsearch.bts.gov/repository/ntlc/nhtsa/index.shtm

Countermeasures That Work

Countermeasures to improve motorcycle safety are listed below and discussed individually in this chapter. The table is intended to give a rough estimate of each countermeasure's effectiveness, use, cost, and time required for implementation. The symbols and terms used are described below. Effectiveness, cost, and time to implement can vary substantially from State to State and community to community. Costs for many countermeasures are difficult to measure, so the summary terms are very approximate. See each countermeasure discussion for more information.

1. Motorcycle Helmets

Countermeasure	Effectiveness	Use	Cost	Time
1.1 State motorcycle helmet use laws	★ ★ ★ ★ ★	Medium	Low	Short
1.2 Helmet use promotion programs	★	Unknown	Varies	Varies
1.3 Helmet law enforcement; noncompliant helmets	★	Unknown	Low	Medium

2. Alcohol Impairment

Countermeasure	Effectiveness	Use	Cost	Time
2.1 Alcohol impairment: detection, enforcement, and sanctions	★ ★ ★	Unknown	Varies	Varies
2.2 Alcohol impairment: communications	★	Medium	Medium	Medium

3. Motorcycle Rider Licensing and Training

Countermeasure	Effectiveness	Use	Cost	Time
3.1 Motorcycle rider licensing	★	High	Low	Medium
3.2 Motorcycle rider training	★	High	Medium	Varies

4. Communications and Outreach

Countermeasure	Effectiveness	Use	Cost	Time
4.1 Conspicuity and protective clothing	★	High	Varies	Medium
4.2 Other driver awareness of motorcyclists	★	High	Varies	Medium

Effectiveness:

★ ★ ★ ★ ★ - Demonstrated to be effective by several high-quality evaluations with consistent results

★ ★ ★ ★ - Demonstrated to be effective in certain situations

★ ★ ★ - Likely to be effective based on balance of evidence from high-quality evaluations or other sources

- ★ ★ - Effectiveness still undetermined; different methods of implementing this countermeasure produce different results
- ★ - Limited or no high-quality evaluation evidence

Effectiveness is measured by reductions in crashes or injuries unless noted otherwise. See individual countermeasure descriptions for information on effectiveness size and how effectiveness is measured.

Use:

- High: more than two-thirds of the States, or a substantial majority of communities
- Medium: between one-third and two-thirds of States or communities
- Low: fewer than one-third of the States or communities
- Unknown: data not available

Cost to implement:

- High: requires extensive new facilities, staff, equipment, or publicity, or makes heavy demands on current resources
- Medium: requires some additional staff time, equipment, facilities, and/or publicity
- Low: can be implemented with current staff, perhaps with training; limited costs for equipment or facilities

These estimates do not include the costs of enacting legislation or establishing policies.

Time to implement:

- Long: more than one year
- Medium: more than three months but less than one year
- Short: three months or less

These estimates do not include the time required to enact legislation or establish policies.

1. Motorcycle Helmets

1.1 State Motorcycle Helmet Use Laws

Effectiveness: ★ ★ ★ ★ ★	Use: Medium	Cost: Low	Time: Short
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Motorcycle helmets are highly effective in protecting motorcycle riders' heads in a crash. The latest research indicates that helmets reduce motorcycle rider fatalities by 22 to 42% and brain injuries by 41 to 69% (Coben, Steiner, & Miller, 2007; Cummings, Rivara, Olson, & Smith, 2006; Deuterman, 2004; Liu, Ivers, Norton, Blows, & Lo, 2008; NHTSA, 2003; NHTSA, 2006a). A Cochrane Collaboration review of 61 studies concluded that risk reductions were on the high end of the ranges mentioned above, with higher quality studies indicating that the protective effect of helmets was about a 42% reduction in risk of death in a crash and 69% for risk of a head injury in a crash. This review found that there was insufficient evidence to determine the effect on neck or facial injuries, or the effects of various types of FMVSS 218 compliant helmets on injury outcomes (Liu et al., 2008). Others have found no evidence that helmets increase the risk of neck injuries (NCHRP, 2008, Strategy E1; NHTSA, 2000a; Ulmer & Preusser, 2003).

State universal helmet-use laws are effective at increasing helmet use. In 2009, compliant helmet use was 86% across States with a universal helmet law that covers all riders, and 55% across States with no law or a law covering only young riders (NHTSA, 2009c). DOT-compliant helmet use increased nationally from 63% in 2008 to 67% in 2009, and use of noncompliant helmets decreased for the second year in a row (from 11% to 9%; NHTSA, 2009c). DOT-compliant helmet use increased in States with and without universal helmet laws, however, DOT-compliant helmet use was 86% in States with a universal helmet use law and 55% in States without a universal law.

Studies in States that enacted universal helmet laws observed use rates of 90% or higher immediately after the law became effective, compared to 50% or lower before the law (Ulmer & Preusser, 2003, Section II). States that repealed universal helmet laws saw the opposite effect, as use rates dropped from above 90% to about 50% (Kyrychenko & McCartt, 2006; Preusser, Hedlund, & Ulmer, 2000, Section V; Ulmer & Preusser, 2003, Sections IV and V). Reenactment of a universal law in Louisiana (after a cycle of repeals and reenactments since 1968) resulted in an increase in use among riders involved in crashes, from 42% before reenactment to 87% following (Gilbert, Chaudhary, Solomon, Preusser, & Cosgrove, 2008).

The first universal helmet law was enacted in 1966. Universal laws were in effect in 47 States and the District of Columbia by 1975. After Federal penalties were eliminated in 1975 for States failing to have a universal law, about half the States repealed their laws. Several States have enacted or repealed helmet laws since then. The Insurance Institute for Highway Safety [IIHS] (20082010b) summarizes the helmet law history in each State.

Use: As of August 2010, 20 States, the District of Columbia, and Puerto Rico had helmet laws covering all riders. Three States (Illinois, Iowa, and New Hampshire) did not have a motorcycle helmet law (GHSA, 2010; IIHS, 2010a). Most other States had laws covering only riders under a specified age, typically 18 or 21 (IIHS, 2010a).

Effectiveness: The U.S. General Accountability Office (GAO) reviewed 46 methodologically sound studies of State helmet laws published before 1990. GAO concluded that motorcycle rider fatality rates were 20 to 40% lower with universal helmet laws (GAO, 1991; Ulmer & Preusser, 2003, Section II). Studies since 1990 confirm these results (Cummings et al., 2006; Houston & Richardson, 2008; Kyrychenko & McCartt, 2006; Morris, 2006; Ulmer & Northrup, 2005; Ulmer & Preusser, 2003, Section II).

Some States have helmet laws that only cover young riders. Helmet use is generally low in these States (GAO, 1991), and non-comprehensive laws do not translate into meaningful reductions in young rider fatalities rates (Houston, 2007). A reduction in fatality rates among all ages was estimated for partial coverage laws compared to no law by Houston & Richardson (2008), but the effect was much smaller (7% to 8%) than that for universal coverage (22% to 33%). Moreover, when Florida eliminated the requirement that all motorcycle riders 21 and older wear helmets, there was an 81% increase in motorcyclist fatalities (Ulmer & Northrup, 2005). Fatalities even increased among riders under age 21 who were still covered by the helmet law. Hospital admissions and treatment costs have also increased following repeal of universal helmet laws (Derrick and Faucher, 2009; GAO, 1991). Almost half of all motorcyclists admitted to hospitals lacked sufficient health care insurance or were covered by government services, so the public ultimately shares many of these costs, as well as a greater long-term burden of care (Derrick and Faucher, 2009; GAO, 1991). Hence, the preponderance of evidence is that universal coverage laws provide greater safety and cost benefits than laws that cover only a specific age group.

Costs: Once legislation requiring helmet use has been enacted, implementation costs are minimal. The inevitable controversy surrounding the legislation will help to publicize the new law extensively. Motorcycle helmet laws can be enforced during regular traffic patrol operations because helmet use is easily observed.

Time to implement: A universal helmet use law can be implemented as soon as the law is enacted.

Other issues:

- **Opposition to motorcycle helmet laws:** Any effort to enact a universal helmet law can expect immediate, well-coordinated, and highly political opposition (NHTSA, 2003). Helmet law opponents claim that helmet laws impinge on individual rights. They also claim that helmets interfere with motorcycle riders' vision or hearing, though research shows that these effects are minimal (NHTSA, 1996). See Jones and Bayer (2007) for a history of opposition to helmet laws in the United States. Derrick and Faucher (2009) also discuss national policy, organized opposition, and helmet law changes over the past four decades.
- **Noncompliant helmets:** Some riders in States with universal helmet laws wear helmets that do not comply with FMVSS 218 in order to avoid a helmet law citation (Glassbrenner & Ye, 2006). See the discussion in Chapter 5, Section 1.3.

1.2 Motorcycle Helmet Use Promotion Programs

Effectiveness: ★	Use: Unknown	Cost: Varies	Time: Varies
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A few States with no universal motorcycle helmet use law have attempted to promote helmet use through communications and outreach campaigns. NCHRP (2008) indicates that thus far there is no effectiveness evidence for efforts to educate and promote helmet use among motorcyclists in the absence of universal helmet laws, unless the publicity helps to gain enactment of universal helmet laws. Parallels from experiences to increase safety belt use through educational and promotional efforts are detailed. It was only after laws requiring use were enacted that seat belt use began to rise substantially. The MSF, GHSA, NHTSA and other groups encourage helmet use. NHTSA has developed helmet use promotion brochures, flyers and public service announcements suitable for television and radio that are available on NHTSA's Web site. NCHRP also provides brief information and links to one State that has developed materials on protective apparel in general (Wisconsin).

Use: Baer, Ayotte, and Baldi (2010) distributed self-report surveys to States on their motorcycle safety programs and received responses from 45 States. Thirty-three of the 43 States that responded to a question on helmet use promotion, both with and without helmet laws, indicated they actively promote helmet use, but the nature and extent of these promotions is unknown. Only one State reported using paid broadcast media spots.

Effectiveness: There appear to be no formal evaluations of the effect of helmet use promotion programs in States without universal helmet laws (NCHRP, 2008). However, helmet use remains substantially lower in States without universal helmet laws than in States with such laws (NHTSA, 2009c). NCHRP (2008) describes elements that should be included, should a campaign be undertaken.

Costs: Good communications and outreach campaigns can be expensive to develop and implement: see Chapter 2, Section 3.1. Helmet use promotion material is available from various sources including MSF, NHTSA (2003), and from States that have conducted these campaigns.

Time to implement: A good campaign, including market research, material development, and message placement, will require at least 6 months to plan and implement. If materials from NHTSA or elsewhere are used, less time may be required.

1.3 Motorcycle Helmet Law Enforcement: Noncompliant Helmets

Effectiveness: ★	Use: Unknown	Cost: Low	Time: Medium
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Law enforcement officers in universal helmet law States easily can observe and cite motorcycle riders who are not wearing a helmet. This likely explains why helmet use rates are high in universal helmet law States (Chapter 5, Section 1.1). However, some helmets are noncompliant in that they do not meet the FMVSS 218 performance requirements. Many State helmet laws require motorcycle riders to wear helmets that comply with FMVSS 218, and Federal regulations require all motorcycle helmets sold in the United States to meet or exceed the FMVSS 218 standards. Use of noncompliant helmets by all riders decreased from 11% in 2008 to 9% in 2009 according to the two most recent nationally-representative observational surveys of helmet use (NHTSA 2009c). Simultaneously, use of compliant helmets increased from 63% to 67%.

Motorcycle riders wearing noncompliant helmets are essentially no safer than if they wore no helmets at all (NHTSA, 2007b). In addition to offering no energy-absorbing materials, noncompliant helmets often cover only a portion of the rider's head and have inadequate chin straps so the helmets are not likely to stay on riders' heads in a crash (NHTSA, 2007b). Some riders fail to use the chin straps. These features are fairly easy for an observer to identify. Some noncompliant helmets also have spikes or other protrusions that mark them noncompliant. A NHTSA brochure discusses how to identify noncompliant helmets (NHTSA, 2004).

The challenge of motorcycle helmet law enforcement in States requiring FMVSS 218 compliant helmets is to actively identify and cite motorcycle riders wearing noncompliant helmets. Identifying a noncompliant helmet is easier than proving that it is noncompliant. Compliant helmets are formally identified by a DOT sticker on the back of the helmet. However, counterfeit DOT stickers are easily available and are found on many noncompliant helmets (although some noncompliant helmets may have labels that say they are novelty helmets and not motorcycle helmets). As a result, it is difficult to obtain a conviction for a noncompliant helmet citation in some courts (NHCRP, 2008, Strategy E1). In September 2008, NHTSA issued a Notice of Proposed Rulemaking to strengthen helmet labeling requirements and to make it easier to prove that a helmet is noncompliant. NHTSA also prepared a video clip for motorcyclists and law enforcement demonstrating how to identify compliant and noncompliant helmets and how to choose a helmet that fits properly (NHTSA, 2006b).

Use: Sixteen of 43 States that reported to Baldi et al. (2010) indicated that they conduct law enforcement activities to identify and cite noncompliant-helmet wearers, but only States having universal helmet laws (20 States) would implement such programs. In 2007, the New York State Police (NYSP) piloted a motorcycle safety checkpoint enforcement program. In the pilot effort, 225 motorcycles of 280 passing through the checkpoint were inspected. Traffic citations were issued to 104 motorcyclists; the most common citation (41 issued) was for operating with non-compliant helmets (Salmon, 2008). Fifteen additional motorcycle checkpoint enforcements were planned for 2008, and according to NYSP, the program is ongoing.

Effectiveness: The effectiveness of an active helmet law enforcement program on noncompliant helmet use has not been evaluated.

Costs: Since helmet laws can be enforced during regular traffic patrols, the only costs will be for training law enforcement officers, prosecutors, and judges to identify noncompliant helmets.

Time to implement: An active helmet-law enforcement program requires planning of an effective enforcement strategy, training for law enforcement to identify noncompliant helmets and carry out the enforcement, and communications and training for prosecutors and judges to assure that citations will be prosecuted and adjudicated. This training probably will require 4 to 6 months to implement. Materials are available to help with non-compliant helmet identification, but other program aspects and training may need to be developed or adapted. These elements may require 6 months or longer.

2. Alcohol Impairment

2.1 Alcohol-Impaired Motorcyclists: Detection, Enforcement and Sanctions

Effectiveness: ★ ★ ★	Use: Unknown	Cost: Varies	Time: Varies
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Alcohol impairment is a substantial problem for motorcycle riders, even more than for drivers of other motor vehicles. In 2008, 29% of motorcycle riders involved in fatal crashes had BACs of .08 g/dL, compared to 23% for passenger car drivers and 23% for light truck drivers (NHTSA, 2009a). Even higher proportions of fatally injured 35- to 49-year-old riders had BAC levels of .08 or higher (38% for riders ages 35-39, 41% for riders ages 40-44, 38% for riders ages 45-49; NHTSA, 2010a). An additional 7% of motorcycle riders in fatal crashes had at least some measurable level of alcohol in their blood (BAC .01 to .07 g/dL). Fatally injured motorcycle riders with BAC levels .08 g/dL during all times of day were less likely to wear helmets than were sober riders (NHTSA, 2010a). Furthermore, in 2009 42% of riders killed in single vehicle crashes had a BAC of .08 or above, and on weekend nights this figure climbed to 63% (NHTSA, 2010b). The 2007 National Roadside Survey similarly found that 5.6% of motorcycle riders on weekend nights had a BAC of .08 or above, as compared to 2.3% of passenger vehicle drivers (Lacey et al., 2009a).

Motorcyclists are included in and affected by the comprehensive strategies to reduce alcohol-impaired driving discussed in detail in Chapter 1. However, some law enforcement and sanction strategies may be especially useful for motorcyclists, while others may be less effective.

Law enforcement officers on traffic patrol use characteristic driving behaviors, or cues, to identify drivers who may be impaired by alcohol. Some of the cues for motorcycle riders, such as trouble maintaining balance at a stop, are different from those for cars and trucks. Stuster (1993) identified and validated 14 cues useful for identifying alcohol-impaired motorcycle riders. NHTSA prepared a brochure discussing the cues, a law enforcement training video, and a pocket detection guide (NHTSA, 2000b). The cues for motorcycle riders are part of the Standardized Field Sobriety Tests training given to all law enforcement officers.

Vehicle impoundment or forfeiture can be an effective deterrent to drinking and driving for all drivers (see Chapter 1, Section 4.3). It may be even more effective for motorcyclists. Research by Becker, McKnight, Nelkin, and Piper (2003) confirmed earlier findings that many motorcyclists do not find traditional impaired driving sanctions such as fines and license suspension to be effective deterrents, although self-reported beliefs may not reflect actual effectiveness of these other sanctions. However, motorcyclists tended to be highly concerned for the safety and security of their motorcycles.

These findings suggest a potentially effective strategy to reduce alcohol-impaired motorcycling: highly publicized enforcement using officers trained in identifying impaired motorcycle riders and other motor vehicle drivers, with offender sanctions including vehicle impoundment or forfeiture. This strategy would treat motorcyclists on an equal footing with other vehicle drivers in impaired-driving enforcement and publicity.

Use: Thirty-two of 43 responding States reported having programs to focus on spotting impaired motorcyclists or on enforcing laws related to operating a motorcycle while impaired (Baer et al., 2010). NHTSA (2006a) provides examples and links of State programs that distribute the NHTSA cue cards and brochures widely to law enforcement (Illinois), present this information in a Web-based seminar for officers (Minnesota), and regularly establish high-visibility law enforcement presence at major rider events (Ohio, Wisconsin).

Effectiveness: Some agencies have reported some success in using the cues for identifying alcohol-impaired motorcycle riders, but no evaluation data on the extent of their use are available (NCHRP, 2008, Strategy B3). Although evidence is lacking for effects of enforcement and sanctions on impaired motorcycle riding, sobriety checkpoints, and saturation patrols have proven to be effective for reducing impaired driving and crashes generally. See Chapter 1 for more information on enforcement strategies and other tools.

Costs: Law enforcement training costs are low and training material is available. Enforcement itself can be carried out during regular traffic patrol and as part of all impaired driving enforcement programs. A major campaign including alcohol-impaired motorcyclists may require additional costs for publicity.

Time to implement: Law enforcement training can be conducted quickly. A major campaign will require 4 to 6 months to plan and implement.

Other issues:

- **BAC limits:** BAC levels as low as .05 g/dL caused some detectable levels of impairment, primarily in reaction time, among experienced riders in tests on a controlled course (Creaser et al., 2007). Puerto Rico passed a law in 2007 lowering the BAC limit for motorcyclists to .02.
- **Drugs other than alcohol:** Drugs other than alcohol can impair motorcycle riders. Potentially impairing drugs include over-the-counter and prescription medications as well as illegal drugs. The 2007 National Roadside Survey reported that 31.9% of nighttime weekend motorcycle riders who provided oral fluid and/or blood samples tested positive for drugs (illegal drugs or medications), as compared to 16.5% of passenger car drivers (Lacey et al., 2009b). The extent to which various drugs impair driving performance or contribute to crashes is not well understood, however, for either four-wheeled vehicles or for motorcycles. Furthermore, individual differences in metabolism of drugs and level of impairment, as well as multiple-drug use complicate the issue (Compton, Vegega, and Smither, 2009). (See Compton et al.'s (2009) Report to Congress on drug-impaired driving for a discussion of current knowledge and recommendations for improving States data and records systems and statutes.) Law enforcement should consider drugs as potential impairing agents for motorcycle riders just as for other vehicle operators. See also Chapter 1, Section 7 on drug-impaired driving.
- **Targeted enforcement:** As with other crash problems, better identification of problem areas (either impaired riding or impaired riding crashes) and targeting enforcement to such locations, events, or times could improve enforcement effectiveness.

2.2 Alcohol-Impaired Motorcyclists: Communications and Outreach

Effectiveness: ★	Use: Medium	Cost: Medium	Time: Medium
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Many States have conducted communications and outreach campaigns directed at drinking and riding. See NHTSA (2006a) and NCHRP (2008, Strategy B1) for more information and links. Organizations including AMA and MSF have produced campaigns and material on drinking and riding. Again, see NHTSA (2006a) and NCHRP (2008) for strategies for implementation, examples, and links to materials. There are few evaluations of the effectiveness of any of these campaigns at any level, from awareness to knowledge and attitude change to any effect on motorcyclists' drinking and riding behavior. The experience of drinking and driving campaigns directed at all drivers suggests that they are unlikely to have a positive effect unless they are carefully researched and planned, well funded, well executed, achieve high levels of target audience exposure (perhaps using paid advertising), use high-quality messages that are pre-tested for effectiveness, and are conducted in conjunction with enforcement activities directed at impaired motorcyclists. See Chapter 1, Section 5.2, for further discussion.

A focus group study (Becker et al., 2003) examined motorcyclists' attitudes, beliefs, and behaviors regarding drinking and riding. It concluded that many motorcyclists have strong feelings of freedom, independence, and individual responsibility and believe that drinking motorcyclists endanger only themselves. Consequently, they believe that government efforts to discourage drinking and riding are inappropriate. These beliefs also limit some motorcyclists' willingness to take actions to prevent others from riding while impaired.

A program, "Riders Helping Riders," targets the expressed willingness of some motorcycle riders to help other riders by encouraging them to intervene to prevent other motorcycle riders from riding impaired and to create a stronger safety culture among motorcyclists. This program is based on the beliefs and attitudes of riders from focus group research (McKnight & Becker 2007a, 2007b; McKnight, Becker, & Tippetts, 2008), and is available on a CD ROM for individual and group use. The material was pilot-tested in Georgia. Riders' attitudes and intentions toward intervening seemed to improve based on surveys taken before and immediately after training. Longer-term evidence of attitude change, interventions actually carried out, or definitive safety effects will require exposure to large numbers of riders and longer follow-up of crashes (McKnight et al., 2008;).

Another program called "Green-Yellow-Red" was recently developed and tested in Wisconsin (Aguilar & Delehanty, 2009). The campaign sought to educate motorcycle riders about the dangers of drinking and riding, encourage them to make safer choices, and provide impaired motorcycle riders with secure storage of their motorcycles so that they could find safe transport home. A coalition was established that included motorcycle riders, tavern owners, law enforcement, and local businesses, and substantial media attention was obtained at the program kick-off. While there is evidence that riders were willing to leave their motorcycles in secure storage containers, only small changes in rider behavior and alcohol-related motorcycle crashes were observed following the program (Aguilar & Delehanty, 2009).

Rider groups can play a critical role in planning and implementing activities to reduce drinking and riding. Some State and local rider groups sponsor alcohol-free events or adopt alcohol-free policies. As examples, the Fox Valley Wisconsin Harley Owners Group (H.O.G.) chapter has an alcohol-free policy for all organized rides and Illinois American Bikers Aimed Toward Education (ABATE) sponsors alcohol-free rides (NHTSA, 2006a, Section 1).

Use: Many States have conducted anti-drinking and riding campaigns (NHTSA, 2006a; NCHRP, 2008, Strategy C1), but the total number of States that have done so is not known. Some examples of States campaigns include Connecticut's "Open the Throttle, Not the Bottle" and Minnesota's "Drinking and Riding: A Really Bad Idea." Many other States have brochures and materials. It also is not known how many States have included messages directed to motorcyclists in their overall alcohol-impaired driving campaigns. However, motorcycle riders are now included in the "Drunk Driving. Over the Limit, Under Arrest" paid media spots.

Effectiveness: There are no evaluations of the safety effectiveness of any drinking and riding campaigns.

Costs: A good campaign will require substantial funds to conduct market research, design and test messages, and place campaign material where it will reach motorcyclists frequently.

Time to implement: A good campaign will require at least 6 months to research, design, test, and implement.

3. Motorcycle Rider Licensing and Training

3.1 Motorcycle Rider Licensing

Effectiveness: ★	Use: High	Cost: Low	Time: Medium
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All 50 States the District of Columbia, and Puerto Rico require motorcycle riders to obtain a motorcycle operator license or endorsement before they ride on public highways (MSF, 2008). The goal of licensing is to assure that motorcycle riders have the minimum skill needed to operate a motorcycle safely (NHTSA, 2000a).

Operator licensing faces three issues.

- Many motorcycle riders are not properly licensed. In 2009, 22% of motorcycle riders involved in fatal crashes did not have a valid motorcycle license, compared to 12% of passenger vehicle drivers who were not properly licensed (NHTSA, 2010a). Licensing systems in some States provide no incentive to become fully licensed because learner's permits may be renewed indefinitely (NCHRP, 2008, Strategy C3).
- State motorcycle licensing practices vary substantially. Most States have a learner's permit requiring only vision and knowledge tests. Motorcycle riders with a learner's permit can ride only in restricted circumstances, typically some combination of no passengers, only during daylight hours, and only with the supervision of a fully licensed motorcyclist. A skill test is required for full licensure. Two-thirds of the States use one of three tests developed by the MSF and American Association of Motor Vehicle Administrators, while one-third use their own tests. Most States will waive the skill test, and sometimes the knowledge test, for motorcyclists who have completed an approved motorcycle rider training course. See Baer, Cook, and Baldi (2005) for a summary of each State's licensing requirements and procedures and NCHRP (2008, Strategy C1) for brief summaries of the major skill tests currently in use.
- The goal of motorcycle operator licensing is to assure that motorcyclists have basic riding skills, but its effectiveness is not known. This is perhaps not surprising given the variability of licensing tests and procedures. NAMS recommends research to "ensure that licensing tests measure skill and behaviors required for crash avoidance" (NHTSA, 2000a). NCHRP (2008, Strategies C2 and C3) describes strategies to couple training and licensing to help ensure that riders are both trained and obtain the necessary endorsements, but notes that there are no evaluations of whether increasing the proportion of motorcycle riders who are validly licensed would reduce motorcycle crashes or injuries.

Baer, Cook, and Baldi (2005) reviewed and summarized each State's motorcycle education and licensing programs and practices. A companion report (Baer, Baldi, & Cook, 2005) describes training and licensing programs and actions to promote training and licensing. Under a cooperative agreement with NHTSA, AAMVA has updated its *Motorcycle Operator Licensing System* and *Integrating Motorcycle Rider Education and Licensing* manuals, by publishing the *Guidelines for Motorcycle Operator Licensing* (GMOL). The GMOL provides guidelines for State motorcycle licensing programs (Hanchulak & Robinson, 2009).

States should encourage all motorcycle riders to be validly licensed. The NAMS (NHTSA, 2000a) recommends that States:

- provide enough convenient testing times and locations to accommodate the demand, for example by offering testing during evening hours;
- waive skill and knowledge tests for graduates of approved motorcycle rider training courses;
- actively enforce motorcycle operator licensing requirements;
- promote motorcycle rider licensing; and
- provide motorcycle-specific training to licensing examiners.

The NCHRP (2008, Strategy C3) describes how Maryland and Minnesota used some of these strategies to increase proper licensing for motorcycle riders. Maryland used the additional strategy of comparing their vehicle registration and driver licensing files. A letter was sent to each owner of a registered motorcycle who did not have a motorcycle operator's license. The letter reminded each registered owner that a motorcycle endorsement was required of anyone operating the registered motorcycle. This quick and inexpensive strategy caused 1,700 owners to become licensed within four months. A randomized controlled experiment of this intervention suggested that while the method did increase licensure, a large percentage remained unlicensed (Braver et al., 2007). Effective July 22, 2007, the State of Washington added an authorization to impound vehicles operated by drivers without a proper endorsement (including, but not limited to, motorcycles).

Maryland and Pennsylvania have “one-stop shops” that provide a motorcycle endorsement immediately upon successful completion of a State-approved motorcycle rider training course or test, without having to wait after receiving a permit. For Pennsylvania's procedures, see www.pamsp.com/CourseInfo_Basic.aspx.

Use: All States require motorcycle riders to obtain a motorcycle license or endorsement to ride on public highways. Less than half of responding States indicated that they enforce laws relating to improperly licensed motorcyclists (Baer et al., 2010).

Effectiveness: The effectiveness of current licensing and testing on crashes and safety has not been evaluated.

Costs: Most States charge a small fee for the motorcycle licensing tests (MSF, 2008). The costs of changing the licensing tests and procedures depend on the extent of changes and the amount of retraining needed for licensing examiners as well as what portion of costs are covered by licensing fees.

Time to implement: Developing new policies to encourage higher rates of full motorcycle licensure (including limiting the number of times a provisional license may be renewed, administrative practices such as adding testing times and locations, or training motorcycle license examiners), or procedures such as waiving the skills test for those who have passed an approved training course, would likely require 6 to 12 months to implement. Enforcement of motorcycle licensing requirements could occur more readily, if requirements for full licensure are clear enough to enforce.

Other issues:

- **Graduated driver licensing (GDL):** The NAMS recommended that States enhance motorcycle licensing practices by incorporating and evaluating use of GDL concepts. Most States employ graduated driver licensing for beginning automobile drivers. Under GDL, new drivers must pass through learner's permit and provisional license stages before becoming fully licensed. A learner's permit allows driving only while supervised by a fully licensed driver and a provisional license allows unsupervised driving under certain conditions, such as limiting the number of passengers and prohibiting driving at night. Many States place restrictions similar to these on motorcycle riders with a learner's permit or younger than a specified age (MSF, 2008). Mayhew and Simpson (2001) describe motorcycle rider GDL programs in California, Maryland and South Dakota. For example, the California GDL prohibits passengers or nighttime riding during the learner permit stage, and requires all people under 25 who are seeking a motorcycle license or endorsement to take the State-sponsored motorcycle rider training course. Baer, Cook and Baldi (2005) report that seven States had some form of graduated licensing in 2001 and five restricted motorcycle riders in some age groups to motorcycles of certain sizes. GDL programs for automobile drivers have been shown to be effective in reducing crashes (Hedlund, Shults, & Compton, 2003, 2006). Evaluations in New Zealand and evidence from Quebec suggest that they may do the same for motorcyclists (Mayhew & Simpson, 2001). NHTSA's *Guidelines for Motorcycle Operator Licensing* includes a model graduated licensing program for motorcycle riders (Hanchulak & Robinson, 2009). In Utah, motorcycle endorsements are restricted to motorcycles no larger than the size of the motorcycle used for the skills test, or used during the approved State training course (substitute). The endorsement can be changed by testing on a larger size motorcycle.

3.2 Motorcycle Rider Training

Effectiveness: ★	Use: High	Cost: Medium	Time: Varies
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Motorcycle rider education and training has been thoroughly integrated into all aspects of motorcycle safety. The National Agenda for Motorcycle Safety encourages training (NHTSA, 2000a, Rider Education and Training). NHTSA’s Motorcycle Safety Program Plan states that “motorcycle rider education provides an opportunity for novice riders to learn the basic skills necessary to operate a motorcycle safely and for experienced riders to refresh and refine their techniques” (p.17) and recommends that States conduct frequent and timely education and training at sites that are accessible throughout the State (NHTSA, 2006b). Congress established grants to States to support rider training and motorcyclist awareness programs under Section 2010 of SAFETEA-LU (NHTSA, 2006b). NCHRP (2008, Strategy C2) further recommends that States evaluate crash experience, compare data and crash scenarios with training and licensing practices, and make adjustments as needed to ensure practices are effectively targeting crash problems. This requires cooperation on the part of multiple agencies, including those responsible for collecting and analyzing crash data and those responsible for training and licensing.

Forty-seven States have State-operated and legislated education and training programs and the other three have privately operated programs (Baer, Cook, & Baldi, 2005). Sixty percent of the 44 States that responded to a survey question from Baer et al. (2010) reported they were able to accommodate all riders seeking training within a calendar year. Training also is provided by some rider organizations (for example, some ABATE and Gold Wing groups), manufacturers (Harley-Davidson), and other private providers. Many States encourage training either by requiring it for all motorcycle operators or those under a specified age, or by waiving some testing requirements for motorcycle riders who complete an approved training course (Baer, Cook, and Baldi, 2005). Most entry-level training uses the *Basic RiderCourse* (BRC) curricula developed by MSF. The *Experienced RiderCourse* suite (ERC) is offered to riders with some previous experience or for seasoned riders who want additional training; however, the ERC represents a very small part of total training provided.

However, it is not at all clear what constitutes good rider education and training, nor whether current training reduces crashes. As to content, the National Agenda concluded that “it is assumed, yet unknown, that the current [rider training] programs are teaching necessary skills to survive in traffic” (NHTSA, 2000a, Rider Education and Training). It recommended that a “uniform, educationally sound” curriculum be adopted. NHTSA (2003, p. 13) reported wide differences in training program content and administration from State to State. Baer, Cook, and Baldi (2005) summarize the curricula offered in each State. Beyond just teaching motorcycle control skills, emerging evidence suggests that better programs would also train riders to recognize potentially hazardous riding situations and encourage riders to assess their own risks and limitations, and ride within those constraints (e.g., Clarke, Ward, Bartle, & Truman, 2007; Elliott, Baughan, & Sexton, 2007). In response to this situation, NHTSA is supporting the development of Model National Standards for Entry Level Rider Training.

Baer, Cook, and Baldi (2005) summarized each State’s motorcycle education and licensing programs and practices. A companion report (Baer, Baldi, & Cook, 2005) describes best practices in training and licensing programs and actions to promote training and licensing.

States should do their best to provide motorcycle training on a timely basis to all who wish to take it. See Baer, Baldi, and Cook (2005) and NHTSA (2006a) for examples of successful methods to use training capacity more effectively, including creative scheduling, centralized on-line registration systems, and use of private providers. Under Section 2010 of SAFETEA-LU, Congress established grants to States to support rider training (NHTSA, 2006b).

Use: Most States offer training to both experienced and beginning motorcycle riders. For more information about the features of training and education programs offered by the States, see Baer et al. (2010).

Effectiveness: Training effectiveness is uncertain. Mayhew and Simpson (1996) reviewed all high-quality studies available at the time on motorcycle rider training programs. Only one of six studies in the United States showed any positive results, and only for the first 6 months following training. Mayhew and Simpson concluded that the studies did not show a safety benefit to offering motorcycle rider training in the forms then offered. A more recent review, which included two additional studies not reviewed by Mayhew and Simpson, similarly concluded that research is equivocal on whether training is effective or ineffective (Daniello, Gabler, & Mehta, 2009). Daniello et al. did find support from two studies that training improves use of protective equipment; both of these studies were based on self-report data. Neither of the same two studies found evidence, however, that training reduced risk of crashes although it isn't clear how the populations taking the courses and riders who had not taken the courses differed (Mortimer, 1988; Savolainen & Mannering, 2007).

Costs: Rider training programs are funded in part by the States and in part by fees paid by the students who take them. State costs per student in 2008 ranged from less than \$19 to \$250, and averaged \$129 for State-sponsored basic courses according to data available from 14 States responding to the SMSA Annual survey. Costs to students in the form of tuition or fees ranged from zero to \$340 and averaged \$150 (SMSA, 2008). Many States offset some or all of their costs through motorcycle license or student registration fees.

Time to implement: Rider training currently is conducted in all States. Training capacity is limited by the number of available training sites (a broad expanse of paved surface is required), qualified instructors, and motorcycles for students to use during training. Some measures to increase capacity can be implemented quickly while others may take 6 to 12 months. See the SMSA Annual Surveys for information on capacity, numbers of students trained, and other program information, by State (SMSA, 2008).

Other issues:

- **Training for experienced motorcyclists:** Many States offer the ERC Suite (*Experienced Rider Course*) for experienced motorcycle riders (www.msf-usa.org/sitemap.cfm). Some States, such as Idaho and Oregon, offer their own experienced rider courses. The courses have not been evaluated.
- **Training for other motorcycle configurations (three-wheeled motorcycles and motorcycles pulling trailers):** Several motorcycle organizations offer courses addressing these special motorcycle configurations. The courses have not been evaluated.

4. Communications and Outreach

4.1 Communications and Outreach: Conspicuity and Protective Clothing

Effectiveness: ★	Use: High	Cost: Varies	Time: Medium
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Motorcycle riders should wear clothing that provides both protection and visibility. FMVSS 218 helmets (Chapter 5, Sections 1.1-1.3) with face shields protect the eyes from wind and foreign objects in addition to protecting the head in a crash. Well-constructed jackets, pants, boots, and gloves can prevent abrasions and bruises. If made of impact-resistant material, they even may prevent arm and leg fractures or serious torso and spinal cord injuries (NHTSA, 2000a). Rider clothing can also enhance visibility (Hurt, Ouellet, & Thom, 1981).

A common perception among riders is that a frequent cause of motorcycle crashes involving other vehicles is that other vehicle drivers do not see the motorcycle. The 1981 Hurt et al. (1981) study from the United States and a 2007 study from the U.K. (Clarke et al., 2007) report that right-of-way collisions involving other motorists are more frequently the fault of the other motorist. Failure of the other motor vehicle driver to perceive the motorcyclist seems to occur in a significant portion of these types of crashes (Clarke et al., 2007). One easy way to increase motorcycle conspicuity is through lighted headlights. Most motorcycles on the road have their headlights on, because motorcycles manufactured since 1979 have this feature (NCHRP, 2008, Strategy D2) and because 24 States require daytime headlight use for all motorcycles manufactured since 1980 (MSF, 2010).

A second way to increase conspicuity is to wear brightly colored clothing, use white or bright-colored helmets (for increased visibility during daylight), and incorporate retro-reflective materials or devices (for increased visibility at night). Research studies confirm that motorcyclists wearing conspicuous clothing or helmets are less likely to be involved in a crash (Wells et al., 2004; NCHRP, 2008, Strategy D1).

Other methods mentioned in the introduction of this chapter include auxiliary head and brake lights, flashing headlights, and other vehicle technologies that enhance conspicuity, but effects on crashes have not been studied. Adoption of these technologies might be usefully promoted among the motorcycling community, may require changes in laws if visibility enhancing technologies are restricted by States, and may also involve working with manufacturers and producers of motorcycles and auxiliary devices (NCHRP, 2008).

There are no data on how many motorcycle riders wear various types of protective clothing other than helmets or use auxiliary devices. Helmet manufacturers and distributors report that more than half the helmets sold for street use are black and the predominant color of motorcycle clothing is black (NCHRP, 2008, Strategy D1).

Communications and outreach campaigns promoting protective and conspicuous clothing have been conducted by States and by motorcyclist organizations. NCHRP (2008, Strategy D1) provides examples of material from Oregon and the MSF and references to additional material from the SMSA, and the Gold Wing Road Riders Association. Also, the Minnesota Safety Center launched a campaign promoting the use of high-visibility gear at www.HighViz.org.

Use: Of the forty-four States responding to a survey question, 33 reported encouraging conspicuity-enhancing clothing and helmets to enhance motorcyclists' visibility (Baer et al., 2010). The extent or nature of these efforts is unknown.

Effectiveness: The use of high-visibility clothing and protective gear enhances safety, but there are no known evaluations of the effectiveness of campaigns to increase the use of protective and conspicuous clothing.

Costs: Good communications and outreach campaigns can be expensive to develop and implement: see Chapter 2, Section 3.1. Information promoting protective and conspicuous clothing is available from various sources including MSF, other motorcyclist organizations, and States that have conducted these campaigns (NCHRP, 2008, Strategy D1).

Time to implement: A good campaign, including market research, message development and testing, and implementation, will require at least 6 months to plan and implement.

4.2 Communications and Outreach: Other Driver Awareness of Motorcyclists

Effectiveness: ★	Use: High	Cost: Varies	Time: Medium
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When motorcycles crash with other vehicles, the other vehicle driver usually violates the motorcyclist's right-of-way (Clarke et al., 2007; Elliott et al., 2007; NCHRP, 2008, Strategy F3; NHTSA, 2000a). Motorcycles and motorcyclists are smaller visual targets than cars or trucks, resulting in low conspicuity (see Chapter 5, Section 4.1). Also, drivers may not expect to see motorcycles on the road (NCHRP, 2008, Strategy F3; NHTSA, 2000a). Clarke et al (2007) reported that even when motorcyclists were using headlights and high conspicuity clothing, drivers sometimes failed to notice them.

Several States have conducted communications and outreach campaigns to increase other drivers' awareness of motorcyclists. Typical themes are "Share the Road" or "Watch for Motorcyclists." Some States build campaigns around "Motorcycle Awareness Month," often in May, early in the summer riding season. Many motorcyclist organizations, including MSF, SMSA, the Gold Wing Road Riders Association, and State and local rider groups, have driver awareness material available. See NHTSA (2006a, Section 5) and NCHRP (2008, Strategy F3) for links and references. Some organizations also make presentations on drivers' awareness of motorcyclists to driver education classes.

Congress established grants to States to support motorcyclist awareness programs and rider training under Section 2010 of SAFETEA-LU (NHTSA, 2006b). As required by SAFETEA-LU, NHTSA developed model language on sharing the road safely with motorcyclists. The model language is appropriate for traffic safety education courses, driver manuals, and other communication and outreach activities (NHTSA, 2007a). NHTSA developed a "Share the Road" program planner for use by States, communities, and the motorcycling community (see www.trafficsafetymarketing.gov/motorcycles/ShareTheRoad/index.cfm).

Use: Thirty-six of 44 States that responded to a survey question reported that they communicate about ways for drivers to increase their awareness of motorcycles and motorcyclists (Baer et al., 2010). NHTSA (2006a, Section 5) and NCHRP (2008, Strategy F3) provide examples or links to campaigns from a dozen States.

Effectiveness: There are no evaluations of the effectiveness of campaigns to increase driver awareness of motorcyclists (NCHRP, 2008, Strategy F3).

Costs: Good communications and outreach campaigns can be expensive to develop and implement: see Chapter 2, Section 3.1. Motorcyclist awareness material is available from various sources including the MSF, other motorcyclist organizations, and States that have conducted these campaigns (NCHRP, 2008, Strategy F3).

Time to implement: A good campaign, including market research, message development and testing, and implementation, will require at least 6 months to plan and implement.

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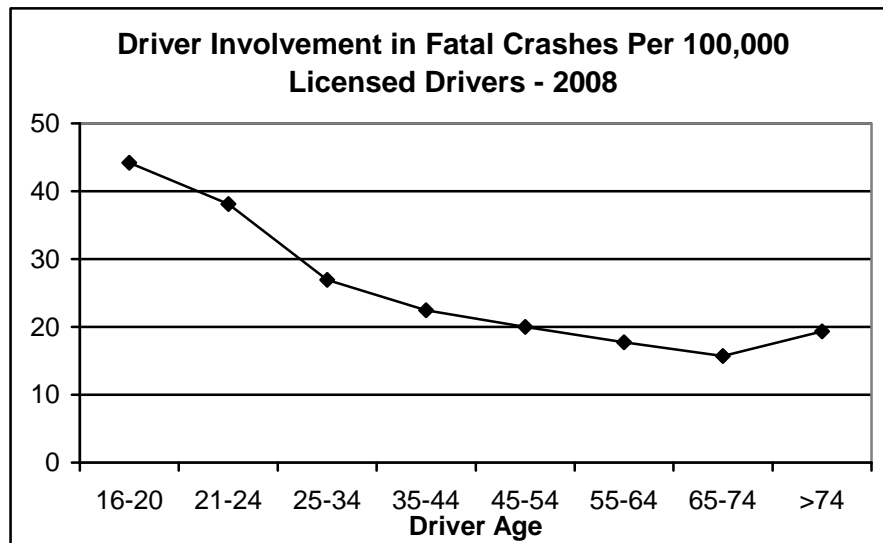
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6. Young Drivers

Overview

Motor vehicle crashes are the leading cause of death for teenagers in the United States. In 2009, 2,336 drivers age 15 to 20 were killed and another 196,000 were injured in motor vehicle crashes (NHTSA, 2010a). In comparison with adult drivers, young drivers are substantially over-involved in crashes. In 2007, drivers age 15 to 20 were 6.4% of all licensed drivers in the United States, but 11% of drivers in fatal crashes, and 14% of drivers in all crashes (NHTSA, 2010a).

Young drivers have the highest involvement in fatal crashes of any age group. As shown in the figure below, fatal crash involvement of drivers age 16 to 20 is approximately twice that of adult drivers.



Source: Traffic Safety Facts 2008 (NHTSA, 2009, Table 64). FARS data.

Per mile driven, young drivers are even more over-involved. From April 2001 through March 2002, 16 year-old drivers were involved in 9.3 fatal crashes per 100 million miles of travel, compared to 4.3 for drivers 20 to 24 and 1.6 for drivers 30 to 59 years old (IIHS, 2009). Only 37% of the people killed in young driver crashes are the teen driver themselves; the majority of fatalities in young driver crashes (63%) are passengers of the teen driver, occupants of other vehicles, or nonmotorists (AAA, 2009).

Trends. Between 1996 and 2005, there was a 42% decrease in the fatal crash rate for 16-year-old drivers (from 33 to 19 per 100,000 population). For 17-year-olds, fatal crash rates declined by 23%. By comparison, fatal crash rates declined by 15% among adult drivers ages 30-59. There was a similarly large decrease (41%) in police-reported crash involvements among 16-year-old drivers, as well as substantial decreases in nighttime fatal crashes and fatal crashes involving passengers (Ferguson, Teoh, & McCartt, 2007). The reasons for the dramatic reductions in fatal and police-reported crashes among 16-year-olds are not entirely known; however, it is

noteworthy that most States implemented new, multi-stage licensing systems during this time period. Presently, fatal crashes among 16-year-olds are at a historic low (Ferguson et al., 2007).

Young-driver characteristics. Young drivers have high crash risks for two main reasons, as documented by extensive research (summarized in Hedlund, Shults, & Compton, 2003). First, they are inexperienced, just learning to drive. The mechanics of driving require much of their attention, so safety considerations frequently are secondary. They do not have experience in recognizing potentially risky situations or in reacting appropriately and controlling their vehicles in these situations. Second, they are immature, sometimes seeking risks for their own sake, often not able or willing to think ahead to the potentially harmful consequences of risky actions. In fact, research on adolescent development suggests that key areas of the brain involved in judgments and decision making are not fully developed until the mid-20s (Dahl, 2008; Keating, 2007; Steinberg, 2007).

Inexperience and immaturity combine to make young drivers especially at-risk in five circumstances:

- **At night:** Driving is more difficult and dangerous at night for everyone, but particularly for teenagers. Young drivers have less experience driving at night than during the day, and drowsiness and alcohol may be more of a factor at night (Lin & Fearn, 2003; Williams, 2003).
- **After drinking alcohol:** Young drivers' inexperience with both driving and drinking means that they have a higher crash risk at all BAC levels than older drivers (Williams, 2003).
- **With passengers:** Teenage passengers can distract young drivers and encourage them to take risks (Lin & Fearn, 2003; Williams, 2003).
- **When unbelted:** Seat belts reduce the risk of injury or fatality in a crash (see Chapter 2, Overview), but teenage drivers and passengers have lower belt use rates than older drivers and passengers (Ferguson, 2003).
- **When using cell phones:** All drivers are at higher risk when talking or texting (see Chapter 4, Section 1.2); however, young drivers use cell phones more frequently than older drivers and have more difficulty handling distractions (Lee, 2007).

Strategies to Reduce Crashes Involving Young Drivers

Graduated driver licensing (GDL) addresses both the inexperience and immaturity of young drivers. GDL provides a structure in which beginning drivers gain substantial driving experience in less-risky situations. GDL raises the minimum age of full licensure and helps parents manage their teenage drivers. GDL's effectiveness in reducing crashes has been demonstrated many times (Hartling et al., 2006; Shope, 2007; Shope & Molnar, 2003; Simpson, 2003; Williams & Shults, 2010).

Driver education was developed to teach both driving skills and safe driving practices. Based on evaluations to date, school-based driver education for beginning drivers does a good job at teaching driving skills, but does not reduce crashes. Rather, some research has suggested that it lowers the age at which teenagers become licensed, and therefore increases exposure, so its

overall effect is to *increase* crashes (Roberts et al., 2006; Vernick et al., 1999). Current research is investigating ways to integrate driver education with GDL and is developing second-level programs for drivers who have acquired basic driving skills and have been, or are nearing, licensure.

Parents play a key role in their teenagers' driving. In many States a parent or guardian must sign the driver's license application for a teenager under 18 and parents can withdraw their approval at any time. Parents can set limits on their teenagers' driving. Through their own driving, parents provide role models for good or bad driving practices. Parents can be involved explicitly and formally through GDL requirements such as minimum hours of supervised driving practice, or they can be involved voluntarily and informally. Several parent-teen driving guide programs can provide assistance. At least one driving guide program has successfully encouraged parents to impose more driving restrictions on their teens (Simons-Morton, 2007) Recently, technologies have become available to assist parents in monitoring their newly licensed teen driver. When combined with a comprehensive system for providing feedback to parents and teens, these technologies have been highly promising in reducing the incidence of risky driving behaviors among teens (McGehee, Raby, Carney, Lee, & Reyes, 2007; Williamson, 2005). Finally, several States are now requiring parent involvement in driver education, usually in the form of a mandatory parent orientation class. All of these approaches are promising, though none have been shown as of yet to reduce young driver crashes or fatalities.

Young drivers are subject to two traffic laws that apply only to them: GDL and the zero-tolerance BAC laws discussed in Chapter 1. In addition, they are subject to all other traffic laws. Enforcement is critical if these laws are to have any effect. The law enforcement system faces several problems when dealing with young drivers. In deciding whether to make a traffic stop, it can be difficult for law enforcement officers to determine a person's age to know whether GDL and zero-tolerance laws apply. It has been suggested that a vehicle decal identifying a driver as "young" and subject to GDL requirements, may be beneficial for enforcement reasons. New Jersey is the first State to pass legislation requiring young drivers subject to GDL restrictions to be identified via a vehicle decal. Even if the driver is young, in many States GDL violations are secondary, and the teen may only be stopped for a primary violation first. Once stopped, there may be a tendency for officers in some situations not to make arrests or for prosecutors to dismiss charges because the offender is "just a kid." Finally, the legal system imposes additional requirements for people under the age of legal adulthood (18 in most States). See NHTSA and NIAAA (1999) for a discussion of these requirements and processes for alcohol-related offenses.

Young drivers are discussed in other chapters of this guide. See in particular:

- Chapter 1, Alcohol-Impaired Driving, Sections 6.1-6.4 (minimum-drinking-age-21 laws, zero-tolerance BAC laws, school and youth alcohol programs).
- Chapter 4, Distracted and Drowsy Driving, Sections 1.1, 2.1, 2.2, and 3.1 (GDL requirements, communications and outreach, and employer programs).
- Chapter 5, Motorcycle Safety, Section 3.1 (GDL for motorcyclists).

Except for GDL requirements applying to automobile drivers, these discussions are not repeated in this chapter.

Environmental and vehicular strategies can improve safety for young drivers, as they can for all drivers. However, these types of countermeasures are not included because State Highway Safety Offices do not have authority or responsibility in these areas.

Resources

The agencies and organizations listed below can provide more information on young drivers and links to numerous other resources.

- National Highway Traffic Safety Administration:
 - Teen Drivers - www.nhtsa.gov/Teen-Drivers
 - Driver Safety Research Reports: New Drivers - <http://www.nhtsa.gov/Driving+Safety/Research+&+Evaluation/Driver+Safety+Research+Reports:+New+Drivers+and+Older+Drivers>
 - Behavioral Safety Research Reports - <http://ntlsearch.bts.gov/repository/ntlc/nhtsa/index.shtm>
- Insurance Institute for Highway Safety: www.iihs.org/research/topics/teenagers.html
- National Safety Council: www.nsc.org/safety_road/TeenDriving/Pages/teen_driving.aspx
- Centers for Disease Control and Prevention: www.cdc.gov/Motorvehiclesafety/Teen_Drivers/index.html
- American Automobile Association: www.aaapublicaffairs.com/Main/Default.asp?CategoryID=14
- Governors Highway Safety Association: www.ghsa.org/html/issues/youngerdriver.html

For an overview of young-driver issues and research, see the papers in the June 2006 Supplement of *Injury Prevention* (ip.bmjournals.com/content/vol12/suppl_1/), the special issue of the 2007 *Journal of Safety Research* (www.sciencedirect.com/science/journal/00224375), or the special issue of the 2008 American Journal of Preventive Medicine (www.bocypf.org/AJPM_TOC_SEPT_2008.html). See also Williams & Shults (2010) for a summary of much of the research on young driver issues. Additionally, an NCHRP Report 500 guide for the American Association of Motor Vehicle Administrators' Strategic Highway Safety Plan provides a detailed discussion of strategies for reducing crashes involving young drivers (NCHRP, 2007).

Countermeasures That Work

Countermeasures to improve young-driver safety are listed below and discussed individually in this chapter. The table is intended to give a rough estimate of each countermeasure's effectiveness, use, cost, and time required for implementation. The symbols and terms used are described below. Effectiveness, cost, and time to implement can vary substantially from State to State and community to community. Costs for many countermeasures are difficult to measure, so the summary terms are very approximate. See each countermeasure discussion for more information.

1. Graduated Driver Licensing

Countermeasure	Effectiveness	Use	Cost	Time
1.1 Graduated driver licensing (GDL)	★★★★★	High	Low	Medium
1.2 Learner's permit length, supervised hours	★★★★★	High	Low	Medium
1.3 Intermediate - nighttime restrictions	★★★★★	High	Low	Medium
1.4 Intermediate - passenger restrictions	★★★★★	High	Low	Medium
1.5 Cell phone restrictions	★★	Medium	Low	Medium
1.6 Belt use requirements	★★	Low	Low	Medium
1.7 Intermediate - violation penalties	★	High	Low	Medium

2. Driver Education

Countermeasure	Effectiveness	Use	Cost	Time
2.1 Pre-licensure driver education	★	Medium	High	Long
2.2 Post-licensure driver education	★	Low	High	Long

3. Parents

Countermeasure	Effectiveness	Use	Cost	Time
3.1 Parent roles in teaching and managing	★★	Medium	Low	Short

4. Traffic Law Enforcement

Countermeasure	Effectiveness	Use	Cost	Time
4.1 Enforcement of GDL and zero-tolerance laws	★★★	Unknown	Medium	Short

Effectiveness:

★★★★★ - Demonstrated to be effective by several high-quality evaluations with consistent results

★★★★ - Demonstrated to be effective in certain situations

- ★ ★ ★ - Likely to be effective based on balance of evidence from high-quality evaluations or other sources
- ★ ★ - Effectiveness still undetermined; different methods of implementing this countermeasure produce different results
- ★ - Limited or no high-quality evaluation evidence

Effectiveness is measured by reductions in crashes or injuries unless noted otherwise. See individual countermeasure descriptions for information on effectiveness size and how effectiveness is measured.

Use:

- High: more than two-thirds of the States, or a substantial majority of communities
- Medium: between one-third and two-thirds of States or communities
- Low: fewer than one-third of the States or communities
- Unknown: data not available

Cost to implement:

- High: requires extensive new facilities, staff, equipment, or publicity, or makes heavy demands on current resources
- Medium: requires some additional staff time, equipment, facilities, and/or publicity
- Low: can be implemented with current staff, perhaps with training; limited costs for equipment or facilities

These estimates do not include the costs of enacting legislation or establishing policies.

Time to implement:

- Long: more than one year
- Medium: more than three months but less than one year
- Short: three months or less

These estimates do not include the time required to enact legislation or establish policies.

1. Graduated Driver Licensing

1.1 Graduated Driver Licensing

Effectiveness: ★ ★ ★ ★ ★	Use: High	Cost: Low	Time: Medium
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GDL is a three-phase system for beginning drivers, consisting of a learner's permit, an intermediate license, and a full license. A learner's permit allows driving only while supervised by a fully licensed driver. An intermediate license allows unsupervised driving under certain restrictions. These usually include limits on driving at night or with teenage passengers. The learner's permit and the intermediate license each must be held for a specified minimum period of time.

GDL serves two functions: reducing risk and reducing exposure. GDL allows beginning drivers to acquire driving experience in less-risky situations, under direct supervision during the learner's permit phase. It helps young drivers avoid dangerous conditions such as late-night driving or driving with teenage passengers in the vehicle during the intermediate phase. GDL delays full licensure by requiring a minimum time in both the learner's permit and intermediate phases. Compared to earlier requirements in many jurisdictions, where beginning drivers could receive a full license at age 16 (and sometimes earlier) by passing a minimal driving test, GDL reduces the amount of driving by 16-year-olds. GDL also assures that young drivers are more mature when they receive their first unrestricted license. In surveys, both parents and teenagers strongly support GDL overall (Williams, Ferguson, Leaf, & Preusser, 1998).

All States now have some form of GDL in place. GHSA (2010a) and IIHS (2010a) document GDL laws in each State. These Web sites are updated monthly. The papers in the special issue of the 2007 *Journal of Safety Research* describe GDL's history, components, effectiveness, parental roles, potential enhancements, and research needs. Strategies for implementing or improving GDL systems are described in NCHRP's *Guide for Reducing Collisions Involving Young Drivers* (NCHRP, 2007, strategies A1 through A5). See also NHTSA's recent *Traffic Safety Facts* on GDL (NHTSA, 2008) and Report to Congress (Compton & Ellison-Potter, 2008).

Use: All States and the District of Columbia had some GDL components in place as of July 2010. In addition, all States with the exception of North Dakota had a three-phase GDL system in place (GHSA, 2010a; IIHS, 2010a).

Effectiveness: GDL's effectiveness in reducing crashes and fatalities has been well-documented (Baker, Chen, & Li, 2007; Hartling et al., 2006; McCartt, Teoh, Fields, Braitman, & Hellinga, 2010; Shope, 2007; Shope & Molnar, 2003; Simpson, 2003; Williams & Shults, 2010). The most restrictive GDL programs – those with at least a 6-month holding period during the learner stage, a night restriction beginning no later than 10 p.m., and restrictions allowing no more than one teen passenger – are associated with a 38% reduction in fatal crashes and a 40% reduction in injury crashes among 16-year-old drivers (Baker et al., 2007). In addition to reducing crashes, GDL is associated with declines in hospitalization rates and charges for 16-year-old drivers (Margolis, Masten, & Foss, 2007; Pressley, Benedicto, Trieu, Kendig, & Barlow, 2009).

Costs: GDL's primary costs result from the intermediate license, which adds to licensing agency workload by requiring each beginning driver to receive three licenses in succession rather than two. These costs are typically covered by small fees charged by the licensing agency.

Time to implement: Licensing changes typically require up to a year to plan, publicize, and implement.

Other issues:

- **Age of licensure:** In recent years, there has been discussion about the most appropriate age for allowing teenagers to drive independently (Williams, 2009). Licensing ages vary from State to State, from a low of 14½ in South Dakota to a high of 17 in New Jersey. Delaying licensure, either through higher entry ages or GDL requirements such as extended learner stages, can reduce young driver crashes. For example, New Jersey's GDL system has eliminated most crashes among 16 year-old drivers, and has reduced crashes among 17 year-olds by 16% (Williams, Chaudhary, Tefft, & Tison, 2010). A survey from three States suggests parents support older licensing ages (McCartt, Hellinga, & Haire, 2007). However, the licensing age represents a balance between safety and mobility. Before raising the licensing age, consideration must be given to what is politically feasible, and the fact that teens will need safe and attractive alternatives for mobility.

1.2 GDL Learner's Permit Length, Supervised Hours

Effectiveness: ★ ★ ★ ★ ★	Use: High	Cost: Low	Time: Medium
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With a learner's permit, novices can drive when accompanied by an adult supervisor. The learner's permit allows and encourages beginning drivers to acquire substantial driving experience. To aid this, most States require the learner's permit to be held for a minimum period of time and most require a minimum number of supervised driving hours. NHTSA and IIHS recommend a holding period of at least 6 months and parental certification of 30 to 50 hours supervised driving (Compton & Ellison-Potter, 2008; IIHS, 2010a). Most States meet or exceed these recommendations.

Use: As of July 2010, 48 States and the District of Columbia required learner's permits to be held for at least 6 months, with 7 of these States requiring a minimum holding period of a full year. Forty-four States and the District of Columbia required some minimum number of supervised driving hours, about half of them requiring 50 hours. Thirty-nine States plus DC required that at least some of these hours be obtained at night. Some States reduced or eliminated supervised driving requirements for driver education graduates. This is not recommended, since evidence suggests this practice results in *higher* crash rates among young drivers (Mayhew, 2007).

Effectiveness: Several studies, summarized in Mayhew (2003), show that learner's permit drivers in various jurisdictions regularly drive under adult supervision and often exceed the minimum requirement for supervised driving hours. Thus the *combination* of a minimum learner's permit holding period and a supervised driving hour requirement is successful in achieving substantial supervised driving practice. Surveys show that parents and teenagers strongly support the learner's permit holding period and supervised driving requirements (Block & Walker, 2008; Mayhew, 2003; McKay, Coben, Larkin, & Shaffer, 2008).

Since learner's permit drivers are being supervised, it's not surprising that crash rates during the learner's permit period are very low. For young drivers holding their first unsupervised license, the limited available evidence suggests that crash rates decreased after jurisdictions with no learner's permit holding requirement implemented a 6-month requirement (Mayhew, 2003). Baker, Chen, and Li (2006) found that the combination of a learner's permit holding period of at least three months and a supervised driving requirement of 30 or more hours reduced fatal crash involvements by 18%.

Costs: Once GDL is in place, requirements for the learner's permit can be implemented at very little cost.

Time to implement: GDL requirement changes typically require about 6 months to notify the public and implement the changes.

1.3 GDL Intermediate License Nighttime Restrictions

Effectiveness: ★ ★ ★ ★ ★	Use: High	Cost: Low	Time: Medium
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Driving at night increases the fatal crash risk per mile of travel for all drivers, and especially for teenage drivers (Hedlund et al., 2003; Williams, 2003). At night, driving is more difficult, driver drowsiness is more common, and alcohol is more likely to be used. Many intermediate license drivers have limited experience driving at night. For all of these reasons, a night driving restriction helps reduce risk for intermediate level drivers.

The restricted hours vary widely, from 6 p.m. to 6 a.m. in the most restrictive State, to 1 a.m. to 5 a.m. in the least restrictive (GHSA, 2010a; IIHS, 2010a). The most common hours are 11 p.m. or midnight to 5 or 6 a.m. NHTSA and IIHS recommend a 9 or 10 p.m. starting time (Compton & Ellison-Potter, 2008; IIHS, 2009); however, as of July 2010, only 11 States start their restrictions as early as 10 p.m., and five States start as early as 9 pm. A starting time earlier than midnight will prevent more crashes, especially since teenage driver crashes occur more frequently before midnight than after (Foss & Goodwin, 2003; Williams, 2003). NHTSA's recent Motor Vehicle Occupant Safety Survey found that 73% of the general public believe teenagers should not be allowed to drive unsupervised after 9 p.m. (Block & Walker, 2008).

Use: As of July 2010, 48 States and the District of Columbia restricted intermediate license drivers from driving during specified nighttime hours. (The exceptions are North Dakota and Vermont.) Many States allowed driving during the restricted hours for work or school-related activities (GHSA, 2010a; IIHS, 2010a).

Effectiveness: The effectiveness of nighttime driving restrictions in reducing both nighttime driving and nighttime crashes has been demonstrated conclusively (Hedlund et al., 2003; Hedlund & Compton, 2004, 2005; Lin & Fearn, 2003; Williams, 2007). The earlier a night restriction begins, the greater the reduction in crashes. For example, night restrictions that begin at 9 p.m. are associated with an 18% reduction in fatal crashes compared to no restriction. The reduction is only 9% when the night restriction begins at 1 a.m. (McCartt et al., 2010).

Costs: Once GDL is in place, a nighttime driving restriction can be implemented or modified at very little cost.

Time to implement: GDL requirement changes typically require about 6 months to notify the public and implement the changes.

1.4 GDL Intermediate License Passenger Restrictions

Effectiveness: ★ ★ ★ ★ ★	Use: High	Cost: Low	Time: Medium
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Passengers substantially increase the crash risk for teenage drivers, especially the youngest drivers. Each additional passenger produces an additional increase in crash risk. In contrast, passengers decrease crash risk for drivers 30 to 59 years old (Williams, 2003; Williams, Ferguson, & McCartt, 2007). Crash risks are highest when young male drivers carry same age passengers, especially if those passengers are also male (Ouimet et al., 2010).

To reduce this risk, most States include a passenger restriction in their GDL requirements for intermediate licensees. NHTSA and IIHS recommend a restriction of not more than one teenage passenger (Comptom & Ellison-Potter, 2008; IIHS, 2010a). According to NHTSA's Motor Vehicle Occupant Safety Survey, 86% of the general public believe that teenagers should have a restriction on the number of teenage passengers they can carry (Block & Walker, 2008).

Use: As of July 2010, 43 States and the District of Columbia restricted in some way the number of passengers who can be carried by an intermediate license driver (GHSA, 2010a; IIHS, 2010a). The most common passenger restrictions limit teenage drivers to zero or just one passenger. Some restrictions apply to all passengers and some only to passengers younger than a specified age. A few States allow exceptions for transporting family or household members.

Effectiveness: There is growing evidence that passenger restrictions are effective in reducing young driver crashes, though the restrictions sometimes are violated (Goodwin & Foss, 2004; Williams, 2007). California allows no passengers younger than 20 for teenagers who hold an intermediate license. Four recent studies demonstrate the positive effects of this restriction. For example, one study showed a 38% decrease in 16-year-old driver crashes in California in which a teen passenger was killed or injured (Williams, 2007). A NHTSA study evaluated passenger restrictions in three States: California, Massachusetts, and Virginia. Results showed that 16-year-old-driver crashes were reduced in all three States, as were motor vehicle related injuries among 15- to 17-year-olds (Chaudhary, Williams, & Nissen, 2007). In North Carolina, a teen passenger restriction was enacted independent of any other changes to the State's GDL system. Subsequent to this restriction, 16-year-old crashes involving multiple passengers decreased by 32% (Foss, 2009).

Costs: Once GDL is in place, a passenger restriction can be implemented at very little cost.

Time to implement: GDL requirement changes typically require about 6 months to notify the public and implement the changes.

1.5 GDL Cell Phone Restrictions

Effectiveness: ★ ★	Use: Medium	Cost: Low	Time: Medium
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Cell phones may distract drivers, as discussed in Chapter 4, Section 1.2. Cell phones are more commonly used by young drivers than adult drivers (NHTSA, 2010b), and they may pose greater risks for young drivers for the reasons outlined in the Overview (see also Ferguson, 2003). To reduce this risk, a growing number of States include cell phone restrictions in their GDL laws. NHTSA recommends that teens not be permitted to use portable electronic communication and entertainment devices while driving (Compton & Ellison-Potter, 2008). See Chapter 4, Section 1.2 for a discussion of cell phone laws applying to all drivers.

Use: As of July 2010, 28 States and the District of Columbia prohibit cell phone use for young drivers. These bans cover *all* cell phone use, not just hand-held phones. In some States the cell phone restrictions cover teenagers holding a learner's permit and intermediate license; in other States the restrictions cover all drivers under a certain age, such as 18 or 19 (GHSA, 2010b; IIHS 2010b). California, Connecticut, Delaware, Maryland, New Jersey, New York, Oregon, Washington, and the District of Columbia prohibit hand-held cell phone use for all drivers. In addition, 30 States and the District of Columbia prohibit text messaging for all drivers (see Chapter 4, Section 1.2).

Effectiveness: One recent study examined the short-term effects of a teenage driver cell phone restriction (Foss, Goodwin, McCart, & Hellinga, 2009). In North Carolina, teenage driver cell phone use was observed one month before and five months after a ban on cell phones took effect. The proportion of teens using cell phones while driving was unchanged following the law. Telephone interviews with parents and teens found that support for the restriction was high among both parents (95%) and teens (74%), but awareness for the restriction was only moderate. There was also very little perceived (and actual) enforcement of the law. Hence, it appears that publicity and enforcement are key to obtaining compliance with teen driver cell phone restrictions (Foss et al., 2009).

Costs: Once GDL is in place, a cell phone restriction can be implemented at very little cost.

Time to implement: GDL requirement changes typically require about 6 months to notify the public and implement the changes.

1.6 GDL Belt Use Requirements

Effectiveness: ★ ★	Use: Low	Cost: Low	Time: Medium
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Properly worn seat belts can dramatically reduce the risk of injury or death to vehicle occupants in the event of a crash (NHTSA, 1999). Seat belts are particularly important for teenage drivers because of their elevated crash risk. Nonetheless, teenage drivers and passengers have lower seat belt use rates than older drivers and passengers (Ferguson, 2003). Belt use is particularly low among teenagers who are male, drive pickup trucks, and live in rural areas (Kim, Depue, Spence, & Reine, 2009).

Young drivers are covered by seat belt laws in all States (with the exception of New Hampshire, which only requires seat belts for people under age 18) (Williams, 2007). Three States have primary enforcement belt use laws for passengers under 18 or 19 but secondary enforcement for older passengers (IIHS, 2010c; see also Chapter 2, Sections 1.1 and 1.4). Some States explicitly require belt use under their GDL laws. NHTSA recommends that States require all GDL license holders and their passengers to be belted (Compton & Ellison-Potter, 2008). An explicit belt use requirement in a State's GDL law may have more influence on beginning drivers than the State's overall belt use law, especially in States with primary enforcement for young drivers and in States where seat belt violations result in delayed graduation to the next GDL stage.

Use: In 2005, GDL laws in 15 States explicitly required belt use (AAA, 2005). Sanctions for violating this requirement varied across the States.

Effectiveness: To date, there has been only one evaluation of the effects of explicit belt use requirements in GDL laws. Tennessee and Wisconsin both have a seat belt restriction within their States' GDL program. Evaluations of the restrictions in these two States found little, if any, effect on teen driver belt use (Freedman & Levi, 2008). One problem is that teens (and parents) may not be aware when seat belt laws are part of a State's GDL system. For example, surveys in North Carolina have shown very high awareness for the State's nighttime and passenger restrictions, but only 3% of teens and 5% of parents were aware of the special GDL provision concerning seat belts (Goodwin & Foss, 2004).

Costs: Once GDL is in place, a belt use requirement can be implemented at very little cost.

Time to implement: GDL requirement changes typically require about 6 months to notify the public and implement the changes.

1.7 GDL Intermediate License Violation Penalties

Effectiveness: ★	Use: High	Cost: Low	Time: Medium
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Probationary licensing preceded graduated licensing. Probationary licensing had no intermediate phase, so that beginning drivers received a full and unrestricted license after their learner's permit. However, the initial full licensure period was probationary in that the license could be revoked or suspended, or some driver improvement actions could be required, at a lower threshold than for drivers with a standard non-probationary license (Simpson, 2003).

The probationary feature has been included in the intermediate phase of graduated licensing, typically by delaying full licensure until the intermediate licensee has demonstrated a good driving record. For example, NHTSA recommends that States require intermediate license holders to remain crash and conviction free for at least 6 consecutive months before full licensure (Compton & Ellison-Potter, 2008).

Use: Almost all States penalize some GDL or traffic law violations by delaying full licensure (IIHS & TIRF, 2004).

Effectiveness: The few evaluations of early stand-alone probationary license systems generally found no substantial benefits (McKnight & Peck, 2003; Simpson, 2003). No recent evaluations have attempted to separate out the effect of penalties for GDL or other traffic law violations from the overall effects of GDL.

An enforcement/education program dubbed "*Ticket Today = License Delay*" (the equals sign is not pronounced) highlighted the resulting delay in licensure for teenagers who are convicted of a moving violation, seat belt violation or GDL violation. Although teens and their parents clearly perceived the increased enforcement, the program had only minimal effects on seat belt use and compliance with GDL restrictions (Goodwin, Wells, Foss, & Williams, 2006). In general, it appears that awareness of penalties for license violations among parents and teens is relatively low, enforcement is rare, and licensing delays are not always applied even when violations are enforced (Goodwin & Foss, 2004; Steenbergen et al., 2001; Williams, 2007).

Costs: Once GDL is in place, penalties for violating its provisions can be changed at very little cost.

Time to implement: GDL requirement changes typically require about 6 months to notify the public and implement the changes.

2. Driver Education

2.1 Pre-Licensure Driver Education

Effectiveness: ★	Use: Medium	Cost: High	Time: Long
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Driver education has long been advocated and used to teach both driving skills and safe driving practices. Driver education in high schools grew in popularity in the 1950s, using a standard curriculum of at least 30 hours classroom instruction and 6 hours on-the-road driving practice. By about 1970, approximately 14,000 high schools taught driver education to about 70% of all eligible teenagers. Many States and insurance companies encouraged driver education: States licensed graduates at an earlier age and insurance companies reduced auto insurance premiums for graduates. During the 1980s driver education offerings decreased as State and Federal funding for driver education decreased. By the early 1990s fewer than half of all high schools offered driver education and the majority of beginning drivers did not take driver education. See Smith (1994), Mayhew (2007) or Williams, Preusser and Ledingham (2009) for a concise review of the history of driver education in the United States.

The evaluations to date find that driver education does not decrease crash rates. Roberts et al. (2006) concluded from three well-designed evaluations in Australia, New Zealand, and the United States that driver education may lower the age at which teenagers become licensed but does not affect their crash rates once they do become licensed. The net effect of driver education may increase crashes because it puts more young drivers on the road. Vernick et al. (1999) reached the same conclusion from a review of nine studies, eight from the United States and one from Australia. It has been suggested that crash outcomes are not appropriate or fair measures for driver education, and are unrealistic to expect (Waller, 2003).

The study most familiar in the United States is the extensive NHTSA-sponsored study in DeKalb County, Georgia, in the late 1970s. Over 16,000 students were randomly assigned to three groups: standard driver education; an 80-hour long course including classroom, simulation, driving range, and on-the-road components; and a control group of no formal driver education. The initial analysis found no significant difference in crashes or traffic violations among the three groups (Smith, 1994). A second analysis, which tracked the students' driving records for a longer period of time, found a slight crash reduction for standard course graduates during their first months of driving only, and no difference between the long course and no course graduates (Smith, 1994). See Vernick (1999) or Williams et al. (2009) for brief summaries of all DeKalb study analyses.

Based primarily on these results, NHTSA dropped driver education from its list of priority highway safety program areas for States (Smith, 1994). NHTSA concluded that driver education should be integrated into a GDL program (Compton & Ellison-Potter, 2008). It also concluded that driver education should be “distributed over time.” NHTSA proposed a two-stage driver education system, both pre-licensure and post-licensure. (See Chapter 6, Section 2.2 for further discussion.) In addition, NHTSA and the driver education community has developed national administrative standards to enhance driver education delivery in the States (NHTSA, 2010c). A NHTSA State assessment program will begin in 2011 to assist States in meeting those standards.

As of July 2010, 11 States encouraged driver education by lowering the minimum learners, intermediate, or unrestricted licensing age for driver education graduates, or by reducing the required number of supervised driving hours (IIHS, 2010a). Research shows that driver education “discounts” increase, rather than reduce, crashes (Mayhew, 2007). For example, a study in British Columbia found that crash rates were 27% higher for driver education graduates who reduced their learner’s permit holding period by three months, than for non-graduates (Wiggins, 2004).

Use: The American Driver and Traffic Safety Education Association (ADTSEA) completed an investigation of driver education requirements in the United States (ADTSEA, 2008). Presently, 33 States and the District of Columbia require some form of driver education before licensure. Most commonly this includes 30 hours of classroom instruction and 6 hours of behind-the-wheel practice, although requirements vary considerably across States. For example, some States require novices to obtain a certain number of hours practice on a driving simulator. Other States require practice on certain types of roadways, such as highways (ADTSEA, 2008). No data are currently available on commercial driver education courses or students.

Effectiveness: Driver education leads to earlier licensure in some States and does not reduce crash rates (Mayhew, 2007; Roberts et al, 2006; Vernick et al., 1999; Williams et al., 2009). Nonetheless, there has been a growing interest in improving and evaluating driver education. Future directions for driver education were summarized in a research circular by the Transportation Research Board (TRB, 2006). In addition, the AAA Foundation for Traffic Safety has produced a series of publications that provide practical information on how to conduct evaluations of driver education (Clinton & Lonero, 2006), and NHTSA has conducted a feasibility study on evaluating driver education curriculum (Williams et al., 2009).

Costs: Even a minimal driver education course of 30 hours in the classroom and 6 hours on the road requires extensive funds. Driver education also requires students to find time for it in their schedules of high school classes, extracurricular and summer activities, and jobs.

Time to implement: A driver education course requires at least a year to plan and implement.

Other issues:

- **Parent involvement:** There has been a growing interest in integrating parents into driver education. For example, Virginia passed legislation in 2009 requiring a minimum of 90 minutes of parent participation in the in-classroom portion of driver education. Similarly, Connecticut requires a parent to attend a two-hour driver education orientation course while the teen gets a learner’s permit. Although parents appear to support these requirements (Chaudhary & Williams, 2010; Hartos & Huff, 2008), research has not yet determined the most effective way to involve parents. One recent study delivered the *Checkpoints* program in driver education classes (Zakrajsek, Shope, Ouimet, Wang, & Simons-Morton, 2009). Relative to a comparison group, parents who participated in the *Checkpoints* program showed greater awareness of teen driving risks, and they were more likely to complete a parent-teen driving agreement. However, participation in the

program was voluntary and, despite diligent recruitment efforts, parent attendance was low. For more information about the *Checkpoints* program, see Chapter 6, Section 3.1.

2.2 Post-Licensure or Second-Tier Driver Education

Effectiveness: ★	Use: Low	Cost: High	Time: Long
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As discussed in Chapter 6, Section 2.1, standard pre-licensure driver education leads to earlier licensure but does not reduce crash rates. Based on this conclusion, driver education research has sought to develop post-licensure driver education curricula and to integrate driver education with GDL (Smith, 1994). These “second-tier” post-licensure courses teach safety-related information, building on the on-road experience that the students have acquired in their initial months of driving. They should not be confused with “advanced driving performance” courses that teach driving skills such as panic braking, skid control, and evasive lane-changing maneuvers.

Previous post-licensure driver education courses were remedial, directed at drivers who had accumulated enough violations or crashes to warrant some attention. For this audience, driver education had no effect (Ker et al., 2005, 2006).

Initiatives in Australia and Europe may provide insight on potential approaches for post-license training for beginning drivers (Senserrick, 2007; Twisk & Stacey, 2007). Christie and colleagues have developed a model “best practice” curriculum for intermediate license drivers with at least 6 months of driving experience in Australia (Christie, Harrison, & Johnston, 2004). The 8-hour curriculum consists of eight modular sessions with a mentor or coach, including one-on-one driving and discussion, group observation and discussion of driving behavior, and telephone follow-up. A trial involving 14,000 intermediate drivers in New South Wales and Victoria, funded by a consortium of government bodies, insurers, industry groups, and automobile clubs, began in 2005.

NHTSA has completed a feasibility study in anticipation of a major evaluation of the benefits of an integrated driver education and GDL program (Hedlund & Compton, 2005).

Use: Post-licensure driver education is still under development. Michigan is the only State that has adopted a two-stage system of driver education (Mayhew, 2007).

Effectiveness: Post-licensure driver education has not yet been evaluated.

Costs: If a post-licensure driver education program proves to be effective, it likely will require substantial funds to implement.

Time to implement: Any course requires at least a year to plan and implement.

3. Parents

3.1 Parental Role in Teaching and Managing Young Drivers

Effectiveness: ★ ★	Use: Medium	Cost: Low	Time: Short
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Most parents are heavily involved in teaching driving skills to their beginning teenage drivers and supervising their driving while they have a learner's permit. Parents are in the best position to enforce GDL restrictions for intermediate drivers, and many parents impose additional driving restrictions on their teenagers. Parents strongly support GDL; however, many parents do not understand the dangers of high-risk situations, such as driving with teenage passengers. Parents could use guidance and assistance in teaching and managing their teenage drivers (Hedlund et al., 2003; NCHRP, 2007, Strategies C1-C3). For summaries of the research on parent involvement in teen driving, see Simons-Morton and Ouimet (2006), or Simons-Morton, Ouimet, and Catalano (2008).

Many programs to assist parents and beginning drivers have been developed. Five examples follow. Only two, *Checkpoints* and *The Novice Driver's Road Map*, have been evaluated.

The central feature of the *Checkpoints* program, developed by Simons-Morton and colleagues at the National Institute of Child Health and Human Development, is a written agreement that parents and teens sign. The agreement limits teens' driving under various higher-risk situations, such as driving at night, with other teens in the car, or in bad weather. A supporting video and periodic newsletters explain the risks that new drivers face and reinforce the need for parents to limit their newly licensed teens' driving under these risky conditions (Simons-Morton & Hartos, 2003).

Driving Skills for Life, developed by Ford and GHSA, emphasizes four skills: hazard recognition, vehicle handling, space management, and speed management (Ford & GHSA, 2003). The program's educational kit includes a video, guide, and brochure, and the Web site contains online learning material, parental tips and a coaching guide. It has been sent to every public high school in the United States and has reached an estimated 4 million teenagers and their parents.

Road Ready Teens, developed by DaimlerChrysler together with AAA, MADD, and the National Safety Council, provides a parent's guide, a parent-teen contract, and a video game and Road Ready Reality Check quiz for teens (DaimlerChrysler, 2003).

The National Safety Council, with input from young driver experts, developed a 68-page book, *Teen Driver: A Family Guide to Teen Driver Safety* (NSC, 2004). The book provides information and advice to parents and teens on crash risks, how to develop a family plan and written agreement for beginning drivers, and GDL components and restrictions.

Finally, *The Novice Driver's Road Map*, produced by the Network of Employers for Traffic Safety, describes eight driving situations of increasing difficulty, from driving in an empty parking lot to driving at night and in inclement weather. Parents complete a checklist when

practice has been obtained in each driving situation. *The Road Map* also includes a brief insert, called *The Coach's Gamebook*, with advice for parents of beginning drivers and a parent-teen driving contract.

Use: *Checkpoints* is still being tested and has not been released to the general public. *Teen Driver* and *The Road Map* can be provided to individual families upon request. *Driving Skills for Life* and *Road Ready Teens* are available on the Web.

Effectiveness: Results from testing in several States show the *Checkpoints* program produces modest increases in parents' restrictions on teen driving (Simons-Morton & Hartos, 2003; Simons-Morton, Hartos, Leaf, & Preusser, 2005). However, a study in Connecticut found no differences in violations or crashes for families who participated in the *Checkpoints* program when compared with families who did not participate in the program (Simons-Morton, Hartos, Leaf, & Preusser, 2006).

Two separate evaluations of *The Road Map* found the material had little effect on parents. In each study, *The Road Map* was provided to parents of teens who had just received their learner's permits. Although parents said that the information was helpful, they used the guidance material in only a general way. The information had no effect on the amount or type of supervised driving during the learner's stage or on parental restrictions on driving after licensure (Chaudhary, Ferguson, & Herbel, 2004; Goodwin, Waller, Foss, & Margolis, 2006).

Although evaluations of programs to assist parents have not yet shown reductions in young driver crashes, there is still reason to be optimistic. Programs such as *Checkpoints* have increased parent limit setting, and several studies show that teenagers whose parents impose more strict driving limits report fewer risky driving behaviors, traffic violations and crashes (see Simons-Morton, 2007, for a review). Educational programs alone are unlikely to produce changes in behavior. However, education in combination with other strategies may deliver stronger results.

Costs: *Driving Skills for Life* and *Road Ready Teens* are available on the Web at no cost. *Teen Driver* and *The Road Map* are available to parents and teenagers at minimal cost.

Time to implement: The *Checkpoints* program has not been released for use by the general public. The other four programs are available immediately.

Other issues:

- **Electronic monitoring:** Various technologies have been developed to aid parents in monitoring their teenage drivers. For example, many GPS companies offer "teen tracking" services that will notify parents if their teens go beyond boundaries, or are speeding at any given time. Video-based devices, such as DriveCam, can provide visual monitoring of teen drivers. When these technologies are combined with weekly report cards to parents, they can reduce the incidence of risky driving behaviors among teens (Farmer, Kirley, & McCartt, 2010; McGehee et al., 2007; Musicant & Lampel, 2010). However, more research is needed to determine the impact of electronic monitoring on crashes and fatalities among young drivers.

4. Traffic Law Enforcement

4.1 Enforcement of GDL and Zero-Tolerance Laws

Effectiveness: ★ ★ ★	Use: Unknown	Cost: Medium	Time: Short
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Two traffic laws apply only to young drivers: GDL laws and zero-tolerance laws that set a maximum BAC of .02 or less for drivers under the age of 21. As discussed in Chapter 1, Section 6.2, zero-tolerance laws are not actively publicized or enforced. It's likely that increased publicity and enforcement would reduce teenage drinking and driving.

GDL laws, discussed in Chapter 6, Sections 1.1-1.7, also appear not to be enforced vigorously. Some GDL provisions such as nighttime driving restrictions are inherently difficult to enforce because violations are difficult to detect (Hedlund et al, 2003). A study in one State found that intermediate license drivers and their parents were quite aware of their GDL law's nighttime and passenger restrictions. Both restrictions were violated, though not frequently. Teenagers expressed little concern regarding GDL enforcement. Although surveys of law enforcement officers found that most were supportive of GDL, officers were not familiar with GDL details and considered GDL enforcement a low priority (Goodwin & Foss, 2004). Another recently completed study found that teen drivers reported frequently violating passenger restrictions, with and/or without their parents' knowledge/permission, because local police did not routinely enforce GDL restrictions (Chaudhary et al., 2007).

Parents are in the best position to enforce GDL requirements (Chapter 6, Section 3.1). However, some law enforcement support for GDL nighttime driving and teenage passenger restrictions may be useful to emphasize that the requirements are important. GDL law violations are penalized by driver license actions, such as suspension or revocation of the learner's permit or intermediate license or an extension of the time before full licensure. This means they can be applied administratively and do not involve criminal court proceedings. As noted in Chapter 1, Section 6.2, administrative penalties for zero-tolerance laws are far easier to enforce than criminal penalties. Another issue with enforcement concerns the difficulties in identifying drivers that qualify as falling under the GDL system in a given State. It has been suggested, and is one of NHTSA's GDL recommendations, that young drivers should be required to affix a vehicle decal identifying them as qualifying for the GDL program to make them more readily identifiable. New Jersey is the first State to implement this potential countermeasure, and efforts will soon be underway to evaluate its effects.

Use: The amount of enforcement of zero-tolerance and GDL laws is unknown but probably is low.

Effectiveness: Zero-tolerance law publicity and enforcement likely will reduce teenage drinking and driving, as discussed in Chapter 1, Section 6.2. Similarly, high-visibility enforcement of GDL provisions should encourage compliance with nighttime and passenger restrictions. One study investigated whether well-publicized enforcement, including checkpoints near high schools, could increase compliance with seat belt laws and GDL provisions. The study found only modest increases in seat belt use and compliance with the GDL passenger restriction,

although levels of compliance prior to the enforcement efforts were already high (Goodwin, Wells, Foss, & Williams, 2006).

Costs: See Chapter 1, Section 6.2, for zero-tolerance law enforcement strategies and costs. GDL law enforcement costs will depend on how the enforcement is conducted. Enforcement through regular patrols will require moderate costs for training. Special patrols or checkpoints will require additional staff time. All enforcement will require good publicity to both teens and parents. Publicity to teens can be delivered through high schools, colleges, recreational venues attended by youth, and media directed to youth.

Time to implement: Enforcement programs can be implemented within three or four months, as soon as appropriate training, publicity, and equipment are in place.

Other issues:

- **Compliance with restrictions:** Several studies have shown that teenagers do not always comply with GDL restrictions (Goodwin & Foss, 2004; Williams, Nelson & Leaf, 2002). To the extent that teens do not adhere to restrictions, the effectiveness of GDL may be reduced. It should be noted, however, that GDL has been shown to be effective even in the absence of police enforcement. For example, focus groups with parents and teen drivers conducted in California, Massachusetts, and Virginia revealed that passenger restrictions were frequently violated in all three States, but even incomplete adherence to the restrictions had a positive impact on teen driver crashes (Chaudhary et al., 2007). In general, compliance with restrictions will be higher in States that have well-designed GDL systems with restrictions that are considered reasonable by parents and teens (Foss & Goodwin, 2003).

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7. Older Drivers

Overview

In 2008, more than 15% of licensed drivers in the United States were 65 or older. By 2030 this proportion will rise to at least 20%. As drivers age, their physical and mental abilities, driving behaviors, and crash risks all change, though age itself does not determine driving performance. Many features of the current system of roads, traffic signals and controls, laws, licensing practices, and vehicles were not designed to accommodate older drivers. Older Americans are increasingly dependent on driving to maintain their mobility, independence, and health. The challenge is to balance mobility for older drivers with safety for all road users.

Trends. From 1982 to 2008, the proportion of licensed drivers 65 and older rose from 11.2% to 15.5% while the proportion of these older drivers in fatal crashes rose slightly more rapidly, from 7.0% to 11.1%.

People 65 and older; number and proportion of total populations

65 & up year	resident population		licensed drivers		drivers in fatal crashes	
	million	%	million	%		%
1982	26.8	11.6%	16.8	11.2%	3,894	7.0%
2008	38.8	12.7%	32.2	15.5%	5,599	11.1%
2030	72*	19.3%*	57- 61**	> 20%**	?	?

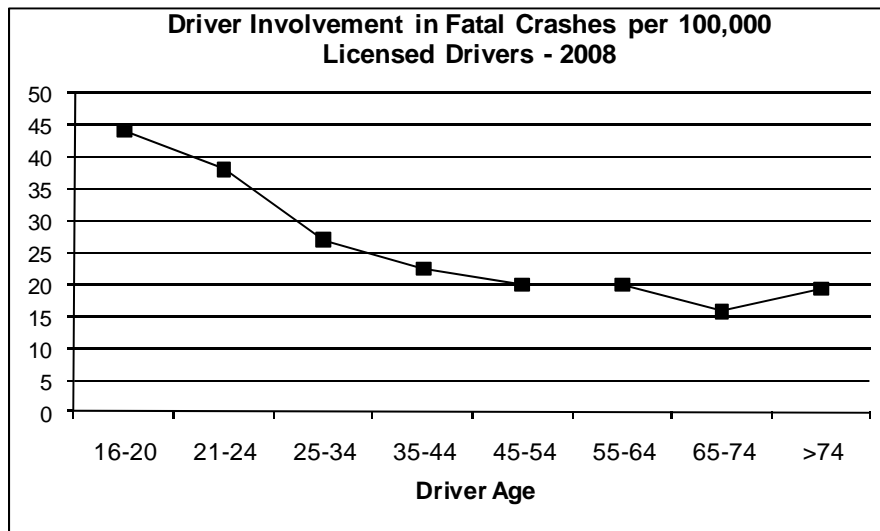
Resident population: U.S. Census Bureau (2008a, 2008b) * estimated
 Licensed drivers: FHWA Highway Statistics (1995, 2010) ** see discussion
 Fatal crashes: NHTSA Traffic Safety Facts (2009a)

By 2030, the Census Bureau estimates that the resident population over age 65 will double, to over 72 million, and will comprise 19.3% of the total population. The licensed driver population likely will grow even faster. The proportion of people age 65 or older who held a driver’s license rose from 63% in 1982 to 83% in 2008. If the licensure rate remains the same, by 2030 there will be nearly twice as many older drivers in the United States as there are today. As of 2008, 94% of people 65 to 69 are licensed, as are 89% of people 70 to 74, 84% of people 75 to 79, 77% of people 80 to 84, and 56% of people 85 and older (FHWA, 2010). The licensure rate probably will increase because tomorrow’s older people likely will be healthier and more accustomed to driving than today’s. By 2030, if 85% of older people are licensed there will be close to 61 million licensed drivers at least 65 years old.

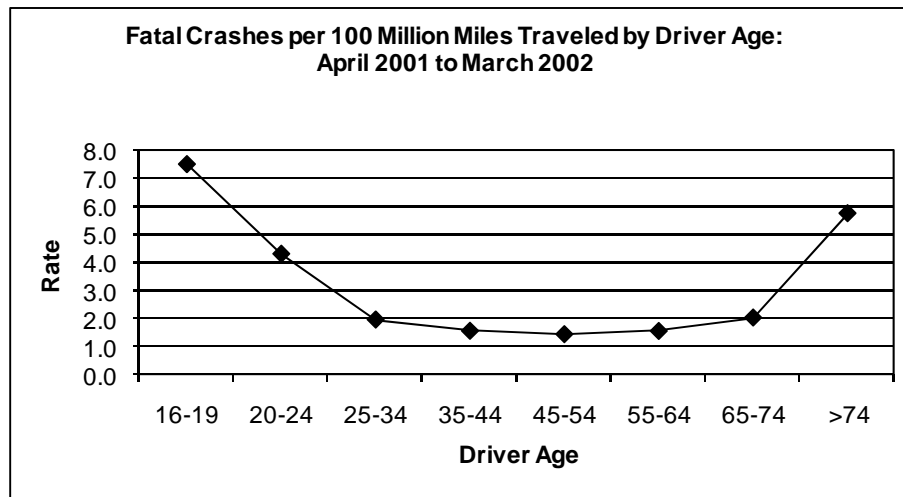
Older driver characteristics. Certain changes are inevitable as drivers age (Potts et. al, 2004; National Cooperative Highway Research Program [NCHRP], 2004, Section III).

- Physical capabilities diminish. Hearing, muscle tone, reaction time, and vision (especially at night) all decline, though at very different rates for different people.
- Fragility increases. The same force produces more serious injuries to a 70-year-old than to a 20-year-old. Injuries take longer to heal.

- Cognitive capabilities can diminish. Driving is a complex activity that requires a variety of high-level cognitive skills that can diminish through changes that occur with normal aging and/or as a result of dementia.
- Many older drivers use medications. These may be necessary to control disease or health conditions but also may cause drowsiness or otherwise affect driving. Older drivers are less likely than younger people to drive after drinking or using recreational drugs.
- Older drivers rarely drive aggressively or speed. However, they may exhibit other risky behaviors such as driving more slowly than prevailing traffic or failing to detect or accurately judge the speed of an oncoming vehicle while making a left turn.
- Most older drivers reduce their driving mileage as their lifestyles change. Many older drivers recognize and avoid driving in situations in which they feel uncomfortable, such as at night, on high-speed roads, or in unfamiliar situations (Staplin & Lococo, 2003).



Source: Traffic Safety Facts 2008 (NHTSA, 2009, Table 64)



Source: Insurance Institute for Highway Safety [IIHS] (2008)

These characteristics produce the following results.

- The older driver crash rate per licensed driver is *lower* than for younger drivers.
- However, the fatal crash rate for older drivers *per mile traveled* is *higher* than for all but the youngest drivers (IIHS, 2008). This is due to changes in driving habits and increased susceptibility to injury among older drivers:
 - Older drivers drive fewer miles annually than younger drivers but tend to drive more on local roads where there are more potential hazards, such as traffic congestion and confusing intersections (Wang, Kosonski, Schwartzberg, & Shanklin, 2003).
 - Because older drivers are more fragile, a crash is more likely to produce a serious injury or fatality than for younger drivers. Fragility, as measured by deaths per driver involved in a crash, begins to increase at ages 60 to 64 and increases steadily with advancing age. Fragility, rather than an increased tendency to get into crashes, accounts for about 60% to 95% (depending on age group and gender) of the increased death rates per miles traveled in older drivers (Li, Braver, & Chen, 2003).
 - More recent research has concluded that the fatal crash risk for drivers 70 and older declined during the 1997-2008 time period at a rate faster than that for the comparison group of 35- to 54-year-old drivers. The authors suggest that this reduction in fatality risk for the older drivers is due to their decreased likelihood of being involved in crashes combined with an increase in their chances of survival when they are involved in crashes (Cheung & McCartt, 2010).

Strategies to Reduce Crashes and Injuries Involving Older Drivers

The overall goal is to enable older drivers to retain as much mobility through driving as is consistent with safety on the road for themselves, their passengers, and other road users. “Safe mobility for life” is the phrase used in the U.S. Department of Transportation’s plan (U.S. DOT, 2003). Four behavioral strategies address this goal.

- Educate and train older drivers to assess their driving capabilities and limitations, improve their skills when possible, and voluntarily limit their driving to circumstances in which they can drive safely. This can be accomplished through formal courses or through communications and outreach provided directly to older drivers or to families, friends, and organizations that deal regularly with older drivers.
- Help drivers adapt to medical or functional conditions that may affect driving, through treatment (such as eyeglasses or cataract surgery to improve vision) or through vehicle adaptations (such as extra mirrors, extended gear shift levers, or hand controls).
- Identify older drivers who cannot drive safely, in certain situations or at all, and restrict or revoke their driver’s licenses. This involves two steps:
 - Bring these drivers to the attention of the motor vehicle department through license renewal procedures or through referral from law enforcement, physicians, family, or friends.
 - At the motor vehicle department, assess their driving abilities and take appropriate action to re-issue an unrestricted license, issue a restricted license, or revoke the license.

- Increase seat belt use, because seat belts are even more effective for older than for younger occupants.

Vehicular, environmental, and societal strategies are critical to provide safety and mobility for older people. Vehicles can be designed with better crash protection for older and more easily injured occupants, with controls and displays that are easier to see, reach and understand, and with crash warning and crash avoidance technology. These measures will make vehicles safer for everyone, not just older people. Aftermarket vehicle devices such as one-hand joystick driving controls can make driving possible or easier for people with some physical limitations. Roadways with separate left turn lanes, protected left turn signal phases, larger and more-visible signage, more-visible lane markings, rumble strips, and a host of other measures will assist all drivers. These subjects are not discussed in this guide because they do not fall under direct SHSO jurisdiction.

Of all the subject areas in this guide, those related to older drivers are perhaps the most complex because they involve so many issues beyond traffic safety. Sooner or later, in the interest of safety, most older drivers must restrict or eliminate driving, either by choice or by “force.” Frequently, this has substantial effects on the older driver’s mobility and on physical and mental health. State Highway Safety Offices and licensing agencies cannot act alone but must plan and implement their older driver policies and programs as part of integrated community activities to improve older people’s safety, mobility, and health. As just one example, some communities have established referral centers where people can go for “one-stop” access to resources for addressing the full range of transportation safety and mobility issues, including driving skills assessment, educational courses, licensing regulations and practices, and public transportation. See Stutts (2005) for summaries of comprehensive programs for older drivers in 6 States.

Several studies and policy papers discuss these issues. See in particular the Department of Transportation’s *Safe Mobility for a Maturing Society: Challenges and Opportunities* (U.S. DOT, 2003) and NCHRP’s *Guide for Addressing Collisions Involving Older Drivers* (NCHRP, 2004) for excellent summaries and references to further information. The Organisation for Economic Co-Operation and Development’s *Ageing and Transport: Mobility Needs and Safety Issues* (OECD, 2001) presents a discussion from an international perspective. The NCHRP synthesis *Improving the Safety of Older Road Users* (Stutts, 2005) summarizes State activities as of 2005. A recent report issued by the AAA Foundation for Traffic Safety (Stutts & Wilkins, 2009) documents current United States policies and practices for improving the safety of older drivers and identifies model programs. These policies and practices and model programs are made available through the AAAFTS “Driver Licensing Policies and Practices” and “Noteworthy Initiatives” databases that can be searched by State or by policy/topic area.

Resources

The agencies and organizations listed below can provide more information on older drivers and links to numerous other resources.

- National Highway Traffic Safety Administration:
 - Senior Drivers - www.nhtsa.gov/Senior-Drivers

- Driver Safety Research Reports: Older Drivers –
www.nhtsa.gov/Driving+Safety/Research+&+Evaluation/Driver+Safety+Research+Reports:+New+Drivers+and+Older+Drivers
- Behavioral Safety Research Reports -
ntlsearch.bts.gov/repository/ntlc/nhtsa/index.shtm
- Insurance Institute for Highway Safety: Older People -
www.iihs.org/research/topics/older_people.html
- National Safety Council: Mature Drivers -
www.nsc.org/safety_road/DriverSafety/Pages/MatureDrivers.aspx
- Centers for Disease Control and Prevention, Injury Prevention & Control: Older Adult Drivers - www.cdc.gov/MotorVehicleSafety/Older_Adult_Drivers/adult-drivers_factsheet.html
- AAA:
 - Senior Drivers - www.aaapublicaffairs.com
 - AAASeniors - www.aaaseniors.com
- AAA Foundation for Traffic Safety:
 - www.aaafoundation.org
 - www.seniordrivers.org
- Governors Highway Safety Association: Mature Drivers -
www.ghsa.org/html/issues/olderdriver.html
- AARP: Driver Safety - www.aarp.org/home-garden/transportation/driver_safety/

Countermeasures That Work

Countermeasures to improve older driver safety are listed below and discussed individually in this chapter. The table is intended to give a rough estimate of each countermeasure's effectiveness, use, cost, and time required for implementation. The terms and symbols used are described below. Effectiveness, cost, and time to implement can vary substantially from State to State and community to community. Costs for many countermeasures are difficult to measure, so the summary terms are very approximate. See each countermeasure discussion for more information.

1. Communications and Outreach

Countermeasure	Effectiveness	Use	Cost	Time
1.1 Formal courses for older drivers	★ ★	Low	Low	Short
1.2 General communications and education	★ ★	Unknown	Low	Short

2. Licensing

Countermeasure	Effectiveness	Use	Cost	Time
2.1 License screening and testing	★ ★ ★ ★	High	Medium	Medium
2.2 Referring older drivers to DMVs	★ ★ ★ ★	Low	Medium	Medium
2.3 License restrictions	★ ★ ★	Unknown	Low	Short
2.4 Medical advisory boards	★ ★	High	Varies	Medium
2.5 License renewal policies	★ ★	Medium	High	Medium

3. Traffic Law Enforcement

Countermeasure	Effectiveness	Use	Cost	Time
3.1 Law enforcement roles	★ ★ ★	Medium	Varies	Varies

Effectiveness:

- ★ ★ ★ ★ ★ - Demonstrated to be effective by several high-quality evaluations with consistent results
- ★ ★ ★ ★ - Demonstrated to be effective in certain situations
- ★ ★ ★ - Likely to be effective based on balance of evidence from high-quality evaluations or other sources
- ★ ★ - Effectiveness still undetermined; different methods of implementing this countermeasure produce different results
- ★ - Limited or no high-quality evaluation evidence

Effectiveness is measured by reductions in crashes or injuries unless noted otherwise.

See individual countermeasure descriptions for information on effectiveness size and how effectiveness is measured.

Use:

High: more than two-thirds of the States, or a substantial majority of communities

Medium: between one-third and two-thirds of States or communities

Low: fewer than one-third of the States or communities

Unknown: data not available

Cost to implement:

High: requires extensive new facilities, staff, equipment, or publicity, or makes heavy demands on current resources

Medium: requires some additional staff time, equipment, facilities, and/or publicity

Low: can be implemented with current staff, perhaps with training; limited costs for equipment or facilities

These estimates do not include the costs of enacting legislation or establishing policies.

Time to implement:

Long: more than one year

Medium: more than three months but less than one year

Short: three months or less

These estimates do not include the time required to enact legislation or establish policies.

1. Communications and Outreach

1.1 Formal Courses for Older Drivers

Effectiveness: ★ ★	Use: Low	Cost: Low	Time: Short
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Formal courses specifically for older drivers are offered by organizations including AAA, AARP, and the National Safety Council, either independently or under accreditation by States (NCHRP, 2004, Strategy D2; Stutts, 2005, Table 12). AARP's Driver Safety Program, formerly called "55-Alive," is the oldest and largest. It has been conducted since 1979 and is offered both in the classroom and online (AARP, 2009). The courses typically involve 6 to 10 hours of classroom training in basic safe driving practices and in how to adjust driving to accommodate age-related cognitive and physical changes. As of 2010, 36 States and the District of Columbia mandated automobile insurance discounts for graduates of accredited courses (AARP, 2010).

Courses combining classroom and on-the-road instruction have been offered in a few locations (NCHRP, 2004, Strategy D2).

Use: Courses are taught in all States but reach only a small fraction of older drivers. For example, AARP reports that over 700,000 people each year complete the AARP Driver Safety Program nationwide, which represents approximately 1% of the eligible driving population age 50 and older (AARP, 2009).

Effectiveness: Graduates of both the AARP classroom and online courses report that they changed some driving behaviors as a result of the course (AARP, 2009; Skufca, 2008). However, none of the courses has been shown to reduce crashes (NCHRP, 2004, Strategy D2). NHTSA's Older Road User Research Plan includes the high-priority research problem statement, "Do assessment and retraining programs improve driving?" (Raymond, Knoblauch, & Nitzburg, 2001, Table 1). The most thorough evaluation studied approximately 200,000 course graduates and a 360,000-driver comparison group in California from 1988 to 1992. It found that course graduates had fewer citations but no fewer crashes than non-graduates (Janke, 1994; NCHRP, 2004, Strategy D2). AARP also concluded that its course reduces citations but has not been shown to reduce crashes (AARP, 2009).

A study conducted in 2004 evaluated the effects of a well-designed three-hour educational course promoting safe driving strategies for older drivers with some visual defects. Course graduates reported that they regulated their driving more following the course than a control group that did not attend the course. There was no significant difference in crash rates between course graduates and the control group (Owsley, McGwin, Phillips, McNeal, & Stalvey, 2004).

Another 2004 study involving a systematic review of studies evaluating the effectiveness of driver retraining programs (Kua, Korner-Bitensky, Desrosiers, Man-Song-Hing, & Marshall, 2007) reached a similar conclusion as did Owsley et al., (2004). These researchers reported that while there is moderate evidence that educational interventions improve driving awareness and behavior, these interventions do not reduce crashes in older drivers. Regardless, the authors felt

that the evidence regarding the effectiveness of retraining aimed at older drivers is encouraging enough warrant further research.

More recent evaluations of courses for older drivers have produced mixed results related to the crash rates of drivers attending these courses. Marottoli (2007) concluded that a training program that combined classroom education with on-road training improved the performance of older drivers on written and on-road tests and may allow these drivers to retain their licenses longer, but did not attempt to assess the program's impact on subsequent crash rates. Bedard et al. (2008) concluded that an in-class education program coupled with on-road education led to improvements in the participants' knowledge of safe driving practices and improvements on some aspects of safe driving performance, but that further research is required to determine if these changes will affect crash rates.

Nasvadi and Vavrik (2007) conducted research in British Columbia evaluating the crash risk of drivers after attending a safe driving class and found that, at least in some cases, these classes may produce a negative benefit - that these classes were associated with an increased number of crashes for men 75 years old and older. However, attendance in these classes had no effect on crashes of younger men and women of all ages. Though acknowledging several limitations of this study, the authors stress that "Recognizing and understanding characteristics and behaviors of older drivers who attend remedial driver education is essential to the design and delivery of successful driver safety programs."

Korner-Bitensky, Kua, von Zweck, and Van Benthem (2009) conducted a review of articles published between 2004 and 2008 on the effectiveness of older driver retraining programs for improving driving skills and reducing crash rates. Four studies met the inclusion criteria for the review and provided strong evidence that education combined with on-road training improves driving performance. They also found moderate evidence that education alone is not effective in reducing crashes and that physical retraining does improve driving performance. The value of physical training in addition to education is reinforced by the results of research by Romoser and Fisher (2009). They found that active training, such as practice with feedback, is a more effective strategy for increasing older drivers' likelihood of side-to-side scanning, looking for threats, during turns than is passive training (classroom lecture or video only) or no training.

Costs: Costs for making courses for older drivers available can be minimal since they have been developed and are offered by organizations such as AAA, AARP, and NSC. Courses typically charge a small fee, which may be offset by insurance discounts available to graduates.

Time to implement: Courses are offered regularly by AAA, AARP, NSC, and other organizations.

1.2 General Communications and Education

Effectiveness: ★ ★	Use: Unknown	Cost: Low	Time: Short
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Many organizations offer educational material for older drivers to inform them of driving risks, help them assess their driving knowledge and capabilities, suggest methods to adapt to and compensate for changing capabilities, and guide them in restricting their driving in more risky situations (NCHRP, 2004, Strategy D2).

Self-assessment tools include:

- AAA's *Roadwise Review*, a CD-ROM and instruction booklet;
- AARP's *Older Driver Skill Assessment and Resource Guide*;
- American Medical Association's *Am I a Safe Driver?* one-page checklist; and
- University of Michigan's *Driving Decisions Workbook*.

See Stutts (2005) for brief descriptions and Web links.

Other programs and material include:

- *Drive Well*, a joint program of American Society on Aging and NHTSA;
- *Getting Around*, from Emergency Nurses CARE, on safe driving decisions, pedestrian safety, and safe medication use; and
- Information from NHTSA and many State motor vehicle offices on general issues of older drivers or specific topics such as driving with glaucoma or arthritis.

See NCHRP (2004, Strategy D2) and Stutts (2005) for examples, brief descriptions, and Web links. See also AAFTS (2009b) for examples of public information and awareness material included in their "Noteworthy Initiatives" database.

Other material is available to assist drivers and family members in understanding how aging affects driving, the effects of medications and health conditions, how to assess an older driver's skills, how to use specialized vehicle equipment to adapt to certain physical limitations, how to guide older drivers into voluntarily restricting their driving, and how to report older drivers to the department of motor vehicles if necessary (Stutts, 2005). Examples include:

- NHTSA's series of fact sheets and more detailed information for older drivers and their families and friends, available from NHTSA's older driver program Web site: www.nhtsa.gov/Senior-Drivers
- AAA's *How to Help an Older Driver*;
- AARP's *At the Crossroads: A Guide to Alzheimer's Disease, Dementia and Driving*;
- The Association for Driver Rehabilitation Specialists' series of fact sheets on issues such as driving after a stroke, driving with rheumatoid arthritis, and driving after a limb amputation;
- New York State Office for the Aging's *When You Are Concerned: A handbook for families, friends and caregivers worried about the safety of an aging driver*.

Use: Data are not available on how frequently these programs or material are used.

Effectiveness: The limited information available suggests that some material may increase driver's knowledge. There are no evaluations of the effects of this material on driving or on crashes (NCHRP, 2004, Strategy D2). As discussed in Chapter 7, Section 1.1, none of the more structured formal courses has been shown to reduce crashes. NHTSA's Older Road User Research Plan includes the high-priority research problem statement, "Do assessment and retraining programs improve driving?" (Raymond et al., 2001).

Costs: Funds are required for producing and distributing material.

Time to implement: Material and programs are available and ready for use.

Other issues:

- **Seat belt use:** Seat belts are even more effective in preventing injuries and fatalities to older than to younger occupants (NCHRP, 2004, Strategy E1). While belt use among older occupants is comparable to that of younger occupants - 84% for occupants 70 and older and for occupants 25 to 69 in 2008 (NHTSA, 2009c) - the fact remains that nearly one in six older occupants is unbelted. Communications and outreach on the benefits of seat belt use may be more effective with older occupants than with younger because they may be more attentive to health and safety issues. For example, signs urging seat belt use increased belt use substantially in six senior communities compared to controls, and use remained higher after four years (Cox, Cox, & Cox, 2005). No other State or local seat belt use efforts directed at older occupants have been identified (NCHRP, 2004, Strategy E1).

2. Licensing

2.1 License Screening and Testing

Effectiveness: ★ ★ ★ ★ [†]	Use: High	Cost: Medium	Time: Medium
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[†] Proven for identifying drivers whose driving should be limited

State licensing agencies vary considerably in their procedures for screening and evaluating a driver's abilities and skills (NCHRP, 2004, Strategy C2). Many State guidelines are outdated, incomplete, or not based on actual functional impairment. Most do not include all the recommendations on medical conditions from the 1st and 2nd Editions of the *Physician's Guide to Assessing and Counseling Older Drivers* (Carr, Schwartzberg, Manning, & Sempek, 2010; Wang et al., 2003).

NHTSA and AAMVA have developed *Model Driver Screening and Evaluation Program Guidelines for Motor Vehicle Administrators* (Staplin & Lococo, 2003). This was the final stage in a research program that investigated the relationships between functional impairment and driving skills; methods to screen for functional impairment; and the cost, time, legal, ethical, and policy implications of the guidelines (Staplin, Lococo, Gish, & Decina, 2003a).

The *Model Driver Guidelines'* goal is to keep drivers on the road as long as they are safe, through early identification and assessment together with counseling, remediation, and license restriction when needed (Staplin & Lococo, 2003). The guidelines outline a complete process of driver referral, screening, assessment, counseling, and licensing action (Staplin & Lococo, 2003). They include nine simple visual inspection tests that licensing agency personnel can administer to screen for functional ability (Staplin & Lococo, 2003). A survey of State motor vehicle departments outlines some of the legal, policy, cost, and other criteria that must be met before the guidelines could be implemented in some States (Staplin and Lococo, 2003, Appendix C). The guidelines were tested in Maryland (Staplin, Lococo, Gish, & Decina, 2003b).

The screening and testing of older drivers was a major issue discussed during the 2008 North American License Policies Workshop sponsored by the AAA Foundation for Traffic Safety. One of the general themes of this workshop was that "while certain declines are generally associated with aging, consensus is lacking on whether or at what age individuals should be required to be screened or tested. Regardless, it is generally accepted that final licensing decisions should be based on functional performance, not age, as there is wide variation in how individuals age" (Molnar & Eby, 2008, p.3).

Use: All States screen and test drivers referred to them, though their procedures and criteria vary considerably (NCHRP, 2004, Strategy C2). No State appears to have implemented the model guidelines. U.S. DOT recommends that further testing and evaluation of the guidelines are needed (U.S. DOT, 2003). See also the AAAFTS (2009a) "Driver Licensing Policies and Practices" database showing each State's driver licensing policies and practices regarding older and medically at-risk drivers.

Effectiveness: There is strong evidence that State screening and assessment programs identify some drivers who should not be driving at all or whose driving should be limited. The Maryland pilot test of the model guidelines concluded that “the analysis results ... have provided perhaps the best evidence to date that functional capacity screening, conducted quickly and efficiently, in diverse settings, can yield scientifically valid predictions about the risk of driving impairment experienced by older individuals” (Staplin et al., 2003b). In a study that evaluated the use of a screening tool on Alabama drivers age 18 to 87 (Edwards et al., 2008), older drivers performed significantly worse than younger drivers and older drivers with a crash history performed worse than older drivers without crashes.

A NHTSA-sponsored project conducted by Eby et al. (2008) had the goal of improving upon existing self-screening tools for older drivers by focusing on symptoms associated with medical conditions. A self-screening instrument was created to provide feedback to older drivers to increase general awareness of issues associated with driving and the aging process, and to provide recommendations for behavioral changes and vehicle modifications to make to be able to maintain safe driving. Evaluation of the self-screening instrument found it to have positive value, but primarily as a “screening tool to determine gross impairment rather than fitness to drive” (Eby et al., 2008, p. 19).

Costs: The model guideline functional screening tests can be administered for less than \$5 per driver, including administrative and support service costs (Staplin et al., 2003a).

Time to implement: States should be able to modify their driver license screening and assessment procedures in 4 to 6 months.

2.2 Referring Older Drivers to Licensing Agencies

Effectiveness: ★★ ★★ ★†	Use: Low	Cost: Medium	Time: Medium
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† Proven for increasing physician referrals

Older drivers come to the attention of licensing agencies at regular license renewals, as discussed in Chapter 7, Section 2.1, or when they are referred to the licensing agency for reevaluation of their driving skills.

Licensing agencies in all States accept reevaluation referrals for drivers of any age. A survey of all State licensing agencies found that three sources accounted for 85% of referrals: law enforcement (37%), physicians and other medical professionals (35%), and family and friends (13%) (Stutts, 2005). The remaining 15% came from crash and violation record checks, courts, self-reports, and other sources.

Law enforcement officers have the opportunity to observe drivers directly at traffic stops or crashes. With appropriate training they can identify many drivers who should be referred to the licensing agency for assessment. NHTSA has developed and field-tested a set of cues that officers can use to identify potentially impaired drivers (NHTSA, 1998; see also NCHRP, 2004, Strategy C3, and Stutts, 2005, Chapter 7).

Physicians are in an excellent position to assess if changes in their patients' physical or cognitive abilities may increase their crash risk. In addition to assessment, physicians should provide counseling and assistance on driving as needed and refer patients to the licensing agency if appropriate. In 6 States, physicians are required to report patients who have specific medical conditions such as epilepsy or dementia (NCHRP, 2004, Strategy C3). Other States require physicians to report "unsafe" drivers, with varying guidelines for defining "unsafe." Physicians must balance their legal and ethical responsibilities to protect their patient's health and confidentiality with their duty to protect the general public from unsafe drivers. Physicians have been held liable for damages from crashes involving patients because they failed to report the patient to the licensing agency (Wang et al., 2003, Chapter 7).

NHTSA's *Physician's Guide to Assessing and Counseling Older Drivers* (Wang et al., 2003; Carr et al., 2010), prepared in cooperation with the AMA, provides detailed information for physicians and medical professionals. Chapter 8 has an extensive summary of State licensing and reporting laws. Chapter 9 contains a list of medical conditions and medications that may impair driving and consensus recommendations on what action to take for each. Other chapters include information on treatment and rehabilitation options that may allow patients to continue to drive and on how to counsel patients about retiring from driving. See also Lococo (2003, Appendix C) for State-level information and NCHRP (2004, Strategy C3) for overall discussion.

Chapter 3 of the second edition of the *Physician's Guide to Assessing and Counseling Older Drivers* (Carr et al., 2010) discusses the assessment of functional abilities and provides physicians with the instructions and basic forms needed for them to conduct a brief in-office "Assessment of Driving Related Skills" (ADReS). The ADReS screening tool assesses some aspects of the key functional areas of vision, cognition, and motor/sensory functions to help

physicians identify specific areas of concern as they relate to driving. An evaluation of ADReS (McCarthy, Mann, & Lanford, 2009) suggests that while this tool was able to identify all of the study participants who failed the behind-the-wheel test included as a part of the study, the ADReS may need to be revised to give physicians a more effective and efficient tool for in-office assessments.

Many States have established procedures for family members and friends to report drivers of any age whose abilities may be impaired. NCHRP (2004, Strategy C3) provides examples and Web links for programs in Florida, Missouri, Minnesota, and Oregon.

States can increase driver referrals by establishing and publicizing procedures for referring drivers, establishing referral policies and providing appropriate training and information to law enforcement officers, and informing physicians and health professionals of their responsibilities. NCUTLO's model law on reporting drivers with a physical or mental disability (NCUTLO, 2005) describes the responsibilities of health care providers and of State Medical Advisory Boards, driver licensing agencies, and license examiners. NHTSA, in collaboration with the American Association of Motor Vehicle Administrators (AAMVA) has produced a guide titled "Driver Fitness Medical Guidelines" that is designed to provide guidance to licensing agencies that can be used in making decisions about an individual's fitness for driving (NHTSA, 2009d). Guidelines are provided for a variety of physical limitations and impairments as well as medical conditions. In addition, this guide provides information that can be used by State licensing agencies to educate medical professionals about the effects of functional impairments and medical conditions on safe driving in order to encourage them to refer drivers for additional evaluations related to driving.

Use: A survey of all State licensing agencies found that fewer than 100,000 drivers 65 and older are referred each year from all sources, or fewer than 0.4% of the 28.6 million older licensed drivers (Stutts, 2005, Appendix E). The number of referrals varies substantially across the States, from a few hundred to 50,000.

Effectiveness: States that establish and publicize effective referral procedures will increase referrals. NCHRP (2004, Strategy C3) provides examples and Web links. As one example, Pennsylvania increased physician referrals substantially by sending letters to all physicians (NCHRP, 2004, Strategy C3).

A study of Missouri's voluntary reporting law and the resulting licensing outcomes found that the crash involvement of reported drivers decreased after implementation of the law and, to a lesser degree, mortality declined as well. Though the Missouri law is not specific as to age, the mean age of reported drivers was 80 and only 3.5% of the 4,100 individuals (reported by a combination of law enforcement officers, driver license office staff, physicians, family members and others) retained their drivers' licenses after the process. (Meuser, Carr, & Ulfarsson, 2009).

The mandatory reporting law in Oregon was enacted in 2002 and requires primary physicians and other health care providers that function as a primary provider to report cognitively impaired drivers to the Department of Motor Vehicles. Reports by primary care providers result in automatic suspensions of driving privileges, but the suspended driver has the opportunity to

request retesting and/or a hearing to appeal the suspension. A study of this Oregon law found that over 1,600 drivers reported as being cognitively impaired between 2003 and 2006, with the majority of the reported drivers being older than 80. The most common cognitive impairments were in judgment and problem solving, but impairments in memory and reaction time impairments were also reported about half the time. Of the 1,664 people reported who lost their license, less than 20% requested retesting or a hearing to contest their license suspensions and only about 10% of the total number reported and suspended (173) regained their driving privileges (Snyder & Ganzini, 2009).

Costs: Costs for establishing and publicizing effective referral procedures vary depending on the procedures adopted, but should not be extensive. Educational and training publications are available for use with law enforcement and medical professionals. Funds will be required to distribute this material and for general communications and outreach. If referrals increase substantially, then licensing agency administrative costs will increase.

Time to implement: States seeking to improve referrals will require at least 6 months to develop, implement, and publicize new policies and procedures.

2.3 License Restrictions

Effectiveness: ★ ★ ★	Use: Unknown	Cost: Low	Time: Short
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If a State licensing agency determines through screening, assessment, medical referrals, road tests, or other means that a driver poses excessive risks only in certain situations, the driver can be issued a restricted license. This process of “graduated de-licensing” preserves the driver’s mobility while protecting the driver, passengers, and others on the road. Drivers whose vision is adequate during daylight hours but not at night present an obvious example. Their licenses can be restricted to daylight driving only. Other common restrictions limit driving to a specific geographical area, such as the town or county where the driver lives, or limit driving only to low-speed roads.

The AAAFTS (2009b) “Noteworthy Initiatives” database lists Iowa, Kansas, and Minnesota as having noteworthy restricted licensing programs. Iowa offers tailored drive tests that allow drivers to be tested in their own community on roads they would typically drive and, if successful, these drivers are allowed to drive where they have demonstrated proficiency. Iowa license examiners conduct approximately 100 to 150 such examinations each year. Kansas offers a “Local Drive” road test program where, if a driver makes a written request, an examiner will meet the driver in his/her community and conduct the test on routes of the driver’s own choosing. The driver must agree that the license will be restricted to areas close to home and possible specific routes. Kansas conducts about 200-250 local drive tests each year. In Minnesota, drivers who live in a rural area and only need driving privileges close to home may arrange for a road test examiner to go to the driver's home. Examiners perform only about 25 of these road test per year, and they may result in very customized licenses such as being limited to a specific route, specific hours of the day, or any combination of restrictions as appropriate.

Use: Iowa and Utah are known to issue restricted licenses (Stutts, 2005; Vernon, Diller, Cook, Reading, & Dean, 2001). A survey of State licensing agencies found that two-thirds of the States said that restricted licenses would be feasible under current State policies, though two-thirds of these would require legislative changes before restricted licenses could be issued (Staplin & Lococo, 2003). The number of States that currently issue restricted licenses specifically for older drivers is not known, but the AAAFTS (2009a) “Driver Licensing Policies and Practices” database shows that 46 States and the District of Columbia place at least some types of conditions or restrictions on licenses of older and/or medically at-risk drivers. The most common restriction is the requirement of corrective lenses.

Effectiveness: Several studies show that driver license restrictions lower the crash risk for these drivers, though their crash risk is still higher than for similar-age drivers with unrestricted licenses (NCHRP, 2004, Strategy C2; Vernon et al., 2001).

Costs: Once drivers have been screened and assessed, the costs of issuing a restricted license are minimal.

Time to implement: Restricted licenses can be implemented as soon as any needed policy or legislation changes are enacted.

2.4 Medical Advisory Boards

Effectiveness: ★ ★ [†]	Use: High	Cost: Varies	Time: Medium
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[†] Quality varies considerably

Thirty-four States and the District of Columbia have medical advisory boards (MABs) to assist the licensing agencies in evaluating people with medical conditions or functional limitations that may affect their ability to drive (AAAFS, 2009a). MABs generally make policy recommendations on what licensing actions are appropriate for people with specific medical conditions or functional limitations. Most State MABs review individual cases, though this activity varies widely: 7 States reported that their MABs review 1,000 cases or more annually while another 7 review 10 or fewer cases (Lococo, 2003).

In 2003, NHTSA and AAMVA surveyed MAB practices in all States. Lococo (2003) contains the results: detailed documentation of how each State's medical review is organized; how drivers are identified, referred, screened, and assessed; and what licensing actions can be taken.

MABs should play a key role in each State as the link between health care professionals, licensing agencies, law enforcement, and the public. They should take the lead in defining how various medical conditions and functional impairments affect driving; defining medical assessment and oversight standards; improving awareness and training for healthcare providers, law enforcement, and the public; advising health care professionals how drivers can compensate for certain medical conditions or functional impairments; and reviewing individual cases. AAA has developed its list of best practices and recommendations for MABs based on the NHTSA-AAMVA study findings (AAA, 2004). The National Traffic Safety Board has made similar recommendations (NTSB, 2004). In June 2005, NHTSA released a summary of recommended strategies for MABs and national medical guidelines for driving, prepared in collaboration with AAMVA (Lococo & Staplin, 2005).

As noted above, NHTSA and AAMVA produced a guide in September 2009 titled "Driver Fitness Medical Guidelines" that is designed to provide guidance to licensing agencies in making decisions about an individual's fitness for driving (NHTSA, 2009d). These guidelines, as well as NHTSA's *Physician's Guide to Assessing and Counseling Older Drivers* (Wang et al., 2003; Carr et al., 2010), can be used to provide guidance to MABs as they define how various medical conditions and functional impairments affect driving and what steps can be taken to compensate for any limitations noted due to relevant conditions and limitations.

Use: The AAAFIS (2009a) Driver Licensing Policies and Practices database shows that 34 States have MABs or obtain input from the drivers' physicians or anonymous physicians.

Effectiveness: There are no studies evaluating the effects of MABs. Maryland's MAB reviewed over 500 individual cases in 2004 and recommended license suspension for about two-thirds of the cases (Soderstrom, 2005).

Costs: MABs are comprised of physicians and other health care professionals together with appropriate administrative staff. Costs will be minimal for an MAB whose activities are limited

to policy recommendations. Costs for an MAB that evaluates individual cases will depend on the caseload.

Time to implement: States probably will need at least a year to establish and staff an MAB, depending on what duties the MAB undertakes. States likely can expand the functions of an existing MAB in 6 months.

2.5 License Renewal Policies: In-Person Renewal, Vision Test

Effectiveness: ★ ★	Use: Medium	Cost: High	Time: Medium
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Driver's licenses in most States are valid for 4 to 6 years, longer in a few States. To renew an expiring license, drivers in many States must appear in person, pay the license fee, and have new pictures taken for their licenses. A few States require a vision test for license renewal. Some States allow all drivers to renew by mail or electronically.

More than half the States change license renewal requirements for drivers older than a specified age, typically 65 or 70. These changes may include a shorter interval between renewals, in-person renewal (no renewal by mail or electronically), or a vision test at every renewal. A very few States require written or road tests for some older renewal applicants. AAA (2010), IIHS (2010), and Stutts (2005, Chapter 5) summarize these requirements. Wang et al. (2003, Chapter 8) and Staplin and Lococo (2003, Appendix B) provide more detail on the requirements in effect in 2001.

License examiners report that the driver's appearance at the motor vehicle office is the single most important criterion for identifying a person of any age whose driving skills may be impaired (NCHRP, 2004, Strategy C2). This observation is supported by Morrissey and Grabowski (2005), who found that in-person license renewal was associated with reduced traffic fatalities among the oldest drivers. Frequent in-person renewals and vision tests may be more useful for older drivers than for younger drivers because their abilities may change more quickly. AAMVA recommends that all drivers renew licenses in person and pass a vision test at least every four years (Staplin & Lococo, 2003; Stutts, 2005). Very few States meet these recommendations for all drivers. In-person renewals would be even more useful, for drivers of all ages, if they included functional ability tests as recommended in the NHTSA-AAMVA *Model Driver Screening and Evaluation Program Guidelines for Motor Vehicle Administrators* (Staplin & Lococo, 2003) (see Chapter 7, Section 2.1).

Use: At least 30 States and the District of Columbia have different license renewal requirements for older than for younger drivers. These include 18 States with a shorter interval between renewals, 9 that require in-person renewals, 10 plus the District of Columbia that require vision tests at renewal, and 2 States that require road tests for applicants 75 and older. On the other hand, Oklahoma and Tennessee reduce or waive licensing fees for older drivers and Tennessee driver's licenses issued to people 65 or older do not expire (AAA, 2010; IIHS, 2010). In 2001, about 12 States met the American Association of Motor Vehicle Administrators [AAMVA] recommendations of in-person renewal, with a vision test, at least every four years for all drivers over some specified age (Staplin & Lococo, 2003). See also the AAFTS (2009a) "Driver Licensing Policies and Practices" database showing each State's driver licensing policies and practices including license renewal requirements for all drivers and, where applicable, older drivers as well.

Effectiveness: License examiners report that in-person renewals and vision tests are effective in identifying people whose driving skills may be impaired (NCHRP, 2004, Strategy C2). No data are available on the number of potentially impaired drivers identified through these practices or

on the effects of more frequent renewals and vision tests on crashes. Furthermore, studies regarding the effectiveness of vision screening for license renewal indicate that the value of the vision tests commonly used for licensing decisions as predictors of increased crash risk is inconclusive and that the aspects of vision currently assessed for licensing do not adequately explain unsafe driving (Bohensky, Charlton, Odell, & Keefe, 2008). Nonetheless, one study found that fatalities among drivers 80 years and older in Florida decreased by 17% after the State passed a law requiring these drivers to pass a vision test before renewing their driver licenses (McGwin, Sarrels, Griffin, Owsley & Rue, 2008).

Costs: More-frequent license renewals or additional testing at renewal impose direct costs on driver licensing agencies. For example, a State that reduces the renewal time from 6 years to 3 years for drivers 65 and older would approximately double the licensing agency workload associated with these drivers. If 15% of licensed drivers in the State are 65 and older, then the agency's overall workload would increase by about 15% to process the renewals. If more frequent renewals and vision tests identify more drivers who require additional screening and assessment, then additional costs are imposed. See Chapter 7, Section 2.1, for additional discussion.

Time to implement: A vision test requirement for renewal or a change in the renewal interval can be implemented within months. The new requirements will not apply to all drivers for several years, until all currently valid licenses have expired and drivers appear at the driver licensing agency for licensing renewal.

Other issues:

- **Age discrimination:** A few States explicitly provide that age alone is not a justification for reexamining a driver's qualifications (AAA, 2010; IIHS, 2010). These States have the same license renewal interval for all drivers.
- **Road tests and medical reports:** Several Australian States require a medical report, a road test, or both for drivers over a specified age to renew their licenses. Langford, Fitzharris, Koppell, and Newstead (2004) compared Australian States with and without these requirements. They found that Australian States with these requirements had higher older-driver crash rates than States without them. They conclude that there are "no demonstrable road safety benefits" to requiring medical reports or road tests for older drivers.

3. Traffic Law Enforcement

3.1 Law Enforcement Roles

Effectiveness: ★ ★ ★	Use: Medium	Cost: Varies	Time: Varies
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Law enforcement plays three overall roles in improving the safety of older drivers:

- Enforce traffic laws. In particular, active publicized enforcement of seat belt use laws can help increase belt use for older drivers and occupants. See Chapter 2, Section 2.1, for discussion.
- Identify drivers with potential driving impairments and refer them to licensing agencies. Traffic stops and crash investigations provide officers excellent opportunities to observe and evaluate driving behavior. See Chapter 7, Section 2.2, for discussion.
- Provide information and education. Law enforcement officers have formed many partnerships with public and private organizations to give talks, teach safe driving courses, work with media on news stories and public service announcements, and other communications and outreach initiatives. Stutts (2005) summarizes several examples. NHTSA (2003) lists law enforcement programs that were active in 2003. They include training for officers, training for older drivers, and community relations programs that promote safety.

NHTSA’s Older Driver Law Enforcement Course is available through the International Association of Directors of Law Enforcement Standards and Training. The four-hour course provides background on older driver issues and discusses traffic stops, referring older drivers to licensing agencies, and community outreach.

Use: NHTSA (2003) describes older driver programs in 28 States.

Effectiveness: Law enforcement officers provide more than one-third of all referrals to licensing agencies for driver screening and assessment (Chapter 7, Section 2.2).

Costs: Costs vary depending on the nature and scope of activities.

Time to implement: Implementation time varies depending on the nature and scope of activities.

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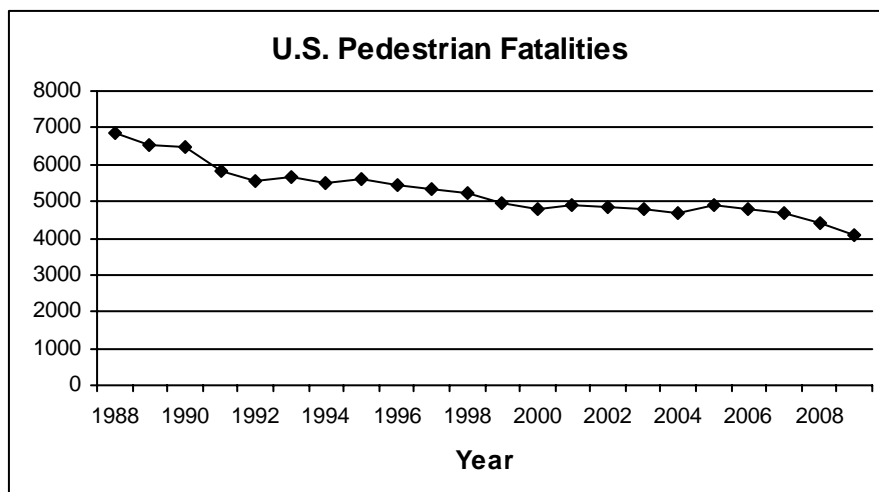
8. Pedestrians

Overview

In 2009, 4,092 pedestrians died and about 59,000 were injured in traffic crashes in the United States. Pedestrians accounted for 12% of total traffic fatalities and 3% of total injuries (NHTSA, 2010a). Of the pedestrian casualties:

- 276 fatalities and 15,000 of the injured were children 15 and younger;
- 775 fatalities and 7,000 of the injured were adults 65 and older;
- 69% of those killed were males;
- 37% of pedestrians fatally injured had a blood alcohol concentration of .08 or greater (NHTSA, 2010a).

Trends. Pedestrian fatalities have dropped gradually over the past 20 years from about 7,000 to less than 5,000 annually. Fatality rate trends, that is, fatalities adjusted per number of walking trips or miles traveled by walking, are unavailable because there is no consistent measure of walking to estimate and compare fatality rates.



Source: Traffic Safety Facts 2009, Early Edition (NHTSA, 2010b, Table 4)

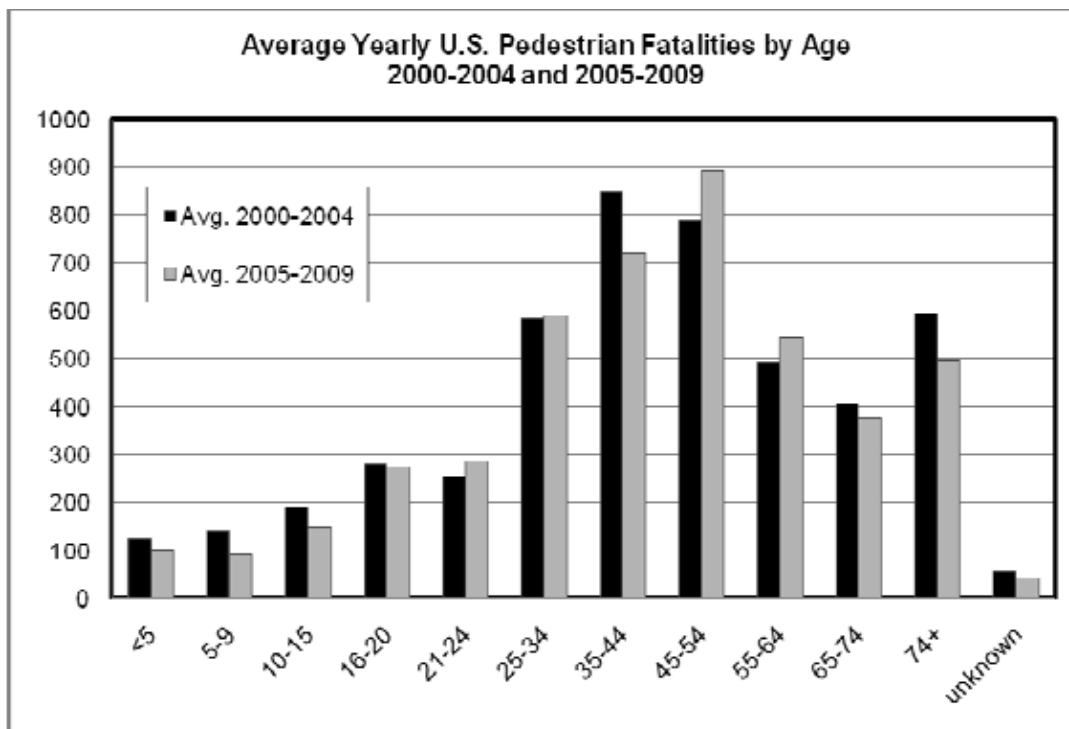
According to the Federal Highway Administration's National Household Travel Survey (NHTS), the number of walking trips increased from 18 billion in 1990 (FHWA, 1990) to 20.3 billion in 1995 (FHWA, 1995) and 35.3 billion in 2001 (FHWA, 2001), though the various surveys used somewhat different methodologies. It is likely, for example, that more trips were captured, beginning with the 2001 survey, partly as a result of the use of multiple prompts (Hu & Reuscher, 2004). Preliminary results from the latest NHTS, conducted in April 2008 through May 2009, indicate that walking trips have again increased up to 42.5 billion per year (FHWA, 2010). This number represents approximately 11% of all trips reported.

Another source of information comes from the U.S. Census (U.S. Census Bureau). The Census reported decreases in estimates of people who commute by walking from 1990 (3.9% of workers,

or about 4.5 million people) to 2000 (2.7%, or 4.4 million people) (Reschovsky, 2004). The latest census information comes from the 2006 to 2008 American Community Survey, which estimates 2.8% of workers (3.9 million) walked to work for this 3-year period, similar to the 2000 proportion.

The 2009 NHTS data reports a higher percentage of commuting trips made by walking: about 6% of trips to work in 2009 (FHWA, 2010). Commuting, however, makes up only a small percentage of all walking trips.

The age distribution of pedestrian fatalities has changed over the last decade. Comparing average fatalities for 2004 to 2008 to those from 1999 to 2003, pedestrian fatalities decreased for children 15 and younger and among adults 65 and older. Among other adults, crashes trended downward for those 35 to 44, but remained relatively the same or increased for other adult ages, particularly among those 45 to 54. These changes may reflect population and walking trends among different ages as well as other exposure factors.



Source data: FARS

Although pedestrian fatalities involving older adults have declined over the past 10 years, older pedestrians are still more likely to die from their injuries when struck. Pedestrians 75 and older have the highest fatality rate per population of any age group (2.2 per 100,000 population; NHTSA, 2010a). In comparison, pedestrians 25 to 64 years old have a fatality rate of 1.6 per 100,000 population (NHTSA, 2010a). Older adults are also more vulnerable when struck in intersection collisions. Although all ages are more frequently killed at non-intersection locations (75% overall), 35% of adults 65 and older died as a result of collisions at intersections in 2009 compared with 21% for other ages (NHTSA, 2010b, p. 131).

Classifying crashes. Pedestrian crashes can be classified into types based on pedestrian and motor vehicle pre-crash actions and crash location. In the early 1990s this methodology was used to classify more than 5,000 pedestrian crashes in California, Florida, Maryland, Minnesota, North Carolina, and Utah (Hunter, Stutts, Pein, & Cox, 1996, summarized in www.walkinginfo.org/pc/types.cfm). Of these pedestrian crashes:

- The largest major grouping was crashes occurring at or within 50 feet of an intersection, accounting for 32% of all crashes. Of these intersection crashes, 30% involved a turning vehicle; another 22% involved a pedestrian dashing into the intersection, and 16% involved a driver violation (e.g., running a red light). Older pedestrians were over-represented in collisions with turning vehicles and motorist violations, while children were over-represented in intersection dashes.
- The second major grouping was crashes occurring in the middle of a block, accounting for 26%. In one-third of these, the pedestrian ran into the street and the driver's view was not obscured; one-sixth were "dart-outs" in which the pedestrian walked or ran into the street from a location where the pedestrian could not be seen. Children were also over-represented in dash-and-dart-out crashes at midblock locations.
- Only 7% of the crashes involved a pedestrian walking along a roadway not on a sidewalk. In three-quarters of these crashes the pedestrian was struck from behind while walking in the same direction as traffic. Darkness was a factor that was over-represented in these types of collisions, as were rural locations. These associations are not unexpected since rural areas are less likely to have sidewalks and supplemental street lighting.

Different crash types at different locations involving different age groups can be targeted by different countermeasures. The Pedestrian and Bicycle Crash Analysis Tool (PBCAT) software is available to assist jurisdictions in typing pedestrian crashes and developing a database for analyzing their own pedestrian crash problems. States and communities can use PBCAT to analyze pedestrian crashes and to help select appropriate countermeasures. PBCAT may be downloaded from www.walkinginfo.org/facts/pbcats/index.cfm. Registration is requested for this free software so the user may receive any software updates or important technical information.

An emerging issue likely to attract attention in future years is the increasing research establishing cell phone use as a source of distraction, not only for motorists, but for pedestrians. Nasar, Hecht, and Wener (2007), Hatfield and Murphy (2007), and Stavrinou, Byington and Schwebel (2009), and others indicate that talking on cell phones is associated with cognitive distraction that may undermine pedestrian safety. Other electronic devices, such as digital audio players – particularly more engaging actions such as finding a song title in a menu – may produce similar distractions for pedestrians. At the moment, however, no studies of crash effects or evaluations of countermeasures to address this emerging issue have been identified.

Strategies to Increase Pedestrian Safety

Countermeasures in this chapter are organized by pedestrian type:

- Pre-school-aged children;

- School-aged children;
- Workers, including highway construction workers; and
- Alcohol-impaired pedestrians.

A final section contains countermeasures that may affect all pedestrians.

Basic countermeasure principles include reducing vehicle speed, which allows pedestrians and drivers more time to react and reduces impact forces if crashes do occur; reducing exposure to known risky situations through behavioral and environmental countermeasures; and increasing enforcement of pedestrian-friendly laws.

Countermeasures need to be tailored to diverse populations, including groups such as recent immigrants who may not be familiar with United States traffic laws, the United States traffic environment, or may not speak or read English. Countermeasures should also address particular problems identified within communities or common to a target group.

Resources

The agencies and organizations listed below can provide more information on comprehensive pedestrian safety issues and countermeasures, and links to numerous other resources.

- National Highway Traffic Safety Administration:
 - Pedestrians - www.nhtsa.gov/Pedestrians
 - Research and Evaluation - www.nhtsa.gov/Driving+Safety/Research+&+Evaluation
 - Behavioral Safety Research Reports - ntlsearch.bts.gov/repository/ntlc/nhtsa/index.shtm
- Federal Highway Administration: www.fhwa.dot.gov/
 - Office of Human and Natural Environment, Bicycle and Pedestrian Program - www.fhwa.dot.gov/environment/bikeped/index.htm
 - Safety Office, Pedestrian and Bicycle Safety - safety.fhwa.dot.gov/ped_bike/ped_focus/
 - Office of Research, Development, and Technology, (Turner-Fairbank Highway Research Center), Human Centered Systems Research, Pedestrian and Bicycle Program - www.tfhr.gov/humanfac/ped-bike.htm
- National Center for Bicycling and Walking: www.bikewalk.org
- Association of Pedestrian and Bicycle Professionals: www.apbp.org
- America Walks: www.americawalks.org
- National Center for Safe Routes to School: www.saferoutesinfo.org
- Pedestrian and Bicycle Information Center: www.pedbikeinfo.org
 - Research and Administrative Technology Administration, National Transportation Library, Bicycle and Pedestrian Research: ntlsearch.bts.gov/repository/category.do?cat=5
- SAFE KIDS Worldwide: www.safekids.org
- Safe Routes to School National Partnership: www.saferoutespartnership.org
- Safe States Alliance: <http://safestates.org/>

- United States Access Board: www.access-board.gov

Several specific resources that provide further information on engineering, enforcement and educational strategies are:

- *A Resident's Guide for Creating Safe and Walkable Communities* (FHWA, 2008): <http://drusilla.hsrc.unc.edu/cms/downloads/residentsguide.pdf>
- *How to Develop a Pedestrian Safety Action Plan* (FHWA and NHTSA, 2006): <http://drusilla.hsrc.unc.edu/cms/downloads/howtoguide2006.pdf>
- *NCHRP Report 500 Guide for Reducing Collisions Involving Pedestrians* (National Cooperative Highway Research Program, 2004): onlinepubs.trb.org/Onlinepubs/nchrp/nchrp_rpt_500v10.pdf
- *PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System* (FHWA, 2004): www.walkinginfo.org/pedsafe/index.cfm
- *The Pedestrian Safety Workshop: A Focus on Older Adults*, (NHTSA): www.nhtsa.gov/staticfiles/nti/older_drivers/pdf/PedSafetyWorkshop-02.pdf

For information on education, engineering, vehicular, and legislative practices and recommended strategies from Europe, refer to *Keeping Children Safe in Traffic* by the Organization for Economic Co-operation and Development (OECD) (2004).

Key Terms

- NHTS: National Household Travel Survey, conducted last in 2009.
- SRTS: Safe Routes to School

Countermeasures That Work

Countermeasures to improve pedestrian safety are listed below and discussed individually in the remainder of this chapter. The table is intended to give a rough estimate of each countermeasure's effectiveness, use, cost, and time required for implementation. The symbols and terms used are described below. Effectiveness, cost, and time to implement can vary substantially from State to State and community to community. Costs for many countermeasures are difficult to measure, so the summary terms are very approximate. See each countermeasure discussion for more information on each item.

1. Pre-school aged Children

Countermeasure	Effectiveness	Use	Cost	Time
1.1 Children's safety clubs	★ ★	Unknown	Varies	Unknown
1.2 Child supervision	★	Unknown	Low	Short

2. School-aged Children

Countermeasure	Effectiveness	Use	Cost	Time
2.1 Elementary-age child pedestrian training	★ ★ ★	Unknown	Low	Short
2.2 "Ice cream vendor" ordinance	★ ★ ★	Low	Low	Medium
2.3 Safe Routes to School (SRTS)	★ ★	High	Low	Short
2.4 Child school bus training	★ ★	High	Low	Short

3. Impaired Pedestrians

Countermeasure	Effectiveness	Use	Cost	Time
3.1 Communications and outreach	★ ★	Low	Varies	Medium
3.2 "Sweeper" patrols of impaired pedestrians	★	Low	Medium	Medium

4. All Pedestrians

Countermeasure	Effectiveness	Use	Cost	Time
4.1 Pedestrian safety zones	★ ★ ★ ★	Low	High	Medium
4.2 Reduce and enforce speed limits	★ ★ ★	High	Low	Varies
4.3 Conspicuity enhancement	★ ★ ★	Low	Low	Medium
4.4 Targeted enforcement	★ ★ ★	Unknown	Medium	Short
4.5 Driver training	★	Low	Low	Medium

Effectiveness:

- ★★★★★ - Demonstrated to be effective by several high-quality evaluations with consistent results
- ★★★★ - Demonstrated to be effective in certain situations
- ★★★ - Likely to be effective based on balance of evidence from high-quality evaluations or other sources
- ★★ - Effectiveness still undetermined; different methods of implementing this countermeasure produce different results
- ★ - Limited or no high-quality evaluation evidence

Effectiveness is measured by reductions in crashes or injuries unless noted otherwise. See individual countermeasure descriptions for information on effectiveness size and how effectiveness is measured.

Use:

- High: more than two-thirds of the States, or a substantial majority of communities
- Medium: between one-third and two-thirds of States or communities
- Low: less than one-third of the States or communities
- Unknown: data not available

Cost to implement:

- High: requires extensive new facilities, staff, equipment, or publicity, or makes heavy demands on current resources
- Medium: requires some additional staff time, equipment, facilities, and/or publicity
- Low: can be implemented with current staff, perhaps with training; limited costs for equipment, facilities, and publicity

These estimates do not include the costs of enacting legislation or establishing policies.

Time to implement:

- Long: more than one year
- Medium: more than three months but less than one year
- Short: three months or less

These estimates do not include the time required to enact legislation or establish policies.

1. Pre-School Aged Children

1.1 Children's Safety Clubs

Effectiveness: ★ ★	Use: Unknown	Cost: Varies	Time: Unknown
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The purpose of children's safety clubs is to help parents and caregivers become more involved in educating young children about safe walking techniques through books and activities on road safety. Related goals are to help promote on-going, age-appropriate training and safe attitudes towards traffic (Gregersen and Nolen, 1994). An equally important outcome of safety clubs is for parents and other caregivers to recognize children's limits and capabilities, and to understand their obligation to provide adequate supervision and control (Gregersen and Nolen, 1994).

Young children have limited abilities to perceive, understand, and react appropriately to traffic hazards. Motor vehicle crashes involving preschool children often involve slow-moving vehicles, frequently backing up in driveways and parking lots (Agran, Winn, & Anderson, 1994; Olson, Sklar, Cobb, Sapien, & Zumwalt, 1993). A NHTSA report estimated that 106 children fourteen and younger were killed by vehicles driving forward and 99 were killed by backing vehicles in non-traffic-related crashes such as in driveways and parking areas in 2007 (NHTSA, 2009). It is important to teach children age-appropriate lessons about traffic and motor vehicles. It is even more important that parents and caregivers take direct responsibility and supervise young children carefully near roadways or in any areas where vehicles may be in use (Rivara, Bergman, & Drake, 1989). See also the following section, Section 1.2 for more information on supervision.

Parents are primary role models and trainers for their children. Research in the United Kingdom has examined the interactions and messages between parents and children with regard to road safety (Green et al., 2008). The researchers found that parents, while feeling competent to the task, were inconsistent role models and lacking in knowledge of best approaches and messages to train their children. Moreover, parents did not take full advantage of opportunities to teach while walking, and attention was focused more on controlling their children's behavior than teaching, particularly under higher risk situations (Green et al, 2008).

The main development of safety clubs took place in Europe a number of years ago, but they have not been adopted broadly in the United States. In many of the European programs, children may be enrolled in a traffic safety club when they reach their third birthday. Books on traffic safety are then sent to the child every 6 months until they reach 5 years or older (Dragutinovic & Twisk, 2006), but other print or electronic media could be provided, bearing in mind that the intent is to engage both the parent and child. There do not appear to be any national or statewide standards, models, or curricula.

NHTSA has several brochures to educate parents and caregivers on child pedestrian safety, as does Safe Kids Worldwide. Most recently, NHTSA released *Teaching Children to Walk Safely as They Grow and Develop: A guide for parents and caregivers*, which can be found on the Safe Routes to School Web site. One online game for parents and young children (Otto the Auto, from the California State Automobile Association) can be found at www.ottoclub.org. For a British traffic club source, see The Children's Traffic Club, www.trafficclub.co.uk.

Use: Pedestrian safety in general may be a topic at preschools, but programs are likely to be unique, without consensus objectives, material, or curriculum.

Effectiveness: Safety clubs are one way to promote understanding and to teach a specific set of appropriate behaviors for young pedestrians. However, the knowledge and skill benefits have not been found to translate into crash and injury reductions (Dragutinovic & Twisk, 2006; Gregersen & Nolen, 1994; West, Sammons, & West, 1993). The one study that evaluated effects on self-reported crashes found a negative result, but concluded that no impact on crashes could be inferred (Gregersen and Nolen, 1994).

Costs: The costs would depend on the cost of materials and delivery and whether the families are charged anything for participation. In most of the clubs, enrollment is free to the participants; some charge a fee for enrollment (Dragutinovic & Twisk, 2006). If integrated into preschool programs, training for teachers may be needed.

Time to implement: Before a safety club program could be implemented, program material must be located and adapted as necessary. Following that, a modest time period would be needed to arrange for material, identify target recipients, disseminate information, and train teachers as needed.

Other issues:

- A challenge would be to garner high enrollment among families with lower socio-economic status (SES) and low-car-ownership. Participation in child safety clubs has been found to be lower among low SES groups in European countries (Dragutinovic & Twisk, 2006).
- It is up to parents and caregivers of young children to use materials appropriately and a lack of control makes it difficult to monitor or assess results.

1.2 Child Supervision

Effectiveness: ★	Use: Unknown	Cost: Low	Time: Short
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The primary purpose of this countermeasure is to increase the supervision of children when they are exposed to traffic, or when they are nearby with direct access to traffic. Because children do not have the impulse control to make safe walking decisions, these programs can be an asset to anyone responsible for the supervision of children. The State can require such training for teachers, day care workers, and others licensed to care for children. The programs can also be made available to parents, babysitters, or other caretakers through PTAs, churches, pediatricians, or even direct mail or Internet access.

One of the ways to “sell” these programs may be to point out that parents don’t know how much their children need supervision (and effective training). Rivara et al. (1989) and Dunne, Asher, and Rivara (1992), for example, have shown that parents consistently overestimate the ability of children younger than 9 or 10 to negotiate in traffic. Adults should actively supervise children and not assume that their presence will be adequate to ensure safer behavior.

Use: The availability and use of programs to improve child supervision is unknown. One valuable resource is NHTSA, with publications such as *Walking Through the Years, Preventing Pedestrian Crashes: Preschool/Elementary School Children*, and *Teaching Children to Walk Safely as They Grow and Develop: A guide for parents and caregivers*. Another key resource is Safe Kids Worldwide, with *Teach Your Child Street Smarts*.

Effectiveness: Programs or material can provide helpful training for caregivers if they point out specific risks as well as guidelines for the kind and degree of oversight that are necessary, but the caregivers need to put the training into practice. Widespread exposure of parents and caregivers to this material and resources should be a goal of such programs.

Costs: Material for individuals is already available and quite inexpensive. Training for licensed caregivers would be inexpensive to develop and distribute.

Time to implement: Short, for existing material; medium, to develop and disseminate a training curriculum with material.

Other issues:

- Cultural differences and social and perceived norms for pedestrian safety should be considered in the development of programs to improve child supervision. For example, in a study by Pfeffer, Fagbemi, and Stennet (2010), 59% of adults held the hands of female children compared with 36% who held the hands of male children when crossing a road. In another recent study, children 9 and younger in one cultural group believed that more of their peers crossed roadways alone than actually did (Rosenbloom, Sapir_Lavid, & Hadri-Carmi, 2009). Addressing discrepancies in perceived norms and actual norms may help to shift the actual norm toward safer trends.

2. School-Age Children

2.1 Elementary-Age Child Pedestrian Training

Effectiveness: ★ ★ ★	Use: Unknown	Cost: Low	Time: Short
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The purpose of elementary school pedestrian training is to equip school-age children with knowledge and practice to enable them to walk safely in environments with traffic and other safety hazards. A number of elementary school pedestrian training programs have been developed over the years. “Willy Whistle” was developed in the 1970s as a film to teach K-3 children to look left-right-left before crossing, and was updated in 2008. NHTSA-developed videos for grades 4-6 include “Keep on Looking” and “Walking with Your Eyes.” Additional curricula have been developed for rural pedestrian concerns (Cleven & Blomberg, 1994). Furthermore, WalkSafe, a program adapted from many of these earlier resources, was implemented initially as a five-day program in a high risk district in Miami-Dade County, Florida and later as a three-day program in all 220 Miami-Dade County elementary schools as part of a comprehensive effort to address pedestrian crashes in Miami-Dade County (Zegeer et al., 2008a).

These programs are useful to teach basic pedestrian concepts and safe behaviors at schools, churches, and other institutions with groups of elementary-aged children. Pedestrian safety programs are especially important for children who may be more likely to make risky pedestrian decisions, such as those from lower-income families or ethnic minority backgrounds, or those who are less able to control their behavior (Barton & Schwebel, 2007). A study from Australia identified younger ages, and attentional and developmental issues including hyperactivity and inattentiveness as factors in unsafe road-crossing decisions by children. Children who had some independent walking experience were less likely to make incorrect decisions (Congiu et al., 2008).

Use: Unknown. Materials have been available for years, and distributed widely, but not in a systematic program. In addition, materials and technology/formats may need to be updated or tailored for local use (e.g., VHS versus DVD). With schools being called on for a wider variety of services and narrower set of teaching requirements, finding time to add child traffic safety modules may be difficult.

Effectiveness: Child pedestrian training programs have been shown to increase knowledge. Long-lasting behavior improvements may be harder to achieve. Evaluations of 5-day and 3-day WalkSafe programs in the Miami school district that used videos, formal curricula, workbooks, and outside simulation activities on an imaginary road on school grounds showed improvements in safety knowledge compared to before, although no control group was used in the evaluation. Improvements were more consistent for grades K-3 than for 4 and 5. Actual in-traffic behaviors were also reportedly improved in the short term, but did not hold up at 3 months after the program, and no comparison group was used (Hotz et al., 2004; Hotz et al., 2009).

Barton, Schwebel, and Morrongiello (2007) also reported that children crossed a road more safely immediately following a brief pedestrian safety training that included instruction followed

by practice crossings on a pretend road. In the United Kingdom, a combination of adult-led training and peer discussions for children 5 to 8 led to improved roadside search skills (Tolmie et al., 2005). In a small study of mostly white and middle class pre-school children, Albert and Dolgin (2009) also reported that 4- and 5-year-olds trained by adults in groups of 3 or 4 using a play-mat model retained real-world behavioral (street crossing choices) improvement 6 months later compared to peers trained using two other less interactive methods or who received no training. According to the authors, the success of this treatment may lie in the opportunities for peer collaboration and corrective feedback from the adult trainers. Thus, although the evidence base is inconclusive, several studies suggest that knowledge and behaviors of young children may be improved through training programs and that behavior is more likely to be modified if the program incorporates interactive training with opportunities for feedback.

Effectiveness of school-based child pedestrian training would likely be enhanced if it combined child training with emphasis to teachers, parents, and other caregivers on the limits of children and the need for careful supervision, particularly for those younger than 10 (see Section 1.2), and on-going safety training and reinforcement of safe behaviors.

Costs: NHTSA publications can be distributed at low expense.

Time to implement: Short, once a decision is made by a school district to offer such a program. Time is needed to review the recommended material, work it into the curriculum, and train teachers.

Other issues: A consensus is that practical training – that is, learning by doing with reinforcement of correct behaviors – is the most effective way for children to learn traffic safety skills (Bruce & McGrath, 2005; Dragutinovic & Twisk, 2006; Percer, 2009). The need for experiential learning is especially key for younger children who lack the capacity to generalize concepts and need to practice in environments with real objects that are as close as possible to those they will experience (Dragutinovic & Twisk, 2006). But real-world practice may be difficult to achieve with large groups of school children and without undue exposure to traffic risks.

- Classroom education may be enhanced by using outdoor simulation, 3-dimensional models, games, or other interactive learning methods such as with computer models, particularly in adult-led and small-group activities. These methods do not replace real-world practice but evidence from a few studies suggests that interactive training with opportunities for feedback, correction and practice (more than one session) may lead to more lasting behavior improvements (Tolmie et al., 2005; Albert & Dolgin, 2009).

2.2 “Ice Cream Vendor” Ordinance

Effectiveness: ★ ★ ★	Use: Low	Cost: Low	Time: Medium
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The purpose of “Ice Cream Vendor” ordinances is to modify the behavior of drivers around ice cream trucks to reduce speeds and improve safety when children approach the trucks. The neighborhood ice cream truck is a very specific hazard for children. As children run to or from the truck, they may pay little attention to traffic. The truck may screen the children from drivers.

The ordinance requires that drivers come to a complete stop before passing an ice cream truck that is stopped to vend. Drivers may proceed when it is safe at no more than 15 mph and must yield to all nearby pedestrians. The ice cream truck must be equipped with flashing signal lamps and a stop signal arm, similar to those found on school buses, which can be activated when the truck is stopped for vending.

The regulation includes provisions for permits and inspections for ice cream trucks and similar on-street vendors. Details of the model regulation are included in Blomberg (2001); see also Hale, Blomberg, and Preusser (1978).

Use: As of 2001 some form of ice cream vendor ordinance was in place in Florida, New Jersey, New York, South Carolina, and Texas, as well as Detroit, Michigan (Blomberg, 2001).

Effectiveness: When tested in Detroit, crashes to pedestrians going to or from ice cream trucks were reduced by 77% (Hale et al., 1978).

Costs: The primary costs are for modifications to vendor trucks, for inspections of trucks prior to issuing vending permits, and for training law enforcement officers.

Time to implement: Medium; following passage of an ordinance, implementation must allow enough time for truck modifications to be made and an inspection system established.

2.3 Safe Routes to School

Effectiveness: ★ ★	Use: High	Cost: Low	Time: Short
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The goal of Safe Routes to School Programs (SRTS) is to increase the amount of walking and bicycling trips to and from school while simultaneously improving safety for children walking or bicycling to school. SRTS programs are community-based and are intended to be comprehensive in nature. Programs include education of children, school personnel, parents, community members, and law enforcement officers about safe bicycling and walking behavior and safe driving behavior around pedestrians and bicyclists. In addition, programs include enforcement and engineering activities to improve traffic safety and risky elements of the traffic environment around primary and secondary schools so children can safely bicycle or walk to school.

Beginning in 2005, SAFETEA-LU has required each State to have its own SRTS program including a full-time coordinator to manage Federal funds. Each year, up to 70% (but not more than 90%) of available Federal funding must be allocated on infrastructure (engineering) improvements, and up to 30% (but not less than 10%) of funding on non-infrastructure projects to encourage walking and bicycling to school (public awareness and outreach, enforcement near schools, education, and training for volunteers). Resources to support these efforts are available online from NHTSA on the pedestrian safety page and the National Center for Safe Routes to School (NCSRTS) Web site (www.saferoutesinfo.org). NCSRTS provides information, guidance, and support for community, State, and national SRTS efforts. A list of current State SRTS coordinators and funding levels may also be found at the NCSRTS Web site.

Use: With the establishment of the national SRTS program, all 50 States and the District of Columbia are now operating SRTS programs. Local SRTS programs exist, in different forms, in nearly all States.

Effectiveness: SRTS material can be effective in teaching children and their parents how to evaluate and choose the safest routes for walking or bicycling to and from school. They are derived from analyses of types of crashes associated with to/from school trips, but it has not been possible to evaluate their effect on preventing crashes and injuries. Although the full program emphasizes broad education, some specific implementations have centered on site-appropriate engineering changes; results have shown behavioral improvements for pedestrians, bicyclists, and motorists (Britt, Bergman, & Moffat, 1995). Dumbaugh and Frank (2007) found that many of the safety benefits associated with SRTS countermeasures are assumed rather than known.

A variation on the SRTS theme, “walking school buses,” uses volunteer adults, usually parents, to walk a specific route to and from school, collecting or dropping off children on the way, so that a group of children walks to school under the supervision of adults. The program has been found popular and practical in New Zealand and Italy (Collins & Kearns, 2005; Roberts, 1995). Roberts found in New Zealand that when parents walked with children to and from school, the risk of injury was only 36% of the risk for unaccompanied children, though the sample sizes were small and the differences were not statistically significant.

Costs: Activities associated with SRTS may be low cost and may also be eligible for grant funding (non-infrastructure grants mentioned above). Grants are administered by each State's SRTS office. Material and resources can be accessed at no cost. NCSRTS provides downloadable material for State and local SRTS programs.

Time to implement: Once the school or district has decided to implement a SRTS program, a range of material, including an on-line step-by-step guide on getting started, is available from NCSRTS. Programs funded through State DOTs typically require applications on a funding cycle and can take significantly longer to implement.

2.4 Child School Bus Training

Effectiveness: ★ ★	Use: High	Cost: Low	Time: Short
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The purpose of school bus training for children is to teach school-age children how to safely approach, board, depart, and walk away from school buses. Approximately 800 school-aged children have died in traffic crashes in each recent year during normal school travel hours. On average, only 5 were school bus passengers and 15 were pedestrians near a school bus (TRB, 2002, p. 1). In 2009, there were 14 children killed in school-bus-related crashes. Of those, 2 were occupants of a school bus and 11 were pedestrians. It is also estimated that 6,000 people were injured while riding as a passenger in a school bus and 1,000 were injured as pedestrians in school-bus related crashes (NHTSA, 2010b). There are no data for pedestrian fatalities and injuries involving school buses during hours not associated with travel to and from school (i.e., for special school-related trips).

Basic training for children who ride school buses should be part of the normal school routine, if it is not already. Training should include behavior on the bus as well as getting on or off the bus at bus stops or school, obeying bus drivers and bus monitors, emergency evacuation procedures, and any topics unique to the school.

Jurisdictions should use a common curriculum for school bus safety training. Targeted behaviors include boarding and exiting from the bus and crossing the street to and from the bus.

Use: Most school districts have some form of school bus training in place, though the content and quality of those programs varies. Schools should be eager to provide this training, both for child safety and for legal liability.

Effectiveness: Burke, Lapidus, Zavoski, Wallace, and Banco (1996) found that stenciled pavement markings, together with in-school training, led to improved behavior in waiting for and boarding the school bus compared to training alone for students in grades 4-6. Reductions in crashes and injuries are difficult to demonstrate because some form of training is very widespread and the choice to adopt a stronger curriculum would be confounded with any number of other factors.

Costs: The primary cost for the SHSOs would be in adapting material for their States and producing, stocking, and distributing the material.

Time to implement: Basic material is available from a variety of organizations, and schools could adopt a curriculum of their choice quickly.

3. Impaired Pedestrians

3.1 Impaired Pedestrians: Communications and Outreach

Effectiveness: ★ ★	Use: Low	Cost: Varies	Time: Medium
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In 2009, 39% of all fatally injured pedestrians had positive BACs, and 35% had a BAC of .08 g/dL or higher (NHTSA, 2010a). Nearly half of fatally injured pedestrians between 21 and 54 had BACs of .08 or higher (NHTSA, 2010a).

Communications and outreach to reduce impaired-pedestrian crashes can be directed at a wide variety of audiences, including law enforcement, drivers, alcohol servers and vendors, civic and neighborhood leaders, and friends and family of likely impaired pedestrians. Impaired pedestrians are also a target audience, of course. However, they are viewed as a very difficult audience for communications and outreach to have a meaningful effect on their behavior. Reaching others who are in a position to prevent these crashes, or to alter the circumstances that lead up to such crashes, may be most effective way to achieve success. Some of the countermeasures proposed for impaired drivers in Chapter 1, such as responsible beverage service training and alternative transportation, are also appropriate for impaired pedestrians.

Use: Low. NHTSA has successfully implemented one zone-based program in Baltimore, Maryland that included public service announcements, posters, flyers, and interventions aimed at alcohol-impaired pedestrians, but the program is not currently active (Blomberg & Clevon, 2000). Most impaired-person programs focus on impaired drivers.

Effectiveness: Blomberg and Clevon (2000) found a 22% decrease in crashes among males 30-59 in the targeted zones where the intervention took place. Although encouraging, there have been no demonstrations of crash or injury reductions unless the communications and outreach is part of a comprehensive program that includes engineering measures and some form of law enforcement involvement, as in the case of Blomberg and Clevon (2000).

Costs: The costs for such a program can range from low to high, depending on the extent of the campaign that is designed and implemented.

Time to implement: The actual time to implement depends on the scope and ambition of the program.

3.2 “Sweeper” Patrols of Impaired Pedestrians

Effectiveness: ★	Use: Low	Cost: Varies	Time: Medium
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The purpose of “sweeping” alcohol-impaired pedestrians from the streets until they no longer have high BACs is intended to reduce the exposure to traffic of these at-risk pedestrians. As shown in 4.1 (above), pedestrians with high BACs are at high risk of injury due to motor vehicle crashes. A program of removing alcohol-impaired pedestrians from the streets can be effective in reducing their exposure and thus the risk.

There are some important issues that need to be resolved when setting up sweeper programs, such as how to identify at-risk pedestrians (e.g., calls from bars or direct observers, observation by police or health professionals), who picks up the targets, where they are kept until they are sober, whether friends or family need to be notified at the time of the pickup, how the pedestrians are returned home after the intervention, and how the costs of the program are borne.

Huntley (1984) focused on police “sweeper” squads and “support on call” programs involving taxis and trained escorts to get intoxicated people home. Services of these types in the Boston area were surveyed. Both types of services appeared practical and effective, though the number of people who could be reached by these services was relatively small. There was a problem related to the number of available detoxification beds in the community. The sweeper squads wanted to deliver intoxicated pedestrians to the mental health community, not to police facilities, and they stopped the sweep when the beds were filled. There were also problems with the number of taxi drivers who wanted to deal with intoxicated people and the availability of volunteer escorts.

Use: Well-publicized sweep operations, which involve picking up intoxicated people from the street and letting them “sleep it off,” have been conducted in Puerto Rico and in Gallup, New Mexico. Puerto Rico’s program, which included a statute, communications and outreach, and law enforcement training, led to a 7% drop in alcohol-related pedestrian crashes (Stewart, 1994). There appear to be no well-publicized programs operating now.

Effectiveness: Such programs typically reach only a fraction of those people who need the services. The sweeps typically deal with people who are too drunk to walk or even know that they are being “swept.” These same people are at risk while they are becoming intoxicated, and, in all likelihood, will be at risk again in the near future as they become sober. As described by Huntley (1984), these individuals need intensive treatment for alcoholism; and sweeper programs may be useful in identifying potential treatment candidates.

Costs: The program incurs ongoing costs directly related to the effectiveness, i.e., the number of people swept up. Depending on how it is set up, the program may incur costs related to the sweeper patrol (or law enforcement overtime), the use of facilities, and any subsequent treatment requirements.

Time to implement: Once it is decided to offer the program, the logistics for starting it up could be handled within weeks or months, depending on the extent and coordination of services.

Other issues:

- The legal rights of those potentially being swept need to be preserved.
- Often if law enforcement or other formal agencies are involved, their regular procedures would require some formal charge or other processing to take place. Alternatively, a sweeper program could be without subsequent consequences to those being swept, with no formal records kept. This might eliminate certain organizations or agencies from participating.

4. All Pedestrians

4.1 Pedestrian Safety Zones

Effectiveness: ★ ★ ★ ★	Use: Low	Cost: High	Time: Medium
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The pedestrian safety zone concept was developed in a joint effort study by NHTSA and FHWA (Blomberg & Cleven, 1998). The idea is to strive for large decreases in pedestrian crashes and injuries by more effectively targeting resources to problem areas. Specifically, the objective of pedestrian safety zones is to increase efficiency by targeting limited resources to geographic areas and audiences where significant portions of the pedestrian crash problem exist (NHTSA, 2008). Pedestrian zone programs, including education, enforcement, and engineering measures, can target at a full range of pedestrian crash problems within a limited geographic area or focused on particular types of problems that make up a large portion of the problem within a limited area.

Blomberg and Cleven (1998) implemented and analyzed an early pedestrian safety zone program in Phoenix, Arizona. Crash data were analyzed to identify areas where older pedestrian crashes occurred and “zones” were drawn around the high-incidence areas. Countermeasures were developed for the kinds of crashes that involved older pedestrians. The measures included signal retiming, providing communications and outreach for both drivers and pedestrians living near the crash zones, and enhanced enforcement. The result was a significant reduction in crashes and injuries to older pedestrians in the target areas.

In a recent Miami-Dade County, Florida, comprehensive application of the safety zone strategy, high crash zones were identified, and then the characteristics of those crashes were further analyzed within the zones (Zegeer et al., 2008a). The four zones, comprising less than 1% of the total land area of the County, accounted for about 20% of the total number of collisions (Zegeer et al., 2008b). Further analyses identified high child involvement in crashes in some areas, young adult involvement in others (particularly at night), and high senior involvement in certain corridors. Overall, there was an 8.5% to 13.3% reduction in pedestrian crash rates during and following the program implementation compared to control groups (Zegeer et al., 2008b).

Use: Pedestrian zone programs are known to have been implemented in only a handful of cities.

Effectiveness: Properly designed and implemented pedestrian zone programs have been shown effective in reducing crashes and injuries for older pedestrians (Blomberg & Cleven, 1998), for impaired pedestrians (Blomberg & Cleven, 2000), and for child and adult pedestrian crashes in Miami-Dade County (Zegeer, et al., 2008a, 2008b).

Costs: If properly done, pedestrian zone programs require up-front analysis and planning, countermeasure development and tailoring, and implementation.

Time to implement: Medium. A pedestrian zone program can take several months of concentrated activity before countermeasures can be implemented. More comprehensive programs, such as in Miami-Dade, may be years-long programs involving data analysis and on-

site evaluations, lining up partners, and identifying, implementing and evaluating countermeasures. Programs to date have included local task forces, usually assembled for the program, to take critical leadership roles.

4.2 Reduce and Enforce Speed Limits

Effectiveness: ★ ★ ★	Use: High	Cost: Low	Time: Varies
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The goal of reducing speeds is to increase reaction time for both drivers and pedestrians to avoid crashes, as well as reduce the severity of injuries that result when pedestrian crashes occur. Higher vehicle speeds produce more frequent and more serious pedestrian crashes and casualties. A literature review and analysis of pre-existing data estimates that 5% of pedestrians are killed when struck by vehicles traveling at 20 mph or less. This increases to 40% for vehicles traveling at 30 mph, 80% for vehicles traveling at 40 mph, and nearly 100 percent for vehicles traveling at 50 mph (Leaf & Preusser, 1999).

Reducing speeds through lowering speed limits is a time-honored countermeasure. Evidence shows, though, that actual speeds are reduced by only a fraction of the reduction in speed limits – typically 1-2 mph speed reduction for every 5 mph speed limit reduction. For maximum effectiveness, speed limit reductions need to be accompanied by communications and outreach that inform the public and make the case for the reduction and by heightened, visible enforcement (Leaf & Preusser, 1999). Some reasons that travel speeds do not decrease by the same proportion as speed limit reductions include drivers not noticing the new speed limit, drivers not understanding the reason to reduce speed or speeding out of habit, or drivers continuing to keep up with the speeds maintained by other drivers. Speed limit reductions need to be made compelling through rational speed limit setting and enforcement (TRB, 1998).

Speed limit reductions can be most effective when introduced to a limited area as part of a visible area-wide change, for example, identifying a downtown area as a special pedestrian-friendly zone through signs, new landscaping or “streetscaping”, lighting, etc. If done cleverly, this can be accomplished with relatively modest engineering changes and expense.

If speed limits are routinely ignored, then enforcing speed limits may be a more effective strategy than attempting to change them. Blomberg and Cleven (2006) reported on demonstration programs in two cities in which speed limit enforcement, combined with engineering changes and extensive publicity, reduced both average speeds and the number of excessive speeders in residential neighborhoods. For more information on strategies to reduce speeding, see Chapter 3.

See Chapter 3, Section 1.1, for further discussion of speed limits.

Use: High, in the sense that all public roads have a speed limit and speed limit enforcement is widely employed.

Effectiveness: Reduced speed limits and enforcement can reduce vehicle speeds and all types of crashes and crash severity. The association of pedestrian injury with speed trends strongly suggests that pedestrian injuries and crashes will be reduced if travel speeds are reduced, although direct evidence is lacking. Just changing speed limits is of limited, though positive, effectiveness as described above.

Costs: Simply changing speed limits is low-cost, only requiring updating speed limit signs or, where few signs exist, adding some new ones. Combining speed limit changes with communications and outreach, enforcement, and engineering changes can be significantly more expensive.

Time to implement: Depending on the scope of the program, the time can be very short, or it can take several months to a year to plan and implement a complex plan.

Other issues:

- Speed limit changes exist in the context of other, unchanged speed limits. The normal expectation is that there is an overall consistent approach to speed-limit setting. Where, for safety, some speed limits need to be reduced in a manner inconsistent with other speed limits, there must be clear and visible reminders that distinct conditions exist that justify the lower limits. For more information on setting speed limits and managing speeds, see TRB (1998), and Chapter 3, Section 1.1.

4.3 Conspicuity Enhancement

Effectiveness: ★ ★ ★	Use: Low	Cost: Low	Time: Medium
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The purpose of enhancing conspicuity for pedestrians is to increase the opportunity for drivers to see and avoid pedestrians at night. Pedestrians who are more visible are less likely to be struck. Retro-reflective materials are built into many shoes, including children's and athletic shoes. Other accessories, such as arm or leg bands, gloves, vests, and caps are available from sporting goods stores and other vendors. Light sources, including strobes and other flashing lights, are also available. Many have been designed for bicyclists but are equally applicable to pedestrians. The difficulty with most of these devices is that the user must decide in advance to take and use them. Because of this extra step, and because most of the conspicuity enhancements do not look like "normal" clothing, they are very much underused. Light-colored clothing, long a recommended solution, does little to improve conspicuity (NCHRP, 2004, Strategy B5).

There are a number of opportunities for improving pedestrian conspicuity. Devices designed to be semi-permanently fastened to children's clothing can be provided to parents through schools, group activities, or pediatricians. Light sticks and reflective bands can be supplied with new cars, or distributed by automobile clubs or insurance companies for use during vehicle breakdowns or emergencies.

Use: Retro-reflective materials are used regularly in athletic-type shoes, occasionally in backpacks and jackets, and minimally in other clothing.

Effectiveness: Widespread use of retro-reflective materials would increase the ability of drivers to detect pedestrians in time to avoid crashes. Pedestrians wearing good retro-reflective materials, particularly materials that highlight a person's shape and extremities, can be detected hundreds of feet farther than can pedestrians in normal clothing, even with low-beam illumination (NCHRP, 2004, Strategy B5). A study in a controlled (closed road) environment found that pedestrians were detected more readily when they wore reflective elements in a bio-motion configuration. Although standing still did reduce recognition by drivers as compared to walking, adding clutter to the background did not significantly reduce detection (Tyrrell et al., 2009).

Costs: Cost to provide retro-reflective materials is low, if such supplementary materials are distributed in quantity and added to existing programs. Such items as reflective wrist and ankle bands are available commercially. To develop new programs promoting use of conspicuity materials would require somewhat more planning and start-up time and costs would also depend on communications strategies used.

Time to implement: Promoting increased conspicuity may require development of targeted messages and a publicity strategy.

4.4 Targeted Enforcement

Effectiveness: ★ ★ ★	Use: Unknown	Cost: Medium	Time: Short
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The purpose of targeted enforcement is to increase compliance with appropriate traffic laws by both pedestrians and motorists. Behavioral pedestrian safety initiatives require drivers or pedestrians to change their walking or driving actions and habits. Once pedestrians and drivers are informed of the changes needed and why they are important, enforcement often is necessary to encourage compliance. Although enforcement was implied or stated for many of the earlier countermeasures, it deserves to be discussed separately.

Enforcement is most effective when it is highly visible and publicized, to reinforce the message of the required behavior and to raise the expectation that failure to comply may result in legal consequences. Enforcement campaigns should be aimed at drivers and pedestrians, starting with the communications and outreach efforts that announce, describe and publicize the campaigns.

A coordinated program of targeted enforcement should involve a range of support activities, such as communications and outreach to notify the public of the campaign, training for the law enforcement officers on enforcement goals and procedures, and training for prosecutors and judges so that they understand the purposes of the campaign and are prepared for the increase in citations that the enforcement will produce.

Use: Unknown. Enforcement is largely a local option, and often is integrated into other police duties, so special enforcement efforts are difficult to isolate and track. Several cities including Chicago and Miami have, within the past few years, implemented training for law enforcement officers and conducted targeted enforcement efforts for pedestrian safety.

Effectiveness: Targeted enforcement can be employed for a wide range of purposes in a wide range of circumstances, so effectiveness is context-dependent. In Queens, New York, enforcement was a key part of a campaign that included minor engineering adjustments and communications and outreach and reduced pedestrian fatalities (CDC, 1989). In Seattle, a variety of communications and outreach and enforcement combinations were tested in conjunction with a change in the law for drivers to yield to pedestrians at crosswalks; the authors concluded that enforcement was not successful in increasing driver yielding (Britt et al., 1995). Van Houten and Malenfant (2004) found that driver yielding to pedestrians increased in response to targeted police enforcement at crosswalks on two corridors in Miami Beach, Florida. Warnings and educational flyers were handed out to most violators, while citations were issued for flagrant violations. Some publicity resulted from the enforcement efforts. Yielding also increased to some extent at other untreated crosswalks in the affected corridors. Increases in yielding were sustained for up to a year following the two-week intensive enforcement efforts with nominal additional enforcement, but effects on crashes and injuries have not been reported.

Costs: The cost of the enforcement is a direct function of the size of the effort, the number of overtime officer hours and associated supplies, ranging from vehicle operating costs to equipment such as speed measurement devices or alcohol test machines.

Time to implement: Short. Law enforcement resources can be diverted to targeted enforcement very quickly. Support equipment can take longer to acquire and deploy, as can developing a plan that coordinates law changes, environmental changes, or support communications and outreach with enforcement activities. Communications and outreach are keys to maximal effectiveness.

4.5 Driver Training

Effectiveness: ★	Use: Low	Cost: Low	Time: Medium
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The purpose of pedestrian safety-related driver training is to increase the sensitivity of drivers to the presence and characteristics of pedestrians. Current training for new drivers typically includes relatively little information on other road users. Information on pedestrians can be significantly strengthened. Specifications for driver education curricula, typically a State requirement, can be adjusted to include more and more specific information on the status of the pedestrian in the traffic environment, right of way requirements for driver and pedestrian, other driver and pedestrian responsibilities, categories of pedestrian crash types, and key ways drivers can avoid being involved in such crashes. Standards for curriculum and training developed by the American Driver and Traffic Safety Education Association include some of these pedestrian-related learning objectives (Driver Education Working Group, 2009).

One way driver training can incorporate pedestrian and bicyclist concerns for new drivers is through “Share the Road” concepts and programs, though many focus exclusively on bicycles. One such resource is the State of New York’s highly readable *Sharing the Road Safely* (www.nysgtsc.state.ny.us/media/sharetheroad.pdf).

Use: As noted, all driver education curricula include some information on other road users, but the kind of expanded information recommended here is sparse.

Effectiveness: Driver education has not been shown to reduce overall crash rates. The objective for adding more pedestrian information would be to increase knowledge and desire to share the road safely with pedestrians, of how to avoid the most common types of crashes, and to improve drivers’ anticipation of and interactions with pedestrians – as well as improve their behavior as pedestrians.

Costs: Low. The cost would be for the development of the new segments of the standard curriculum and for getting it into the material used by driver education instructors and schools.

Time to implement: Material would need to be developed and integrated into the standard driver education curriculum, and adjustments made elsewhere in the curriculum to reflect likely additional time required for the new pedestrian material.

The same timeframe would be appropriate for making changes to official State driving manuals, license exams, and related material and procedures.

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9. Bicycles

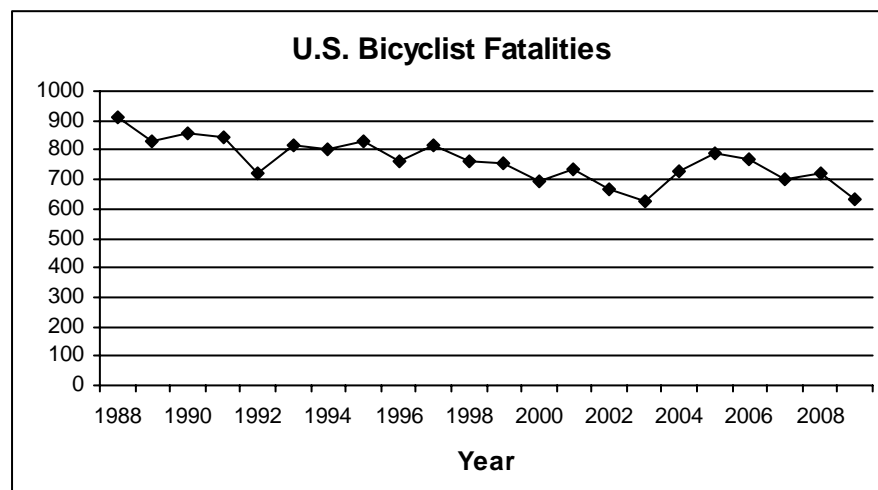
Overview

In 2009, 630 bicyclists died and 51,000 were injured in traffic crashes in the United States. Bicyclists accounted for 2% of total traffic fatalities and 2% of total injuries (NHTSA, 2010a).

Of the bicyclist casualties:

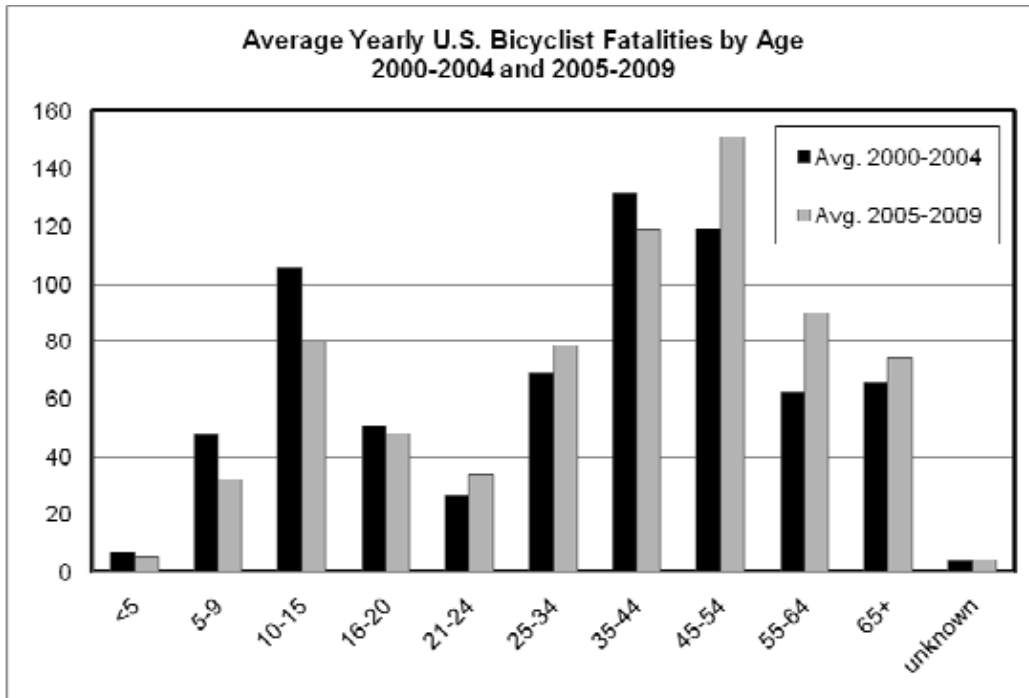
- 85 children 15 and younger were killed and about 10,000 were injured;
- 137 young adults 16 to 34 were killed and about 24,000 were injured;
- 244 adults ages 35 to 54 were killed and about 12,000 were injured;
- 164 adults 55 and older were killed and about 5,000 were injured;
- 87% of the bicyclists killed and 80% of those injured were male (NHTSA, 2010a).

Trends. Bicyclist fatalities dropped from an average of 815 per year for the years 1989 – 1993 to an average of 740 for the years 2004-2008, an approximate 9% decrease between these two time periods. There are substantial fluctuations in fatalities year-to-year.



Source: Traffic Safety Facts 2009, Early Edition (NHTSA, 2010b, Table 4)

Over the past decade, fatalities have decreased for bicyclists under 16 years old and increased for most adult ages. Comparing average yearly fatalities for 2004 to 2008 to those from 1999 to 2003, fatalities have risen substantially for adults 45 and older (see Figure). In 2008, the average age of bicyclists killed was 41, up from 32 in 1998. In 2008, the average age of bicyclists injured was 31, up from 24 in 1998 (NHTSA, 2009a).



Source data: FARS

It is also worth noting, especially as trends indicate increasing fatalities involving riders ages 45 and above, that older adult bicyclists are more vulnerable when involved in a crash. Recent data from Sweden found that older adult bicyclists were twice as likely to be hospitalized when injured, and spent three times as long in the hospital as cyclists under age 65 (Scheiman et al., 2010).

Fatality rate trends, that is fatalities adjusted per number of bicycling trips or miles traveled by bicycle, are unavailable because there is no consistent measure of bicycling to estimate and compare fatality rates. According to the Federal Highway Administration's National Household Travel Survey, the number of bicycling trips has, however, increased from 1.7 billion in 1990 (FHWA, 1990) to 3.3 billion in 1995 (FHWA, 1995) and 2001 (FHWA, 2001), though the various surveys used somewhat different methodologies. For example, the use of multiple prompts beginning with the 2001 survey has resulted in capturing more bicycle trips in the 2001 and later surveys (Hu & Reuscher, 2004). Preliminary results from the latest NHTS, conducted in April 2008 through May 2009, indicate that trips made by bicycle have again increased up to 4.1 billion per year (FHWA, 2010). In addition to the number of trips increasing, the proportion of all trips made by bicycle has generally trended upwards since 1990, from 0.7% to 0.9% in 1995 and 1% in 2009. (The exception to this upward trend was the 0.8% of trips made by bicycle in 2001.) While the increase might seem small, a change from 0.8% to 1% between 2001 and 2009 represents a 25% increase in the proportion of trips made by bicycle.

Another source of information comes from the U.S. Census. The Census data indicate that bicycle commuting increased by 43% between 2000 and 2008 to 0.6% of work trips (League of American Bicyclists, 2009). The 2009 NHTS estimated that a similar 0.7% of work trips were made by bike (FHWA, 2009). Commuting, however, makes up only about 7% of all bicycle trips (FHWA, 2009).

In addition to number of trips, exposure to traffic and crashes is affected by where, when, and for how long a cyclist rides, as well as the skill, knowledge and application of safe behaviors by the cyclist and the drivers around him or her. The risk of a crash may also be increased due to inattention, distraction, or impairment by either the bicyclist or driver. Emerging problems include the use of media players or other electronic devices while riding or driving.

Classifying crashes. Bicycle crashes can be classified into types based on bicyclist and motor vehicle pre-crash actions and the location of the crash. In the early 1990s this methodology was used to classify more than 3,000 bicycle-motor vehicle crashes in California, Florida, Maryland, Minnesota, North Carolina, and Utah (Hunter, Stutts, Pein, & Cox, 1996). The sample was approximately evenly divided among small/rural communities, medium-sized cities, and large cities (as opposed to representing the proportion of crashes that occurred in each of those area types). Of these bicycle-motor vehicle crashes:

- Half (51%) occurred at intersections or were related to intersections. The most common type of crash involved bicyclists riding out or through intersections and into the path of a motorist. The second most common type of crash involved motorists failing to yield at intersections. Another common type included motorists turning or merging into the path of a parallel moving bicyclist (same or opposite direction). Child bicyclists were over-represented when the bicyclist failed to yield at an intersection and adult bicyclists were over-represented in crashes at intersections where motorists turned across their path.
- Twenty-two percent of bicycle-motor vehicle crashes occurred at junctions with commercial and private driveways or alleys. Children were highly over-represented in these crashes.
- Twenty-seven percent of bicycle-motor vehicle crashes occurred at roadway sections with no special features; fatal and serious injuries occurred at a higher rate at such non-junction locations. Adult cyclists were over-involved in crashes with overtaking motor vehicles at midblock locations.

In the Hunter et al. (1996) study, bicyclist factors contributing to crashes, especially at intersections or other junctions, included bicyclists riding wrong-way. Thirty-two percent of all bicyclists in the study were riding against traffic; for intersection collisions, the proportion was 42%. In 15% of crashes, bicyclist riding wrong-way was coded as a contributing factor to the crash (Hunter et al., 1996). Bicyclist failure to yield was coded in 21% of the study crashes and stop sign violations were coded in 8%. Children were over-represented in stop-sign and yield violations and crashes on local and two-lane streets, whereas adults were more likely to contribute to their crashes through alcohol or drug use and lane position and lane change errors. The most common driver contributing factor was a yield violation at either an intersection or midblock location; however, as mentioned the bicyclist riding wrong-way may have been a contributing factor in such crashes.

Different crash types can be targeted by different countermeasures. The Pedestrian and Bicycle Crash Analysis Tool (PBCAT) software is available to assist jurisdictions in typing bicycle-motor vehicle crashes and developing a database that contains information on pre-crash maneuvers as well as other crash factors. States and communities can then analyze their own

bicycle crashes and can also use PBCAT and PedSafe (www.walkinginfo.org/pedsafe/) to help select appropriate countermeasures. PBCAT may be downloaded from www.walkinginfo.org/facts/pbcats/index.cfm. Registration is requested for this free software so the user may receive any software updates or important technical information.

Bicyclist attributes: Bicyclists come in all ages with many levels of knowledge, skill, perception and judgment. Thus, educational and enforcement programs must take these factors into account and be designed to target age-specific concerns and the knowledge, skills and behavioral attributes of these different groups of riders.

Bicycles have an even smaller profile than motorcycles, are usually purchased without head lights and rear active lights attached, and are more difficult for many motorists to notice than four-wheeled vehicles, especially at night. Because they are human powered, there may be substantial speed differentials between bicycles and motorized traffic. Bicyclists also lack the protective body of a motorized vehicle in the event of a crash and some riders feel uncomfortable mingling with traffic, especially in high speed, high volume situations.

Strategies to Reduce Bicycle Crashes and Injuries

Several strategies may be used to decrease bicycle crashes and injuries.

- Increase the use of properly fitted bicycle helmets by all bicyclists, including children and adults, and the enforcement of helmet laws to increase compliance.
- Increase the conspicuity of bicyclists.
- Reduce distracted riding or driving behaviors (cell phones, headphones, etc.). See the chapter on distracted and drowsy driving for countermeasures targeting drivers.
- Decrease riding or driving while impaired. See the chapter on strategies to reduce alcohol-impaired driving. Some of the countermeasures would be applicable to target any type of impaired roadway use.
- Enact laws to facilitate safe and efficient bicycling in traffic, to update and fill gaps in existing laws. Educate the public on any new laws.
- Increase traffic law compliance by both motorists and bicyclists. Train law enforcement officers in appropriate enforcement strategies. In particular, decrease wrong-way riding, sidewalk riding, and traffic control violations by bicyclists; and decrease speeding, cutting off bicyclists, passing too closely, or blocking or driving in a designated bicycle lane by motorists.
- Educate motorists and bicyclists on how they should interact safely with each other and what the relevant laws require.
- Improve bicycle handling skills for bicyclists of all ages.
- Tailor countermeasures to diverse populations, including groups such as recent immigrants who may not be familiar with United States traffic laws, the United States traffic environment, or may not speak or read English.

Finally, the idea that vulnerable road users' safety may be improved by increasing the numbers of bicyclists (and pedestrians) is gaining traction and some empirical support. If there are more

bicyclists on the road, it may enhance the likelihood that motorists will expect to see a bicyclist and be better prepared to respond appropriately. A 2009 scanning tour by U.S. transportation officials and researchers of Denmark, Sweden, Germany, Switzerland, and the United Kingdom reported that the concept of “safety in numbers” has motivated promotion of more bicycling and walking in these countries as a safety countermeasure (Fischer et al., 2010). Research from abroad as well as the United States finds that, although actual numbers of crashes may go up, individual risk of crashes with motor vehicles declines as numbers of bicyclists and pedestrians increase (Geyer, Raford, Ragland, and Pham, 2006; Jacobsen, 2003; Leden, Garder, and Pulkkinen, 2000).

Resources

The agencies and organizations listed below can provide more information on bicycle safety issues and countermeasures and links to numerous other resources.

- National Highway Traffic Safety Administration:
 - Bicycles - www.nhtsa.gov/Bicycles
 - Research and Evaluation - www.nhtsa.gov/Driving+Safety/Research+&+Evaluation
 - Behavioral Safety Research Reports - ntlsearch.bts.gov/repository/ntlc/nhtsa/index.shtm
- Federal Highway Administration:
 - Office of Human and Natural Environment (Bicycle and Pedestrian Program) www.fhwa.dot.gov/environment/bikeped/index.htm
 - Office of Safety: http://safety.fhwa.dot.gov/ped_bike/
 - Office of Research, Development, and Technology (Turner-Fairbank Highway Research Center), Human Centered Systems Research, Pedestrian and Bicycle Program – www.tfhrc.gov/humanfac/ped-bike.htm
- Association of Pedestrian and Bicycle Professionals: www.apbp.org
- Consumer Product Safety Commission: www.cpsc.gov
- Pedestrian and Bicycle Information Center: www.bicyclinginfo.org
- National Center for Safe Routes to School: www.saferoutesinfo.org
- League of American Bicyclists: www.bikeleague.org
- National Bicycle Safety Network: www.bicyclinginfo.org/network/
- National Center for Bicycling and Walking: www.bikewalk.org
- Bicycle Helmet Safety Institute: www.helmets.org
- SAFE KIDS Worldwide: www.safekids.org
- Safe Routes to School National Partnership: www.saferoutespartnership.org

Specific resources that provide further information on engineering, enforcement, and educational strategies are:

- *BIKESAFE: Bicycle Countermeasure Selection System* (Hunter, Thomas, & Stutts, 2006, and interactive selection tool at www.bicyclinginfo.org/bikesafe/)

- *National Cooperative Highway Safety Research (NCHRP) Report 500, Volume 18, A Guide for Reducing Collisions Involving Bicycles*, (NCHRP, 2008),
- *Pedestrian and Bicyclist Safety and Mobility in Europe*. (Fischer et al., 2010) FHWA's Office of International Programs report on pedestrian and bicycle safety scanning tour to Europe.

For more information on education, engineering, vehicular, and legislative practices and recommended strategies from Europe, refer to *Keeping Children Safe in Traffic* by the Organization for Economic Co-operation and Development (OECD) (2004).

Key Terms

- NHTS: National Household Travel Survey conducted last in 2009.
- SRTS: Safe Routes to School

Countermeasures That Work

Countermeasures to improve bicycle safety are listed below and discussed individually in the remainder of this chapter. The table is intended to give a rough estimate of each countermeasure's effectiveness, use, cost, and time required for implementation. The symbols and terms used are described below. Effectiveness, cost, and time to implement can vary substantially from State to State and community to community. Costs for many countermeasures are difficult to measure, so the summary terms are very approximate. See each countermeasure discussion for more information on each item.

All States are required by Congress and FHWA to have a Pedestrian and Bicyclist Coordinator in their Department of Transportation. The coordinator will be aware of active programs within the State and will have access to resources for implementing many of the countermeasures listed below.

1. Children

Countermeasure	Effectiveness	Use	Cost	Time
1.1 Bicycle helmet laws for children	★ ★ ★ ★ ★	Medium	Medium	Short
1.2 Safe Routes to School (SRTS)	★ ★	High	Low	Short
1.3 Bicycle education for children	★ ★	Unknown	Low	Short
1.4 Cycling skills clinics, bike fairs, bike rodeos	★	Unknown	Low	Short

2. Adult Bicyclists

Countermeasure	Effectiveness	Use	Cost	Time
2.1 Bicycle helmet laws for adults	★ ★ ★	Low	Low	Short

3. All Bicyclists

Countermeasure	Effectiveness	Use	Cost	Time
3.1 Active lighting and rider conspicuity	★ ★ ★	High*	Low	Varies
3.2 Promote bicycle helmet use with education	★ ★	Medium	High	Medium
3.3 Enforcement strategies	★	Unknown	Medium	Varies

*High for active lighting laws; unknown for promoting other conspicuity measures

4. Drivers and Bicyclists

Countermeasure	Effectiveness	Use	Cost	Time
4.1 Driver training	★	Low	Low	Medium
4.2 <i>Share the Road</i> awareness programs	★	Unknown	Medium	Medium

Effectiveness:

- ★★★★★ Demonstrated to be effective by several high-quality evaluations with consistent results
- ★★★★ Demonstrated to be effective in certain situations
- ★★★ Likely to be effective based on balance of evidence from high-quality evaluations or other sources
- ★★ Effectiveness still undetermined; different methods of implementing this countermeasure produce different results
- ★ Limited or no high-quality evaluation evidence

Effectiveness is measured by reductions in crashes or injuries unless noted otherwise. See individual countermeasure descriptions for information on effectiveness size and how effectiveness is measured.

Use:

- High: more than two-thirds of the States, or a substantial majority of communities
- Medium: between one-third and two-thirds of States or communities
- Low: less than one-third of the States or communities
- Unknown: data not available

Cost to implement:

- High: requires extensive new facilities, staff, equipment, or publicity, or makes heavy demands on current resources
- Medium: requires some additional staff time, equipment, facilities, and/or publicity
- Low: can be implemented with current staff, perhaps with training; limited costs for equipment, facilities, and publicity

These estimates do not include the costs of enacting legislation or establishing policies.

Time to implement:

- Long: more than one year
- Medium: more than three months but less than one year
- Short: three months or less

These estimates do not include the time required to enact legislation or establish policies.

1. Children

1.1 Bicycle Helmet Laws for Children

Effectiveness: ★ ★ ★ ★ ★	Use: Medium	Cost: Medium	Time: Short
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The purpose of bicycle helmet laws for children is to reduce the number of severe and fatal head injuries to children involved in bicycle crashes. Bicycle helmets, when used properly, reduce head injuries and fatalities. Attewell, Glase, and McFadden (2001) examined all research studies published between 1987 and 1998. They found that helmets reduced overall head injuries by about 60% and reduced fatalities by about 73%. A Cochrane review and meta-analysis reported a reduction in injury rates between 63% and 88% (Thompson, Rivara, & Thompson, 2006).

A helmet use law is a significant tool in increasing helmet use, but as with all laws effectiveness is related to implementation.

Legislation effectiveness is enhanced when combined with supportive publicity and education campaigns. See, for example, Rivara, Thompson, Patterson, and Thompson (1998), Kanny, Schieber, Pryor, and Kresnow (2001), and Rodgers (2002). The practical effect of bicycle helmet laws is to encourage parents to require their children to use helmets (and educate parents to serve as role models and wear a helmet despite the lack of a law).

Law enforcement and other safety officials can reinforce the need to wear a helmet through positive interactions such as free or discounted helmet distribution programs and incentives for helmet use. Publicizing helmet laws, and child/parent education on helmet fitting and the importance of wearing a helmet every ride may enhance effectiveness. Schools may also implement policies requiring helmet use by children riding to school.

Use: As of August 2010, 21 States, the District of Columbia, and at least 201 municipalities or counties have child helmet laws (BHSA, 2010). Most laws cover all bicyclists under age 16. Only 13 States have no State or local bicycle helmet laws.

Effectiveness: Two systematic reviews, of 12 studies and three studies respectively, using different study inclusion criteria found that legislation may be effective at increasing helmet use (Karkhaneh, Kalenga, Hagel, & Rowe, 2006; Macpherson & Spinks, 2007). The degree of improvement varied but there was a lack of evidence to determine whether enforcement, supporting publicity, and helmet distribution efforts explain some of the variation (Karkhaneh et al., 2006; Macpherson & Spinks, 2007). There was a non-significant trend toward a greater overall increase in helmet use in communities with laws covering all cyclists compared to those covering only children, and effects were larger among children (Karkhaneh et al., 2006). Study methods also explained some of the variation, with before-after studies resulting in a smaller effect sizes than cross-sectional control studies.

A Cochrane review examined the effectiveness of helmet use laws in reducing head injuries. Again, only three hospital-based studies met the strict inclusion criteria with respect to injury

reductions. Two of the three controlled studies reported reductions in head or traumatic brain injury following legislation (Macpherson & Spinks, 2007).

Earlier crash-trend analyses using FARS data suggested that State helmet-use laws for children reduce child bicycle fatalities by about 15% in the long run (Grant & Rutner, 2004). Wesson et al. (2008) examined before and after trends in child and adult fatalities in Ontario, Canada following implementation of a law requiring helmets for riders under 18 years of age. A reduction was found in child fatalities but not in adult bicycle-related deaths. Supporting data from one community suggested that the declines were not due to decreases in child bicycling. The authors attributed the lower child mortality rates to multiple factors including education, promotion, and general trends.

Costs: A helmet law should be supported with appropriate communications and outreach to parents, children, schools, pediatric health care providers, and law enforcement. NHTSA has a wide range of material that can be used to educate and promote the use of a helmet every ride, demonstrate helmet effectiveness, and educate and demonstrate how to properly fit a helmet. While helmets that meet safety requirements can be purchased for under \$20, States may wish to provide free or discounted helmets to some children. When considering the costs of providing helmets, agencies should consider the benefits. A NHTSA summary of helmet laws reported that “every dollar spent on bicycle helmets saves society \$30 in indirect medical and other costs” (NHTSA, 2008).

Time to implement: A bicycle helmet law can be implemented as soon as the appropriate legislation is enacted. Enacting local ordinances may take less time than enacting statewide legislation. To develop custom communications and outreach, train law enforcement officers on implementing the law, or start a helmet distribution or subsidy program in support of the law may require a medium-to longer-term effort.

1.2 Safe Routes to School

Effectiveness: ★ ★	Use: High	Cost: Low	Time: Short
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The goal of Safe Routes to School (SRTS) Programs is to increase the amount of bicycling and walking trips to and from school while simultaneously improving safety for children walking or bicycling to school. SRTS programs are community-based and are intended to be comprehensive in nature. Programs include education of children, school personnel, parents, community members, and law enforcement officers about safe bicycling and walking behavior and safe driving behavior around pedestrians and bicyclists. In addition, programs include enforcement and engineering activities to improve traffic safety and risky elements of the traffic environment around primary and secondary schools so children can safely bicycle or walk to school.

Beginning in 2005, SAFETEA-LU has required each State to have its own SRTS program including a full-time coordinator to manage Federal funds. Each year, up to 70% (but not more than 90%) of available Federal funding must be allocated on infrastructure (engineering) improvements, and up to 30% (but not less than 10%) of funding on non-infrastructure projects to encourage walking and bicycling to school (public awareness and outreach, enforcement near schools, education, and training for volunteers). Resources to support these efforts are available online from NHTSA on the pedestrian safety and bicycle safety pages and the National Center for Safe Routes to School (NCSRTS) Web site (www.saferoutesinfo.org). NCSRTS provides information, guidance, and support for community, State, and national SRTS efforts. A list of current State SRTS Coordinators may also be found at the NCSRTS Web site.

Use: With the establishment of the national SRTS program, all 50 States and the District of Columbia are now operating SRTS programs. Local SRTS programs exist in different forms in nearly all States.

Effectiveness: SRTS materials can be effective in teaching children and their parents how to evaluate and choose the safest routes for walking or bicycling to and from school. The material is derived from analyses of types of crashes associated with trips to and from school, but it has not been possible to directly evaluate effects of these programs on crashes and injuries. Although the full program emphasizes broad education, some specific implementations have centered on site-appropriate engineering changes; results have shown behavioral improvements for pedestrians, bicyclists, and motorists (NHTSA, 2004). Dumbaugh and Frank (2007) found that many of the safety benefits associated with SRTS countermeasures are assumed rather than known.

Costs: Activities associated with SRTS may be low cost and may also be eligible for grant funding (non-infrastructure grants mentioned above). Grants are administered by each State's SRTS coordinator. Significant materials and resources can be accessed at no cost. NCSRTS provides downloadable material for State and local SRTS programs.

Time to implement: Short. Once a school or district has decided to implement an SRTS program, a range of material, including an on-line step-by-step guide on getting started, is available from the NCSRTS. Programs funded through State DOTs typically require applications on a funding cycle and can take significantly longer to implement.

1.3 Bicycle Education for Children

Effectiveness: ★ ★	Use: Unknown	Cost: Low	Time: Short
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The purpose of bicycle education is to teach children traffic laws, how to ride on streets with traffic present, proper helmet use, and bicycle safety checks and maintenance. As part of a regular school curriculum, education can reach every student, but providing training outside of school settings such as through parks and recreation departments, community centers or churches may be more feasible in some circumstances. Community-based programs could also provide greater flexibility in tailoring to meet the needs of specific target groups.

Whether school or community-based, bicycle education should include, at a minimum, a demonstration and handout on how to properly fit a bicycle helmet, a helmet effectiveness demonstration, and an emphasis on wearing a helmet every ride. In addition, pedestrian safety training should be reinforced, making it part of a comprehensive traffic safety program, with components assembled from NHTSA or comparable programs. Many bicycle safety education materials target children in grades K-8, though some are aimed at younger children.

For a careful review of training programs, many aimed at school children, see Rivara and Metrik (1998). A listing of many training programs and their characteristics can be found in the FHWA Bicycle Safety Education Resource Center, available on the bicyclinginfo.org Web site. See also the *Good Practices Guide for Bicycle Safety Education* (FHWA, 2005).

NHTSA has also produced publications on how to properly fit a bicycle helmet, rules of the road and games to educate children and parents on bicycle safety. The material is available in English and Spanish on NHTSA's Bicycles page.

Use: The use of school-based programs, which is at the discretion of local school districts, is unknown. In-school education and training, however, is a frequent part of local Safe Routes to School programs. In addition to programs offered by teachers and school personnel, local bicycling coalitions sometimes offer age-appropriate bicycle training within a school setting. Examples are the Bicycle Transportation Alliance in Portland, OR, and the Hawaii Bicycling League. The prevalence of community-based programs is also unknown.

Effectiveness: Programs such as these can increase knowledge of laws and proper behaviors. A recent review of evaluations of 13 educational programs (without legislation enactment) among children and youth found that these programs were effective at increasing observed helmet use. Most of the programs also offered discounted or free helmet distribution. Meta-analyses found the odds of observed helmet wearing to be more than 2 times higher than at baseline or among the non-intervention group, but results were quite varied across the different studies (Royal, Kendrick, and Coleman, 2007). The authors were unable to tease apart differences in programs that might contribute to different outcomes other than whether they were community-based or school-based, and whether or not they offered free or reduced-priced helmets. Community educational programs that provided free helmets were reported to be more effective than programs set in schools or that provided only an opportunity to purchase a discounted helmet, although the latter types also increased use. School-based programs also tended to obtain best

results among the younger participants (Royal et al.). Three of the studies found helmet use benefits persisting at 9 to 12 months follow-up, although evidence is still lacking regarding longer-term (1 year or more). Based on the evidence of effectiveness of helmets at preventing head-injuries when worn, injury-reduction benefits would be expected from programs that increase proper use of helmets. Crash reduction benefits of educational programs have not been demonstrated. Evidence is also lacking as to whether programs might have any unintended effects such as reducing amounts of riding.

Costs: Coalitions may be paid by the State, or otherwise use SRTS funds. Teachers can provide education using NHTSA's free materials, but training, administration, and supervision of a comprehensive program could increase costs somewhat.

Time to implement: Short, for existing material; medium, to develop and disseminate a training curriculum with material.

1.4 Cycling Skills Clinics, Bike Fairs, Bike Rodeos

Effectiveness: ★	Use: Unknown	Cost: Low	Time: Short
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The purpose of cycling skills clinics, bike fairs, or bike rodeos is to teach children about traffic laws that apply to them and how to ride defensively in a number of traffic conditions. Young children are just learning about traffic. They have little experience with which to anticipate and interpret potential traffic hazards, and limited abilities to reason and react. Their brains are still developing and they lack the maturity and judgment needed to negotiate traffic safely and limit risk-taking behaviors. They are also less skilled at riding than older children or adults. Young children should not ride without supervision until they are at least ten years old and are able to ride in a straight line, swerve to avoid hazards in the roadway, comfortably start and stop their bicycles, and maintain balance at slow speeds.

A cycling skills clinic, bike fair, or rodeo is an event that provides children an opportunity to learn and practice bicycling skills. A clinic typically has several stations for specific skills and also includes bicycle and helmet inspections. Parental involvement can also be a valuable component of bicycle fairs, providing reinforcement of desired safe riding behaviors and modeling appropriate bicycling behaviors. Events should also include discussions and examples of proper bicycle helmet fitting.

There are a number of bicycle safety courses and models for fairs, rodeos, and clinics. Examples include Washington Area Bicyclist Association (undated), Chaplin (2005), Minnesota Safety Council (undated), and Williams and Burden (1994). In addition, the League of American Bicyclists has numerous League Certified Instructors across the country that can teach a variety of classroom-based and on-bicycle courses and new youth instructor training for those wishing to be certified to provide cycling skills clinics.

Use: Bicycle safety fairs and rodeos are local events. They are often run by law enforcement, school personnel, or other civic and volunteer organizations. There may be permanent “neighborhood” layouts where the rodeos are conducted, and the events may be scheduled as part of the elementary and middle school curriculum. Although the extent of use is unknown, they are increasingly implemented as part of Safe Routes to School projects.

Effectiveness: While rodeos can result in increases in knowledge and skills, a review of the research literature does not reveal any studies that document crash and injury reduction, at least not in isolation. One program of comprehensive education for preschool children and their parents, that included a skills and safety rodeo, led to a doubling of helmet use (Britt, Silver, & Rivara, 1998; Rivara & Metrik, 1998). Some studies have found that single event bike rodeos did not lead to increases in knowledge or improvements in behaviors or attitudes (Macarthur, Parkin, Sidky, & Wallace, 1998). However, the intent of a rodeo is to introduce or reinforce bicycle safety concepts as part of a more comprehensive program of traffic safety education and training, parent education, and other efforts. Again, see Rivara and Metrik (1998) for a more in-depth discussion.

Costs: A one-time rodeo can be operated with volunteers at minimal cost. A permanent rodeo facility could cost thousands of dollars.

Time to implement: A one-time rodeo can be organized in a few months. Implementing a permanent rodeo program with a facility may take up to a year or longer.

2. Adults

2.1 Bicycle Helmet Laws for Adults

Effectiveness: ★ ★ ★	Use: Low	Cost: Low	Time: Short
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As with helmet laws for children, the purpose of bicycle helmet laws for adults is to reduce the number of severe and fatal injuries resulting from bicycle crashes. Bicycle helmets, when used properly, reduce head injuries and fatalities. Attewell et al. (2001) examined all research studies published between 1987 and 1998. They found that helmets reduced overall head injuries by about 60% and reduced fatalities by about 73%. The Cochrane review and meta-analysis (Thompson et al., 2006) confirms these findings.

Use: No States have yet enacted laws requiring adults to wear bicycle helmets. About 60 localities require people of all ages to wear helmets when bicycling (BHSI, 2010).

Effectiveness: Likely to be effective. Ginsberg and Silverberg (1994) analyzed a prospective helmet law in Israel, finding a 3:1 benefit-to-cost ratio. Puder, Visintainer, Spitzer, and Casal (1999) found a helmet law for all ages produced higher helmet wearing than laws for children only; consistently, teens were least likely to wear helmets. Studies have also found that when children are accompanied by adults using helmets, the children are also more likely to be using helmets (Wesson et al., 2008). Universal (all ages) helmet requirements for motorcyclists result in the greatest reductions in fatalities and injuries (see Chapter 5, Section 1.1).

Costs: Minimal costs could be incurred for informing and educating the public and providing training for enforcement personnel.

Time to implement: A universal helmet use law can be implemented as soon as the law is enacted.

3. All Bicyclists

3.1 Active Lighting and Rider Conspicuity

Effectiveness: ★ ★ ★	Use: High*	Cost: Low	Time: Varies
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*High for active lighting laws; unknown for promoting other conspicuity measures

Improving bicyclist conspicuity is intended to make bicyclists more visible to motorists and to allow motorists more opportunity to see and avoid collisions with bicyclists. A common contributing factor for crashes involving bicyclists in the roadway is the failure of the driver to notice the bicyclist, particularly at night.

New bicycles must be sold with reflectors meeting the Consumer Product Safety Commission requirements. The reflectors may improve a bicycle's night-time visibility when they are illuminated by motor vehicle lights approaching from behind. Active bicycle lighting can be critical for the detection of bicyclists coming toward the path of a motor vehicle, because the bicyclist is outside the vehicle's headlight beam until the last moment (NCHRP, 2008). In most States and jurisdictions, bicycles ridden after dark are required by law to have active white front lights and most States also require red rear reflectors or lights. However, most bicycles do not come equipped with such lighting (Osberg, Stiles, & Asare, 1998). Efforts to increase enforcement of laws requiring use of lights is needed to maximize use of lights at night (NCHRP, vol. 18, 2008).

Though standard headlights and taillights are continuously lit, bicycle lights that flash are readily available; the user may even switch modes from continuously lit to flashing. Lights also may be applied to helmets or backpacks to make the rider more conspicuous to other vehicles. More extreme lighting is also available. For example, bright neon tubes are designed to be mounted on the bicycle frame, where they cast a bright, broad pattern of light onto the roadway, creating the illusion of a vehicle much wider than a bicycle.

Most active lights are not permanently mounted on bicycles, so they may not be available when needed. Newer mounting devices may, however, make it easy to attach or remove the lights as needed. Batteries also last much longer with LED lighting, increasing convenience and safety. Communications and outreach to the general public and law enforcement officers about State and local laws regarding the use of active bicycle lighting should be provided.

Additional materials attached to bicyclists or bikes can increase their conspicuity day or night. For daytime, bright-colored or fluorescent clothing, including shirts, vests, caps, etc., make the bicyclist more noticeable. In low light conditions (rain, fog, etc.) and at night, the same items can have retro-reflective materials incorporated in them, to make the bicyclist visible and identifiable from much greater distances. Retro-reflective bicycle tires are also available, but may be costly. White or light-colored clothing, long a recommended solution, does little to improve conspicuity (NCHRP, 2008, Strategy F2).

Use: Most States have laws requiring use of active lights and reflectors on bikes ridden at night. There is no data on how frequently active lighting is used among those who bicycle after dark,

but bicyclists involved in collisions at night appear to use lights infrequently. Use of bicycle reflectors is high since they come pre-attached to bicycles at purchase.

Use of retro-reflective clothing is unknown. Most, if not all, athletic shoes contain some retro-reflective material. Some athletic clothing also has retro-reflective material. Bicycle helmets may have retro-reflective elements. Some bicyclists may be seen wearing additional retro-reflective materials, such as vests, jackets, arm bands, or rear-mounted reflective triangles.

Effectiveness: A Cochrane review of studies of pedestrian and bicycle conspicuity aids concluded that “fluorescent materials in yellow, red and orange improved driver detection during the day...” (Kwan & Mapstone, 2004). Even low beam headlights can illuminate figures wearing florescent materials hundreds of feet away, much farther than figures wearing normal clothing (NCHRP, 2004, Strategy B5; NCHRP, 2008, Strategy F2). One study among a cohort of riders participating in a large mass bicycle event found results suggesting that consistent use of fluorescent colors provides a protective effect against crashes and injuries (Thornley, Woodward, Langley, Ameratunga, & Rodgers, 2008).

The challenge is getting bicyclists to wear retro-reflective materials and use proper lighting routinely. It is possible to obtain widespread use of lighting. Osberg et al. (1998) found nearly half of nighttime bicyclists in Paris used active lighting, compared to just 14% of Boston bicyclists, reflecting differences in laws, public health priorities, and perceived risk.

Evidence is unavailable about the effectiveness of various conspicuity promotional measures, or of laws requiring use of active lighting at increasing use. NCHRP (2008) suggests that increased enforcement of laws enhanced by coordinated communications and outreach efforts could heighten awareness among cyclists of the need for using proper lighting and the benefits of retro-reflective materials at enhancing conspicuity. Logic suggests that if bicyclists are more noticeable, the frequency and severity of crashes would likely be reduced.

Costs: Moderate costs are involved for communications and outreach and for law enforcement training to enforce active lighting laws. Conspicuity-enhancing gear such as retroreflective wrist and ankle straps, are sometimes distributed for free in such promotional programs. Additional costs for such materials are modest.

Time to implement: Brochures and flyers for a bicycle safety education campaign highlighting conspicuity can be created quickly. Several months can be taken up by designing, producing, and implementing the communications and outreach and law enforcement training for enforcing active lighting laws. See section 3.3 for more on enforcement and available resources.

3.2 Promote Bicycle Helmet Use with Education

Effectiveness: ★ ★	Use: Medium	Cost: High	Time: Medium
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The purpose of bicycle helmet promotions is to increase use of helmets and thereby decrease the number of severe and fatal injuries to bicyclists involved in crashes. Bicycle helmet promotions are frequent, but are usually aimed only at child bicyclists, often through youth health organizations and schools. Promotions can target various barriers to helmet use, including lack of a helmet, lack of understanding of the importance of helmet use, and negative attitudes or beliefs about helmet use. Programs that provide helmets can include sponsoring organizations and often involve law enforcement and schools to deliver helmets and teach their proper use. Promotions can be conducted through single events or extended campaigns to promote helmet distribution and use. Expanding helmet promotions to include adults requires an expansion in focus, and perhaps different sponsors. However, adding adult-oriented riding tips may increase the appeal of the program. Other adult-oriented strategies should also be included, such as peer-based interventions on a college campus (Buckley, Sheehan, & Chapman 2009).

Regardless of the target audience, bicycle helmet promotions must include instruction on how to properly fit the helmet and the importance of wearing helmets on every trip. Programs might also need to target differences in tendency to adopt helmet use for different riding purposes (e.g. recreational versus commuting), or riders who identify as only one type of rider (Kakefuda, Stallone, & Gibbs, 2009). All bicyclists could benefit from utilizing resources that demonstrate how helmets work to reduce injury. Moreover, further efforts are needed to encourage parents and authority figures (e.g., law enforcement officers, school officials) to reinforce and model desired behaviors including the use of a properly fitted bicycle helmet every ride. Trained and skilled cyclists may also be more likely to adopt helmet use (Kakefuda et al., 2009), so adult bicycle training programs that incorporate the importance of helmet use may help increase wearing by adult riders.

Use: Most States have conducted bicycle helmet promotions for children within the last few years, although only a few have ongoing or regular programs. Some States have conducted bicycle helmet promotions for a general audience.

Effectiveness: Bicycle helmets are proven to reduce injuries and fatalities (see Chapter 9, Sections 1.1 and 2.1). Helmet promotions are successful in getting more helmets into the hands of bicyclists. Rouzier and Alto (1995) describe a comprehensive program of presentations, media coverage, messages from doctors to patients, as well as low-cost helmet availability, which significantly increased helmet purchases and use for all ages. A peer-led, social marketing program on a medium-sized college campus also raised observed helmet use, at least for the short term (Ludwig, Buchholz, & Clarke, 2005). A school-based injury-reduction program targeting 13- and 14-year-olds based on the theory of planned behavior and incorporating opportunities for instruction, demonstration, rehearsal, feedback, social reinforcement and practice was associated with a 20% increase in observed rate of helmet use among this challenging target age group at 6 months follow-up (Buckley et al., 2009). Programs that increase proper use of helmets would be expected to reduce injuries (see section 1.3).

Costs: The cost for underwriting large numbers of helmets can be quite high, including supporting communications and outreach material. Adequate helmets can be purchased for as little as \$8 each, within reach of most adult bicyclists. Making those helmets or more expensive ones available at no cost or reduced cost, through subsidies or merchant-manufacturer participation, could greatly increase the possible impact of the program by making helmets available to all at-risk segments of the population.

Time to implement: A good campaign, including market research, material development, and message placement, will require at least six months to plan and implement.

3.3 Enforcement Strategies

Effectiveness: ★	Use: Unknown	Cost: Medium	Time: Varies
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The purpose of targeted enforcement is to increase compliance with appropriate traffic laws by both bicyclists and motorists. Enforcement of traffic laws for all operators, including speed enforcement, may help to reduce the severity and frequency of collisions as well as promote bicycle safety. (See Chapter 3 for more information on strategies to reduce aggressive driving and speeding.)

The SHSO can help ensure correct riding through a communications and outreach campaign and through training law enforcement officers about the laws, the safety benefits of obeying the laws, and how to enforce bicycle safety-related laws. Some types of violations may be especially pertinent to bicyclist safety. For example, motorists may violate bicyclist' right-of-way following an overtaking maneuver by immediately turning across the bicyclist's path, or passing a bicyclist too closely. Similarly, bicyclists riding the wrong-way put themselves at greater risk of head-on collisions or angle collisions with motorists pulling out at side streets who are looking to the left for oncoming traffic. By enforcing relevant laws, the motoring and bicycling public may become better-informed about the risk of these types of violations and importance of obeying all traffic laws. Law enforcement can also reinforce active lighting and helmet use laws in effect by stopping and educating offending bicyclists as well as writing citations if appropriate. (Also see Chapter 9, Section 1,1, and BIKESAFE Law Enforcement countermeasure, www.bicyclinginfo.org/bikesafe/countermeasure.cfm?CM_NUM=40 for more information.)

Specific training for law enforcement to enhance the safety of bicyclists can be found from several sources including:

- Pedestrian and Bicycle Information Center:
www.bicyclinginfo.org/enforcement/training.cfm
- NHTSA's *Enhancing Bicycle Safety: Law Enforcement's Role*:
www.nhtsa.gov/Driving+Safety/Bicycles/Enhancing+Bicycle+Safety:+Law+Enforcement's+Role
- Safe Routes to School's *Enforcement: Role for Law Enforcement in SRTS*:
www.saferoutesinfo.org/resources/enforcement_role-for-law-enforcement.cfm

These products can satisfy the needs of departments regardless of how they choose to emphasize bicycle safety. Additional training for prosecutors and judges is important as well so that there is appropriate follow-up for citations throughout the judicial system. Educational diversion programs are an alternative to other penalties, for adjudication of citations involving bicyclists. Diversion programs may be easier to implement in settings such as universities and college campuses.

Use: Unknown. Targeted enforcement of bicycle-related violations is likely a rarely used intervention.

Effectiveness: Gilchrist, Schieber, Leadbetter, and Davidson (2000) describe an enforcement program in Georgia that impounded the bicycles of unhelmeted children and produced long-term

increases in helmet wearing. This specific example seems unlikely to be broadly popular. Increasing community awareness and law enforcement efforts through the training courses and approaches noted above could, however, yield benefits that go beyond bicycle safety, to include improved community relations and more positive interactions between law enforcement and members of the community.

Costs: Training currently exists for law enforcement officers. Roll-call videos can be implemented at essentially no cost to the departments. The CD-ROM training can be taken by officers on their work or personal computer. It has been designed and incentivized to allow them eligibility for in-service training hours. The longer courses take officers away from their regular duties or require overtime commitment and may incur a financial cost as well. SHSOs may be able to provide funding for departments to participate in such training. Training for prosecutors and judges would likely need to be developed, as would a supporting communications and outreach program for the public, motorists and bicyclists.

Time to implement: For existing law enforcement training, with ongoing presentation schedules, implementation time can be quite short. For the full effort described above, a longer time frame would be needed.

4. Drivers and Bicyclists

4.1 Driver Training

Effectiveness: ★	Use: Low	Cost: Low	Time: Medium
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The purpose of addressing bicycle safety as part of driver education is to increase the sensitivity of drivers to the presence and characteristics of bicyclists and how to safely share the road with them. Although driver education and most State driver manuals address sharing the road with bicyclists, many spend relatively little time on the topic. Model driver handbook materials that may be adapted by States to enhance their driver handbook information on sharing the road with bicyclists were released by NCHRP (Thomas, Stutts, & Gillenwater, n.d.). These materials could also be used in driver education courses. Other existing print and electronic publications could also be used to increase the emphasis on driving around bicyclists. For example, the Utah Department of Health developed a 12-minute video to be shown in driver education classes to reinforce how drivers can safely share the road with bicyclists.

One standard approach would be to implement a *Share the Road* module (see section 4.2), covering interactions with bicyclists into driver education curriculums. For complete coverage, the same messages would need to be included in State-provided material for new drivers and covered by new questions added to the license knowledge exam. Standards for driver education curriculum and training developed by the American Driver and Traffic Safety Education Association mentions sharing the road with cyclists and pedestrians as a learning objective (Driver Education Working Group, 2009).

For links to more resources and discussion of considerations in educating motorists about bicycle safety, see the Pedestrian and Bicycle Information Center, under Educating Motorists (www.bicyclinginfo.org/education/motorists.cfm).

Use: As noted, all driver education curricula have some coverage of bicycles on the road. However, enhanced modules in the spirit of this countermeasure are quite likely rare.

Effectiveness: Driver education has not been shown to reduce overall crash rates. The objective for adding more bicycle information would be to increase knowledge and desire to share the road safely with bicyclists, of the most common crash types and hazards and to improve new drivers' anticipation of and interactions with bicyclists – as well as improve their behavior as bicyclists.

Costs: Materials such as those listed above are available from TRB, AAMVA and the League of American Bicyclists. The cost would be for the adaptation or development of the new segments of the standard curriculum and for getting it into the material used by driver education instructors and schools. Changes to State driver manuals and other publications could be done within the normal material update budget.

Time to implement: Material would need to be adapted and integrated into the standard driver education curriculum, and adjustments made elsewhere in the curriculum to reflect likely additional time required for the new bicycle material.

The same timeframe would be expected for making changes to official State driving manuals, license exams, and related material and procedures.

4.2 Share the Road Awareness Programs

Effectiveness: ★	Use: Unknown	Cost: Medium	Time: Medium
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The purpose of Share the Road programs is to increase drivers' awareness of bicyclists, as well as improve both bicyclist and driver compliance with relevant traffic laws. *The National Strategies for Advancing Bicycle Safety* was developed from a July 2000 conference of bicycle advocates, injury prevention specialists, and government representatives (NHTSA, 2001). The result was five goals, each with a series of strategies and action steps. The first goal, Motorists Will Share the Road, called for the creation of a "coordinated 'Share the Road' public education campaign that can be adapted at the State and local levels."

For an example of communication and outreach material, see www.bicyclinginfo.org/ee/ed_motorist.htm.

Use: Unknown.

Effectiveness: Share the Road awareness materials can be effective in increasing knowledge and appropriate attitudes, but as with other awareness programs, there is no evidence of behavior change or reductions in crashes.

Costs: Medium, including the costs to develop new publications or tailor current ones. The material can be delivered as training for specific target audiences, such as new drivers or all high school students, or drivers as they renew their licenses, or general communications and outreach intended for mass media delivery.

Time to implement: A good campaign, including market research, message development and testing, and implementation, will require at least six months to plan and implement.

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