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Chapter 8

Motor Vehicle Occupant Injury

*Insufficient evidence means that we were not able to determine whether or not the intervention works.

The Task Force approved the recommendations in this chapter in 1998 (child safety seats), 2000 (safety belts), and 2000–2002 (alcohol-impaired driving). The research on which the findings are based was conducted between 1966 and March 1998 (child safety seats); 1966–June 2000 (safety belts; alcohol-impaired driving; and 1966–December 2001 (mass media campaigns). This information has been previously published in the American Journal of Preventive Medicine [2001;21(4S):16–22, 23–30, 31–47, 48–65, 66–88; and 2004;27(1):57–65, 66] and the MMWR Recommendations and Reports series [2001; 50(no. RR-7):1–13]. No updates have been issued since journal publication.

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Motor vehicle–related injuries are the leading cause of death among children and young adults in the United States[1,2] and the leading cause of death from unintentional injury for people of all ages.[2,3] More than 41,000 people in the United States die in motor vehicle crashes each year,[4] and another 3.5 million people sustain nonfatal injuries.[1] Crash injuries result in about 290,000 hospitalizations and 3.4 million emergency department visits annually.[2]

Viewed from a purely economic perspective, the societal burden of crash injuries and deaths is tremendous. Motor vehicle–related deaths and injuries cost the United States more than $230 billion annually, including $59 billion in property damage, $61 billion in lost productivity, and $33 billion in medical expenses.[5] Alcohol-related crashes contribute substantially to these costs, with a direct economic impact of about $51 billion in 2000 alone.[5]

Reduction of motor vehicle injuries remains a formidable public health challenge, despite sharp declines in motor vehicle–related death rates since 1925.[6] Three of the most important preventive measures to further reduce motor vehicle occupant injuries and deaths are use of child safety seats, use of safety belts, and deterrence of alcohol-impaired driving.[7,8]

This chapter provides recommendations on interventions to increase use of child safety seats, to increase use of safety belts, and to reduce alcohol-impaired driving. These areas were chosen because (*1*) use of child safety seats and safety belts are below national goals;[9] (*2*) 55% of traffic deaths are among motor vehicle occupants who were not properly restrained;[4] and (*3*) 41% of traffic deaths involve alcohol.[4] In addition, these three behaviors are modifiable risk factors that can be addressed using a variety of intervention strategies. Thus, reducing these three risk behaviors could dramatically reduce injuries to motor vehicle occupants.

OBJECTIVES AND RECOMMENDATIONS FROM OTHER ADVISORY GROUPS

The interventions recommended by the Task Force can be used to achieve objectives set out in *Healthy People 2010*[9] and by the National Highway Traffic Safety Administration (NHTSA; Table 8–1). In addition, the recommendations complement and add to information published by other groups. For example, the U.S. Preventive Services Task Force recommends counseling individual patients (including adults and parents of young children) to use occupant restraints (lap-shoulder safety belts and child safety seats), to wear helmets when riding motorcycles, and to refrain from driving while under the influence of alcohol or other drugs.[12] The American Academy of Pediatrics[13,14] (AAP; www.aap.org) suggests ways for pediatricians to implement office-based injury prevention counseling through The Injury Prevention Program (TIPP). The National Center for Injury Prevention and Control (Centers for Disease Control and Prevention; www.cdc.gov/ncipc/) makes recommenda-

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Table 8–1. Selected *Healthy People 2010*[9] Objectives and NHTSA* Goals Related to Motor Vehicle Occupant Injury

Healthy People 2010 Objective	*NHTSA Goal*
General	
Reduce deaths caused by motor vehicle crashes from 15.0 per 100,000 persons (1998 preliminary data, age adjusted to the year 2000 standard population) to 9.0 (Objective 15–15a)	Reduce the number of fatal and nonfatal injuries to no more than 1.0/100,000,000 vehicle miles traveled by 2008 (from 1.7 in 1996)[10]
Reduce deaths from 2 per 100 million vehicle miles traveled (in 1997) to 1 (15–15b)	
Reduce nonfatal injuries caused by motor vehicle crashes from 1270 per 100,000 persons (in 1997) to 1000 (21% improvement) (15–17)	
Child Safety Seat Use	
Increase use of child restraint devices for passengers up to 4 years of age from 92% (1998 preliminary data) to 100% (15–20)	Reduce child occupant fatalities (0–4 years) by 25% by 2005 (from 653 fatalities in 1996)[11]
Safety Belt Use	
Increase use of safety belts from 69% (in 1998) to 92% (33% improvement) (15–19)	Increase national seat belt use to 79% by 2004 (from 73% in 2001)[10]
Alcohol-Impaired Driving	
Reduce deaths caused by alcohol-related motor vehicle crashes from 6.1 per 100,000 persons (1997 baseline) to 4 per 100,000 (26–1a)	Reduce alcohol-related fatalities to no more than 0.53/100 million vehicle miles traveled by 2004 (from 0.63 in 2001)[10]
Reduce injuries caused by alcohol-related motor vehicle crashes from 122 per 100,000 persons (1997 baseline) to 65 per 100,000 (26–1b)	
Reduce the proportion of adolescents who report that they rode, during the previous 30 days, with a driver who had been drinking alcohol from 37% (in 1997) to 30% (26–6)	
Extend administrative license revocation laws, or programs of equal effectiveness, for persons who drive under the influence of intoxicants from 41 states (in 1998) to all states and the District of Columbia (26–24)	
Extend legal requirement for maximum blood alcohol concentration levels of 0.08% for motor vehicle drivers aged 21 years and older from 16 states (in 1998) to all states and the District of Columbia (26–25)	

*NHTSA: National Highway Traffic Safety Administration, U.S. Department of Transportation.

Reprinted from Am J Prev Med, Vol. 21, No. 4S, Task Force on Community Preventive Services, Recommendations to reduce injuries to motor vehicle occupants: increasing child safety seat use, increasing safety belt use, and reducing alcohol-impaired driving, p. 17, Copyright 2001, with permission from American Journal of Preventive Medicine.

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tions through the MMWR (Morbidity and Mortality Weekly Report; www.cdc.gov/mmwr/) on child safety seats, safety belts, and alcohol-impaired driving. Recommendations are also available from NHTSA[15] (www.nhtsa.dot.gov), the National Transportation Safety Board[16] (www.ntsb.gov), the American Medical Association (www.ama-assn.org),[17] and the Department of Health and Human Services (HHS; www.dhhs.gov).[9]

METHODS

Methods used for the reviews are summarized in Chapter 10. Specific methods used in the systematic reviews of motor vehicle occupant injury have been described elsewhere[18] and are also available at www.thecommunityguide.org/mvoi. Figure 8–1 depicts the conceptual framework used in these reviews.

ECONOMIC EFFICIENCY

A systematic review of economic evaluations was conducted for all recommended interventions, and a summary of each review is presented with the related intervention. The methods used to conduct these economics reviews are summarized in Chapter 11.

RECOMMENDATIONS AND FINDINGS

This section presents a summary of the findings of the systematic reviews conducted to determine the effectiveness of the selected interventions in this topic area. Interventions are grouped into three categories: increasing child safety seat use, increasing safety belt use, and reducing alcohol-impaired driving.

Increasing Child Safety Seat Use

For children up to four years of age, correctly installed child safety seats reduce injury-related hospitalization by 69%,[19] and they reduce the risk of death by 70% for infants and by 47%-54% for toddlers (aged 1–4 years).[20] If all children in this age group rode in safety seats, an additional 138 lives could be saved each year and 20,000 injuries could be prevented.[4,21]

Nearly 30% of children under the age of four do not ride in a proper child restraint, and are therefore at twice the risk of fatal and nonfatal injuries of those riding restrained.[4,22,23] Of those children riding in safety seats, approximately 85% are improperly restrained.[24] Seating position imposes an additional risk factor: in passenger vehicles, children aged 12 years and younger are 36% less likely to die in a crash if seated in the back seat.[25]

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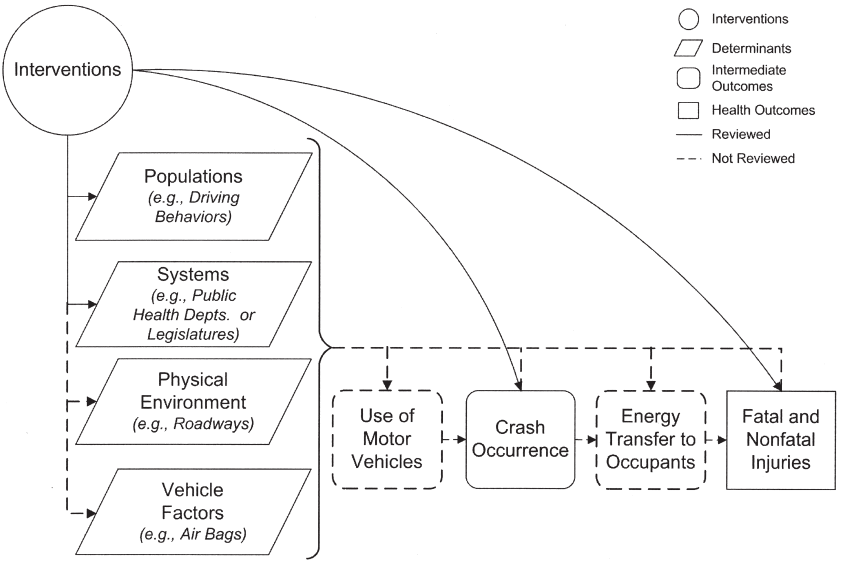

Figure 8–1. Logic framework illustrating the conceptual approach used in the systematic reviews of interventions to reduce injury to motor vehicle occupants. (Reprinted from Am J Prev Med, Vol. 21, No. 4S, Zaza S et al., Methods for conducting systematic reviews of the evidence of effectiveness and economic efficiency of interventions to reduce injuries to motor vehicle occupants, p. 25, Copyright 2001, with permission from American Journal of Preventive Medicine.)

Some groups of children are at greater risk than others. Child safety seat ownership and use are lower among rural populations and low-income families.[23,26–28] Although these families may not be able to afford safety seats, it may well be worthwhile to provide them for free or at a reduced cost, as 95% of low-income families who have safety seats use them.[21,29–31]

This chapter does not look at children who are too old or large to sit in child safety seats but who are too small to wear safety belts without the use of booster seats (generally children aged four to eight years).[32] Future updates of these reviews and recommendations should address this vulnerable population. Many of the studies reviewed were conducted when rates of child safety seat use were much lower than they are at present. Based on patterns observed with interventions to increase safety belt use, increased baseline usage rates could cause the effects of child safety seat interventions conducted in the future to be smaller than those reported in these reviews.[33]

Child Safety Seat Laws: Recommended (Strong Evidence of Effectiveness)

Child safety seat laws require children traveling in motor vehicles to be buckled into federally approved infant or child safety seats that are appropriate for

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the child's age and size. All states currently have child safety seat laws in place. The laws, which vary from state to state, specify the children they cover in terms of age, height, weight, or a combination of these factors.

Effectiveness

- Child safety seat laws are effective in reducing fatal injuries to children by approximately 35%.
- These laws are also effective in reducing all injuries to children by approximately 17%.
- These laws are also effective in increasing child safety seat use by approximately 13 percentage points.

Applicability

- These findings should be generally applicable in all U.S. communities.

The findings of our systematic review of child safety seat laws are based on nine studies evaluating the effectiveness of child safety seat laws that went into effect between 1978 and 1986 in the 50 states.[34–42] An additional 14 studies were identified but did not meet our quality criteria and were excluded from the review.[43–56] Two additional reports provided information on a study already included in our review.[57,58] All the laws allow for primary enforcement, which means that a driver can be stopped, cited, or fined simply for not restraining child passengers properly. The laws apply to children of various ages: some apply to children up to one year old and others apply to children up to five years old. Most laws do not specify a seating position, although one law applies only to children in the front seat. The various laws allow for penalties ranging from an oral warning to a $25 fine. No studies in this review examined other activities related to child safety seat laws, such as programs to lend seats to low-income families, levels of enforcement, or publicity about the law.

Child safety seat laws led to a 35% decrease in fatal injuries (range, 25.0% to 57.3%) and a 17.3% decrease in any type of injury (range, 10.5% to 35.9%). They also led to a 13 percentage point increase in child safety seat use (range, 5.0 to 35.0). The effect was the same for children of all ages covered by the law. Not enough information was available to determine how the other requirements of the laws (such as seating position or penalties) affect injury rates. These results show that child safety seat laws are effective in decreasing both fatal and nonfatal injuries and in increasing the use of the safety seats.

The results of these studies should be applicable to most child passengers in the United States. However, more specific information on applicability is not available because none of the studies looked at age, sex, race, socioeconomic status, or regional differences within states.

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We did not find any other positive or negative effects of child safety seat laws, nor did we find any economic evaluations.

One barrier to strengthening or enhancing enforcement of these laws may be resistance to such changes by people who believe that the laws limit parental discretion.

In conclusion, the Task Force recommends maintaining or implementing child safety seat laws on the basis of strong evidence of their effectiveness in reducing injuries to children and increasing safety seat use. The findings of this review should be applicable in most communities in the United States.

Distribution and Education Programs: Recommended (Strong Evidence of Effectiveness)

Distribution and education programs provide free or low-cost child safety seats to parents, along with education about proper use of the seats. The idea behind such programs is that parents who cannot afford a safety seat or who have a poor understanding of the importance of the seat might be more likely to use it if they receive financial help in acquiring a safety seat and learn about the importance of using it.

Effectiveness

- Safety seat distribution and education programs are effective in reducing injuries by approximately 6%.
- These programs are also effective in increasing rates of correct child safety seat use by approximately 23 percentage points.
- The programs are also effective in increasing possession of child safety seats by approximately 51 percentage points.

Applicability

- These findings should be generally applicable across a range of settings and populations.

Other Effects

- A potential harm exists. The safety of seats that have been involved in crashes cannot be guaranteed, and such seats should be discarded. Programs must use new, not refurbished, seats and ensure that loaner seats that have been involved in crashes are discarded.

The findings of our systematic review of distribution and education programs are based on 10 studies that evaluated programs providing free loaner child safety seats, low-cost rentals, or direct giveaways to parents.[31,59–67] An additional seven studies were identified but did not meet our quality criteria and were excluded from the review.[29,68–73] The programs reviewed also gave parents information on how to use the seats correctly. This educational compo-

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nent varied considerably across programs in terms of content, length, intensity, and type of teaching method. Some programs simply provided lectures, brochures, or pamphlets on how to use the safety seat, whereas others used more active educational and behavioral techniques, such as discussions, problem solving, demonstrations, or rehearsal of correct use. These programs primarily focused on parents of infants rather than older children.

One program showed a relative decrease of 6.4% in fatal and nonfatal injuries of children up to age four. Measurements taken at the end of each of the 10 programs showed improvements in the correct use of child safety seats (median 22.6 percentage point increase; interquartile range, 4.0 to 62.3). Three programs also assessed safety seat use a second time, within a year of the first assessment, and found that the median increase had dropped to 6 percentage points (range, 2.1 decrease to 7.0 increase). In five studies, possession of child safety seats increased by 51 percentage points (range, 16.0 to 93.0). These results show that combining child safety seat distribution programs with education is effective in reducing injuries and in increasing both possession of safety seats and the proper use of those seats.

These results should be applicable to families of any socioeconomic status and ethnic background across the United States. The programs were effective in a variety of settings, including hospitals and clinics, as part of postnatal home visitation, and when provided by an automobile insurance company. However, only three reports described the effectiveness of such programs for children older than nine months.

These programs have a potential negative effect. By increasing the number of people with safety seats, the programs might also increase improper use of safety seats, particularly among new users. Intensive education and practice on proper use of safety seats, which were carried out in most of the studies included in this review, are important components of this intervention that guard against this potential misuse.

Warning: Programs that lend or give away safety seats must use new seats, not refurbished ones. The safety of seats that have been involved in crashes and then refurbished cannot be guaranteed, and such seats should be discarded.

We found economic evaluations of these programs, but none of them met our quality criteria. We did not, therefore, report results of these economic evaluations.

Potential barriers to implementation of child safety seat distribution and education programs include liability, the initial expense of purchasing seats, storage of seats, and training of personnel to provide education and distribute the seats. In addition, some child safety seats might be incompatible with certain vehicles.

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In conclusion, the Task Force recommends programs that distribute child safety seats and educate recipients about proper use of the seats on the basis of strong evidence of effectiveness in (*1*) reducing injuries to infants and young children who are passengers in vehicles and (*2*) increasing both possession and correct use of safety seats. These findings should be applicable to most young child passengers (birth to age four) in the United States. Only new safety seats, not used or refurbished ones, should be distributed, because the safety of seats previously involved in crashes cannot be guaranteed.

Community-Wide Information and Enhanced Enforcement Campaigns: Recommended (Sufficient Evidence of Effectiveness)

Community-wide information and enhanced enforcement campaigns provide information about child safety seats and child automobile safety to an entire community (usually defined geographically). These campaigns use several approaches: mass media, publicity, safety seat displays in public places, and special law enforcement strategies, such as checkpoints, dedicated law enforcement officials, or alternative penalties (e.g., warnings instead of tickets).

Effectiveness

- These campaigns are effective in increasing child safety seat use by approximately 12 percentage points.

Applicability

- Our findings should be generally applicable in a variety of settings and populations, including populations of mixed socioeconomic status.

The findings of our systematic review are based on four studies that evaluated the effectiveness of community-wide information and enhanced enforcement campaigns.[74–77] An additional 10 studies were identified but did not meet our quality criteria and were excluded from the review.[78–87] We looked at campaigns that provided information on the importance and correct use of child safety seats through paid advertisements, public service announcements, commentaries by community leaders on local television and radio programs, newspaper articles and editorials, displays of safety seats in public locations, and direct mailings. In three studies conducted in states with existing child safety seat laws, the campaigns also incorporated special enforcement components, such as traffic checkpoints, assignment of law enforcement officers dedicated to enforcing the safety seat use law, and alternative penalties in place of citations (for example, informational warnings or vouchers to waive fines if a safety seat is purchased). The campaigns were conducted in cities, suburbs, and statewide. Numerous community organiza-

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tions and government agencies—such as public safety and public health offices, schools, advocacy organizations, and parent groups—worked together to design and implement the campaigns.

In the four studies, a median 12.3 percentage point increase in safety seat use (range, 3.8 to 20.8) was measured from one to six months after the intervention began. Among campaigns that also included an enhanced law enforcement component, the two that used publicity to highlight the enhanced enforcement showed greater increases in safety seat use (20.8 and 13.1 percentage points) than the study that did not use publicity (4.4 percentage points). These results show that the combination of community-wide information campaigns and enhanced enforcement of safety seat laws is effective in increasing the use of child safety seats.

These results should be applicable to most communities in the United States, including those of mixed socioeconomic status. The studies were conducted in the United States, Canada, and Australia and involved populations at all socioeconomic levels. The campaigns were directed at parents of children from birth to 11 years of age. Two statewide campaigns most likely included urban, suburban, and rural populations, although this was not specified. None of the studies reported the racial or ethnic makeup of the study population.

Additional positive effects of enhanced enforcement may include increased detection and arrest for alcohol-impaired driving and other offenses and increased awareness of the importance of restraining child passengers. We did not find any negative effects.

We did not find any economic evaluations of the effects of these campaigns.

Although we hypothesized several barriers to implementing community-wide information and enhanced enforcement campaigns, we did not find any reported in the literature. Potential barriers could be the costs of developing and disseminating public information and educational material; airing television and radio announcements; enlisting the support and cooperation of the media, police departments, and other community leaders; and training enforcement personnel about the importance of enforcing child-restraint device laws. Another barrier might be the burden on court systems that need to handle additional offenders.

In conclusion, the Task Force recommends community-wide information combined with enhanced enforcement campaigns on the basis of sufficient evidence of effectiveness in increasing the use of child safety seats. The findings of this review should be applicable to most parents of children covered by child safety seat laws.

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Incentive and Education Programs: Recommended (Sufficient Evidence of Effectiveness)

Incentive and education programs reward parents for obtaining and correctly using child safety seats or directly reward children for correctly using safety seats. These programs also include educational components of varying intensity.

Effectiveness

- These programs are effective in increasing child safety seat use in the short term (up to five months after the intervention) by approximately 10%.

Applicability

- Our findings should be generally applicable to a variety of populations and settings using a variety of rewards.

The findings of our systematic review are based on four studies.[88–91] One additional study was identified but did not meet our quality criteria and was excluded from the review.[92] In these studies, the rewards—ranging from inexpensive trinkets, stickers, or coupons for fast food meals or movies to relatively expensive prizes donated by community merchants—were distributed constantly over program periods ranging from one to five months. Parents had to show correct use of safety seats to receive rewards. In all programs, larger rewards were provided to randomly selected eligible participants. Some programs also gave smaller rewards to all eligible participants.

The programs all included educational components of varying intensity. Some programs simply provided information about the reward program itself, whereas others provided information about existing laws on safety seat use and the importance of using safety seats. The programs also varied in *how* they provided information: some used only brochures or other printed materials; others used more interactive educational and behavioral techniques, such as supervised practice of correct safety seat use, signed pledge cards, and educational videos.

Before they participated in these programs, parents and caregivers had low rates of safety seat use (median, 25.9%; range, 11.4% to 48.0%). The effectiveness of these programs in the short term was demonstrated by the increased use of safety seats (median 9.9 percentage points, range, 4.8 to 36.0) up to 4.5 months after the intervention. No studies in the review reported longer follow-up times.

These results should be applicable to a variety of populations and settings using a variety of rewards. Incentive and education programs were imple-

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mented in day care centers and as community-wide efforts in a variety of target populations (including parents of children of varying ages, all socioeconomic groups, urban and rural populations, white and African-American populations), all showing similar increases in safety seat use.

A potential (but unmeasured) benefit might be that parents introduced to safety seats through these programs will continue to use them after the program has ended. We did not find any negative effects of these programs. None of the identified studies measured improper use of safety seats as a result of incentive and education programs.

We did not find any economic evaluations of these programs.

We did not identify any barriers to implementation of incentive and education programs. Potential barriers might include the costs of purchasing incentive rewards, training personnel to provide the education component, and garnering the support and participation of schools, day care centers, and other sites.

In conclusion, the Task Force recommends the combination of incentive and education programs on the basis of sufficient evidence that these programs increase use of child safety seats in the short term (up to five months). These findings should be applicable to most parents of young children in the United States.

Education Programs When Used Alone: Insufficient Evidence to Determine Effectiveness

Education programs provide information to parents, children, or professional groups about the importance of child safety seats and how to use them properly. A goal of providing information is to give people a cognitive foundation for behavior change and for instituting new policies.

This review excluded any child safety seat education programs delivered solely through one-on-one counseling of a patient by a primary care clinician. Those interventions have been reviewed and recommended in the *Guide to Clinical Preventive Services.*[12]

Effectiveness

- We found insufficient evidence to determine the effectiveness of education programs alone in increasing correct use of child safety seats.
- Evidence was insufficient because the educational interventions evaluated in these studies varied widely and the small number of available studies produced inconsistent results.

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- Insufficient evidence means that we were not able to determine whether or not the intervention works.

The results of our systematic review are based on six studies that provided education to three different populations: parents, children, and professionals.[93–98] Ten additional studies were identified but did not meet our quality criteria and were excluded from the review.[47,99–107] Of the six studies reviewed, three that provided education to parents during the perinatal period found no evidence that perinatal programs increase correct use of safety seats. Parent education consisted of such activities and materials as a mock-up for practice with use of car safety seats, printed instructions or guidelines for new mothers, posters identifying safe versus unsafe seats, and a video from the Insurance Institute for Highway Safety about infants and children in crashes. One program providing education to children in a day care center increased knowledge about correct safety seat use but did not increase actual use. The education, a modified version of the "Riding with Bucklebear" program, used a real car seat and seat belts, a toy car with seat belts and a child safety seat, family figures represented by dolls, and pictures of desirable and undesirable behavior for riding in cars. Children learned songs about auto safety, watched a video, had brief lessons about safety, and played with Bucklebear. Training for police officers resulted in an increase in the number of citations issued for failure to use safety seats (from 0–10 to 10–20 per month) six months after the training period. Training for nursing or obstetrical directors in hospitals that offer newborn delivery services produced significant increases in the proportion of hospitals with written safety seat policies for newborns (62.3 percentage points higher than the baseline of 25.9%), hospitals with short-term loan programs for child safety seats (14.1 percentage point increase over a baseline of 58.8%), and hospitals with patient education programs (44.1 percentage point increase over a baseline of 51.2%). The variety of approaches used, the small number of studies of each approach, and the inconsistent improvement in correct use of child safety seats provided insufficient evidence to determine the effectiveness of this intervention.

Because we could not establish the effectiveness of these programs when used alone, we did not examine situations in which the programs would be applicable, information about economic efficiency, or possible barriers to implementation.

In conclusion, although education is a central component of many other interventions, the Task Force found insufficient evidence to determine the effectiveness of education programs alone in increasing proper use of child safety seats, because the small number of studies produced inconsistent results.

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INCREASING SAFETY BELT USE

The use of safety belts is the single most effective means of reducing fatal and nonfatal injuries in motor vehicle crashes. Safety belt use is estimated to have saved 164,753 lives between 1975 and 2002.[108] In all types of crashes, manual lap-shoulder belts are approximately 45% effective in reducing fatalities in passenger cars and 60% effective in light trucks.[109,110] They are estimated to reduce the risk of serious injury to the head, chest, and extremities by 50% to 83%.[110] Lap belts alone are estimated to be 17% to 58% effective in preventing death in various seating positions compared with no restraints.[111–113]

Although safety belt use has risen dramatically in the United States over the past two decades, further increases in use remain a public health priority.[6,9,114] In 1983, only 14% of motor vehicle occupants wore safety belts.[115] That percentage rose to 51% by 1994, 69% by 1998, and 75% by 2002.[108] However, certain groups (e.g., teenagers, drinking drivers) consistently report lower than average usage rates.[116–119]

Airbags, although widely available, are considered only supplemental protection to safety belts. Airbags alone are 10% and 14% effective in reducing deaths and injuries, respectively, whereas airbags used with lap-shoulder belts reduce the risk of death by 50% and injury by 66% in front seats.[110]

Safety Belt Laws: Recommended (Strong Evidence of Effectiveness)

Safety belt laws—a critical component of efforts to increase safety belt use—require motor vehicle occupants to use safety belts. All current U.S. safety belt laws cover use by front seat occupants; other provisions, such as rear seat coverage, fines, affected age groups, type of enforcement, and exempted vehicles and drivers, vary by state. Every state except New Hampshire has some form of safety belt law.

Effectiveness

- Safety belt laws are effective in reducing fatal and nonfatal injuries by approximately 8%.
- These laws are also effective in increasing observed safety belt use by approximately 33 percentage points.
- These laws are also effective in increasing self-reported safety belt use by approximately 16 percentage points.

Applicability

- These findings should be generally applicable to adolescents and adults.

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Other Effects

- Adults who use safety belts are also more likely to buckle up their child passengers.
- We found no evidence that drivers who use safety belts may be more likely to engage in risky driving behavior.

The findings of our systematic review of safety belt laws are based on 33 studies.[120–152] An additional 11 studies were identified but did not meet our quality criteria and were excluded from the review.[153–163] Two additional studies provided information on a study already included in our review.[164,165] The studies in the review showed that enactment of safety belt laws consistently increased safety belt use, whether use was self-reported (median 16 percentage point increase; range, 13 to 19) or observed (median 33 percentage point increase; interquartile range, 20 to 36). The research also showed that safety belt laws decrease fatal and nonfatal injuries by a median of 8% (interquartile range, 3% to 20%). After the systematic review had been completed, we found eight additional studies.[166–173] Although they were not included in the review, our preliminary analysis revealed that all eight studies also found that safety belt laws were effective.

These results should be applicable to adolescents and adults, as most of the studies looked at motor vehicle occupants who were at least 16 years old. Some studies looked at specific groups. Women consistently showed greater increases in safety belt use than men and usually began with higher usage rates. Older drivers also showed higher use rates. Adolescents had low use rates to begin with, but showed increases in safety belt use proportional to increases seen in other drivers after laws were enacted.

An additional benefit of safety belt laws is that adults who use safety belts are more likely to buckle up their child passengers. One study reported that a law mandating safety belt use in the front seat increased use by children aged 2–10 years in all seating positions within the vehicle.[142]

The decrease in fatal and nonfatal injuries associated with increased safety belt use is not as large as might be expected given the known effectiveness of safety belts in decreasing the risk of injury and death.[174,175] One explanation offered for this, and thus a potential negative effect of safety belt laws, is the concept of *risk compensation,*[176–178] which suggests that individuals compensate for reduced risk by acting more recklessly. According to this concept, when drivers wear safety belts they feel safer and will engage in more risky driving behaviors than they otherwise would. However, several studies[175,179,180] that looked at whether injury reductions associated with safety belt use are offset by injury increases associated with risky driving produced

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inconclusive results. In addition, no study has found a relationship between increased safety belt use and increased risky driving.[181–183] Thus, the concept that safety belt laws increase risky driving, thereby increasing crash or injury risks, is not supported by the available evidence.

We did not find any economic evaluations of the effects of these laws.

As with many legislative interventions, public opposition and the political climate are potential barriers to effective implementation. When states first began enacting safety belt laws, it was commonly argued that these laws interfered with personal freedom. However, NHTSA's 2000 Motor Vehicle Occupant Survey reported that 87% of individuals over the age of 16 support safety belt laws, with 67% supporting them "strongly" and 20% supporting them "somewhat."[118]

In conclusion, the Task Force recommends maintaining or implementing safety belt laws on the basis of strong evidence of their effectiveness in reducing fatal and nonfatal injuries and increasing both observed and self-reported safety belt use. These findings should be applicable to adolescents and adults in the United States.

Primary Enforcement Laws (vs. Secondary Enforcement Laws): Recommended (Strong Evidence of Effectiveness)

Primary enforcement laws allow police officers to stop a motorist solely for not wearing a safety belt. In contrast, secondary enforcement laws only allow a police officer to issue a safety belt citation after the motorist is stopped for another reason.

Although common in Europe, Great Britain, New Zealand, and Australia, primary enforcement laws are the exception, not the rule, in the United States. As of December 31, 2003, only 20 states, the District of Columbia, and Puerto Rico had enacted primary enforcement laws. Primary laws are thought to be more effective in getting drivers to buckle up. Police officers are more likely to write tickets if the law is primary. In addition to the greater freedom that officers have to enforce primary laws, they may also believe that such laws indicate that legislators, judges, and the general public view safety belt use as important. Therefore, primary laws are likely to generate stronger concerns among drivers that they will be caught and punished if they break the law.

Effectiveness (relative to secondary enforcement safety belt laws)

- Primary enforcement laws are effective in decreasing fatal injuries by approximately 8%.

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- These laws are also effective in increasing observed safety belt use by approximately 14 percentage points.

Applicability

- These findings should be applicable to all U.S. drivers and passengers.

Other Effects

- We found no evidence that primary safety belt laws contribute to differential enforcement based on race, although this has been proposed as a potential harm.

For this systematic review, we included only studies that compared the effects of primary laws with those of secondary laws in the United States. The results of the review are based on 13 studies (in 12 reports), of which 9 compared states with primary laws to states with secondary laws and 4 evaluated the effect of changing from a primary law to a secondary law.[116,129,130,147,149,152,175,184–188] An additional two studies were identified but did not meet our quality criteria and were excluded from the review.[160,162] Five other studies provided information on studies already included in the review.[117,164,189–191] Primary laws were found to decrease fatal injuries (five studies: median 8% decrease; range, 3% to 14%); increase observed safety belt use (five studies: median increase of 14 percentage points; range, 12 to 23); and increase self-reported safety belt use (two studies: 1 and 22 percentage point increases).

These results should be applicable to all U.S. motorists. Studies were conducted in 49 states and the District of Columbia and looked at drivers and passengers of all ages.

According to one study,[187] when a primary enforcement law is passed, those who drive while intoxicated show a greater increase in safety belt use than other drivers. Two studies[116,147] also showed that passage of primary enforcement laws increased use among African-American and Hispanic populations more than it did among whites.

An additional benefit of safety belt laws is that adults who use safety belts are more likely to buckle up their child passengers (see Safety Belt Laws). One possible negative effect of primary safety belt laws is the potential for enforcement officers to stop drivers based purely on race or ethnicity. However, studies examining the issue have found no evidence that primary belt laws contribute to such differential enforcement or *racial profiling.*[116,188]

We did not find any economic evaluations of the effects of primary safety belt laws.

Perceived public opposition to primary safety belt laws presents a serious barrier to their implementation. Infringement on personal freedom and the

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potential for differential enforcement are the most frequently voiced concerns. To increase public acceptance, some states have included anti-harassment language in their primary safety belt laws.

Public support for primary safety belt laws appears to be strong. In 2000, 61% of the American public favored primary enforcement laws (in states with these laws, 70% supported them; in states with secondary laws, 53% supported primary laws).[118]

In conclusion, the Task Force recommends primary enforcement laws on the basis of strong evidence of their effectiveness in decreasing fatal injuries and increasing safety belt use. These findings should be applicable to all drivers in the United States.

Enhanced Enforcement: Recommended (Strong Evidence of Effectiveness)

Enhanced enforcement of safety belt laws can involve increasing the number of officers on patrol, increasing the number of citations issued for safety belt violations during regular patrols, conducting safety belt checkpoints, or a combination of these efforts. These programs are conducted in addition to normal enforcement practices and are usually publicized through media campaigns.

Enhanced enforcement programs are designed to increase public awareness of safety belt laws and the enforcement of these laws. Such heightened awareness is expected to increase the perceived risk of being detected and punished for failing to wear a safety belt, and thereby increase safety belt use and reduce injuries and deaths. Both the level of publicity and the visibility of enforcement may influence motorists' behavior and their perception of risks.

Enhanced enforcement programs are either intense efforts of short duration (called *waves* or *blitzes*) lasting for days or weeks, which may be repeated periodically, or maintenance of continuous enforcement levels over several weeks, months, or years. Enhanced enforcement programs are often referred to as *Selective Traffic Enforcement Programs* (STEPs) or *Special Traffic Enforcement Programs* (sTEPs).[192]

This review focused on enhanced enforcement programs that specifically targeted safety belt use and excluded studies of programs targeting multiple unsafe driving practices.

Effectiveness

- Enhanced enforcement is effective in decreasing both fatal and nonfatal injuries (by 7% and 15% in two studies).
- This activity is also effective in increasing observed safety belt use by approximately 16 percentage points.

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Applicability

- These findings should be generally applicable to all U.S. motorists covered by safety belt laws.

Other Effects

- Enhanced enforcement may lead to increased arrests for other crimes, such as possession of weapons or drugs, impaired driving, or license violations.

The findings of our systematic review are based on 15 studies that looked at the effect of enhanced enforcement on fatal and nonfatal injuries and on safety belt use.[193–207] An additional two studies were identified but did not meet our quality criteria and were excluded from the review.[208,209] One additional study provided information on a study already included in our review.[210] Two studies that looked at fatal and nonfatal injuries combined found relative decreases of 7% and 15%, respectively, from enhanced enforcement programs. These programs also increased safety belt use by a median of 16 percentage points (interquartile range, 8 to 24). Increases in safety belt use were similar whether the program increased the number of officers on patrol or increased citations during regular patrols.

As for long-term effects, in the 11 programs that collected follow-up data, safety belt use decreased by a median of 6 percentage points (interquartile range, 0 to 8) in the months after enhanced enforcement programs ended, but still consistently remained higher than before the programs took place.

Overall, these findings show that enhanced enforcement is effective both in increasing the use of safety belts and in decreasing fatal and nonfatal injuries.

These results should be applicable to all U.S. motorists covered by safety belt laws. We reviewed a variety of enhanced enforcement programs in the United States and Canada, including city, county, state, provincial, and national programs. These programs varied in the amount of publicity they used, and were conducted both in states with primary safety belt laws and those with secondary laws. The programs may be less effective in urban areas. Studies in the United States that evaluated results by population density found greater increases in safety belt use in suburban and rural areas than in urban areas.

An additional positive effect of enhanced enforcement of safety belt laws is that it may lead to increased arrests for other crimes such as impaired driving, possession of weapons or drugs, or license violations. We did not identify any negative effects of enhanced enforcement programs.

We did not find any economic evaluations of enhanced enforcement programs.

One potential barrier to implementation of enhanced enforcement programs is the reluctance of state and community officials to implement such pro-

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grams because of concerns about public opposition. However, two statewide telephone surveys conducted in California and North Carolina during such programs found that 70% and 87% of respondents, respectively, were in favor of enhanced enforcement programs to increase safety belt use. Another potential barrier is that police officers may be reluctant to participate in enhanced enforcement programs out of concern that they will be diverted from investigating more serious crimes. However, one study found that crime rates do not increase during enhanced enforcement campaigns. Additionally, interviews with both police and the public have revealed increasingly positive attitudes toward enhanced enforcement programs.[211]

In conclusion, the Task Force recommends enhanced enforcement of safety belt laws on the basis of strong evidence of their effectiveness in decreasing fatal and nonfatal injuries and in increasing observed safety belt use. These findings should be applicable to all motorists in the United States who are covered by safety belt laws.

REDUCING ALCOHOL-IMPAIRED DRIVING

The United States has made substantial progress in reducing alcohol-related traffic fatalities in recent decades. Since NHTSA began keeping records on alcohol involvement in fatal crashes in 1982, the proportion of alcohol-related traffic fatalities has declined from 57% to 41%.[4] Despite this progress, alcohol-related motor vehicle crashes continue to be a major public health problem, resulting in 17,448 deaths and 275,000 injuries in 2001.[4]

Since 1970, individual states and communities have used various approaches to reducing alcohol-impaired driving, most commonly laws to deter alcohol-impaired driving or to control the sale or public consumption of alcohol. By 1987, the minimum legal drinking age was 21 years in all states. As of July 12, 2004, 50 states, the District of Columbia, and Puerto Rico had lowered the illegal blood alcohol concentration (BAC) for drivers aged 21 years and older from 0.10 g/dL (grams per deciliter) to 0.08 g/dL (0.08%). Some states have also used sobriety checkpoints, enhanced enforcement of alcohol control policies, and training programs for servers of alcoholic beverages.

These systematic reviews looked at the effectiveness of laws and other community-based interventions in reducing alcohol-impaired driving and alcohol-related motor vehicle deaths. Of the 84 studies included in the reviews 59 were conducted in the United States and the remainder were conducted in Australia, Canada, New Zealand, France, and the Netherlands.

The review focused on interventions for which the primary goal is to reduce alcohol-impaired driving. Interventions intended to restrict access to al-

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cohol (e.g., alcohol taxation, alcohol outlet zoning restrictions) or to address health outcomes of alcohol abuse or misuse other than alcohol-impaired driving were not reviewed. These topics may be included in a subsequent *Community Guide* review of interventions to prevent alcohol abuse and misuse.

The effectiveness of interventions to reduce alcohol-impaired driving may lie in their ability to increase drivers' perceived risk of detection and punishment, to reduce alcohol consumption in high-risk settings or among high-risk groups, and to foster a social norm in which drinking and driving is unacceptable.

0.08% Blood Alcohol Concentration Laws: Recommended (Strong Evidence of Effectiveness)

All U.S. states have long-standing laws prohibiting driving while impaired by alcohol. In 49 states, it is also illegal to operate a motor vehicle with a blood alcohol concentration (BAC) above a specified limit, regardless of whether the operator is visibly impaired. Originally, a BAC of 0.10% or 0.15% was considered illegal, but all states have since lowered the limit. At a BAC of 0.08%, all drivers are expected to experience impairment in driving-related skills.[212] In support of 0.08% BAC laws, the U.S. Congress included a provision in the Fiscal Year 2001 Department of Transportation and Related Agencies Appropriations Act[213] requiring states to implement 0.08% BAC laws by October 1, 2003, or risk losing federal highway construction funds. By that date, 45 states, the District of Columbia, and Puerto Rico had enacted laws lowering the illegal BAC to 0.08%. This review evaluates the effects of lowering the BAC limit from 0.10% to 0.08%.

The illegal BAC for drivers under the minimum legal drinking age of 21 is even lower. As of July 1998, all states had enacted laws for drivers up to 20 years old that establish BAC limits of 0.02% or less (see Lower Blood Alcohol Concentration Laws for Young or Inexperienced Drivers).

Effectiveness

- These laws are effective in reducing alcohol-related motor vehicle fatalities by approximately 7%.

Applicability

- Our findings should be applicable to all U.S. drivers.

The findings of our systematic review are based on nine studies that evaluated the effect of lowering the BAC to 0.08%.[214–222] All studies analyzed data from police reports of crashes. The studies showed a consistent reduction in alcohol-related motor vehicle fatalities (7% decrease; interquartile range, 4% to 15%) when measured 1 to 14 years after the law was passed (median 5

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years). These results show that lowering the BAC limit to 0.08% is effective in reducing alcohol-related motor vehicle fatalities.

These results should be applicable to all drivers affected by 0.08% BAC laws. The studies used statewide fatal crash data, and the states studied are geographically diverse with varying population densities; we did not, however, find information on the effectiveness of these laws in various subgroups.

We did not find information on other positive or negative effects in this review, nor did we find any economic evaluations of the effects of 0.08% BAC laws.

One potential barrier to implementation of 0.08% BAC laws is the view held by some that the laws discourage *social drinkers* from driving after drinking small amounts of alcohol but do not deter *hard-core* drinkers from driving while incapacitated. However, our findings provide some evidence to counter this view: five studies[214,215,217,218,222] found that in most states, fatalities involving drivers with BACs of 0.10% or higher were reduced after 0.08% BAC laws were implemented.

In conclusion, the Task Force recommends the enactment and enforcement of 0.08% BAC laws on the basis of strong evidence of their effectiveness in reducing alcohol-related motor vehicle fatalities. These findings should be applicable to all U.S. drivers.

Minimum Legal Drinking Age Laws (Maintaining at 21 Years of Age): Recommended (Strong Evidence of Effectiveness)

Minimum legal drinking age (MLDA) laws specify an age below which it is illegal to purchase or publicly consume alcoholic beverages. This review assessed the effect of raising or lowering the MLDA on crashes and related fatal and nonfatal injuries.

In the United States, several states lowered their MLDA during the early 1970s. In response to an increase in motor vehicle deaths among young people, some of these same states later raised their MLDA. To address continuing concerns over youth drinking and driving, federal legislation was passed in 1984 that required states to adopt a minimum drinking age of 21 or lose highway funds. By 1987, all U.S. states had adopted laws establishing the MLDA of 21 years.

Effectiveness

- Raising the MLDA is effective in reducing fatal injury crashes by approximately 17% and fatal and nonfatal injury crashes combined by approximately 15%.

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- Lowering the MLDA leads to approximately an 8% increase in fatal injury crashes and approximately a 5% increase in fatal and nonfatal injury crashes combined.

Applicability

- These findings should be applicable to all drivers 18–20 years of age.

Other Effects

- Raising the MLDA may lead to decreased alcohol consumption.
- Postulated increases in crash rates among newly eligible drinkers are not supported by the evidence.

The findings of our systematic review of MLDA laws are based on 33 studies (in multiple reports) that assessed the effects of raising or lowering the MLDA on motor vehicle crashes.[132,155,223–250] An additional 13 studies were identified but did not meet our quality criteria and were excluded from the review.[185,186,251–261] Three additional studies provided information on a study already included in our review.[262–264] The studies found that changes in the MLDA result in changes of 10% to 16% in alcohol-related crash outcomes for the targeted age groups: crashes decreased when the MLDA was raised (e.g., from 18 to 21 years) and increased when it was lowered (e.g., from 21 to 18 years).

These results should be applicable to drivers 18 to 20 years of age. They are based on studies from the United States, Australia, and Canada and may not apply to countries with different alcohol consumption or driving patterns.

An additional benefit of raising the MLDA is that it may decrease alcohol consumption. Raising the MLDA may also reduce the number of crashes involving adolescent drivers who are younger than the MLDA: some studies found that raising the MLDA led to an overall 6% relative decrease in crashes in this age group. However, the size of this effect was inconsistent across studies, with several showing no effect.

A possible negative effect of raising the MLDA is referred to as the *drinking experience* effect. Some researchers have proposed that when drivers who have not been legally allowed to drink reach the MLDA, their risk of alcohol-related crash involvement will dramatically increase because they are new to drinking and unfamiliar with its effects. However, it is difficult to estimate the drinking experience effect directly, and studies that attempted to do so have produced inconsistent results. One study examined the overall effect of raising the MLDA and found that, even with the drinking experience effect included, raising the MLDA substantially reduces fatal crashes.

We did not find any economic evaluations of the effects of these laws.

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A potential barrier to strengthening or maintaining MLDA laws could be the belief held by some opponents of these laws that prohibition of drinking among young adults unjustly punishes them for the irresponsible behavior of the few who drink and drive.

In conclusion, the Task Force recommends maintaining or implementing the MLDA of 21 years on the basis of strong evidence of its effectiveness in reducing fatal and nonfatal injury crashes. These findings should be applicable to all 18–20-year-old drivers. An additional benefit of raising the MLDA may be a decrease in overall alcohol consumption in this age group.

Sobriety Checkpoints: Recommended (Strong Evidence of Effectiveness)

The primary goal of sobriety checkpoints is to reduce driving after drinking by increasing drinking drivers' perceived risk of being caught. Checkpoints therefore need to be highly visible and well publicized. The United States uses selective breath testing (SBT) checkpoints, at which law enforcement officials must have a reason to suspect that a driver who is stopped has been drinking before a breath test can be administered. Australia and some European countries use random breath testing (RBT) checkpoints, at which all drivers stopped are given breath tests. However, the potential for violating constitutional protections against unreasonable search and seizure prevents use of RBT checkpoints in the United States.

In the United States, law enforcement officers follow established procedures to properly conduct checkpoints.[265] These procedures include using objective criteria to determine checkpoint locations (e.g., the incidence of alcohol-related crashes in the area) and using a predetermined system for stopping cars (e.g., every third car that approaches the checkpoint).[266–268]

Effectiveness

- Selective breath testing checkpoints (used in the United States) are effective in reducing fatal and nonfatal injury crashes by approximately 20%.
- These checkpoints are also effective in reducing alcohol-impaired driving, alcohol-related crashes, and associated fatal and nonfatal injuries in a variety of settings and populations.

Applicability

- These findings should be applicable to all drivers in areas where sobriety checkpoints are permitted.

Other Effects

- Sobriety checkpoints also increase arrests of drivers for other offenses, such as driving with a suspended license or carrying weapons.

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- Checkpoints have been criticized for potential inconvenience and intrusion on driver privacy, but their use was upheld by the U.S. Supreme Court.

The findings of our systematic review of sobriety checkpoints are based on 11 papers reporting on SBT checkpoints[266–276] and 12 studies (in 10 reports) on RBT checkpoints.[277–286] Nine papers included studies that did not meet our quality criteria and were excluded from the review.[282,287–294] Four additional papers provided information on studies already included in the review.[295–298] The use of both SBT and RBT checkpoints consistently resulted in fewer crashes. Selective breath testing checkpoints reduced fatal and nonfatal injury crashes by a median of 20% (range, 5% to 23%), and RBT checkpoints reduced these crashes by a median of 16% (interquartile range, 11% to 20%). These reductions were still evident over follow-up periods that ranged from 1 month to 10 years (median 14 months).

Checkpoints may also reduce drinking and driving in general. One study found that an RBT checkpoint program reduced the number of drivers with any detectable BAC level by 13% and the number of drivers with BACs above 0.08% by 24%.

Random breath testing checkpoints are more likely to detect drinking drivers than are SBT checkpoints, but passive alcohol sensors, which allow police to sample air in the car for alcohol vapors, can improve the detection rate at SBT checkpoints by approximately 50%.[299] If such technology becomes more widely used, the sensitivity in detecting drinking drivers at SBT checkpoints may approach that of RBT checkpoints.

These results should be applicable to all drivers in areas where sobriety checkpoints are permitted. The studies in our review generally assessed intensive enforcement and publicity campaigns, so the results may generalize best to these intensive interventions. Studies were conducted on interventions implemented at the city, county, state, and national levels, and were evaluated in rural areas, urban areas, and mixed rural and urban areas.

An additional benefit of sobriety checkpoints is that they can lead to increased arrests of drivers for other offenses, such as driving with a suspended license or carrying weapons. One negative effect of stopping drivers at checkpoints is the resulting inconvenience and intrusion on driver privacy. However, according to the U.S. Supreme Court, the brief intrusion of a properly conducted sobriety checkpoint is justified in the interest of reducing alcohol-impaired driving.[300] Some civil libertarian groups have also endorsed this position.

The findings of our systematic review of economic evaluations are based on four studies:[274,278,301,302] two[274,301] evaluated SBT checkpoints and two[278,302]

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evaluated RBT checkpoints. All studies conducted cost–benefit analyses. Of the four studies, three[278,301,302] reported annual net benefits and one[274] reported net benefits for the length of the intervention (nine months).

Selective Breath Testing Checkpoints. The first economic evaluation[301] modeled a one-year campaign conducted in a hypothetical community of 100,000 licensed drivers in the United States. The modeled campaign consisted of 156 checkpoints per year, each four hours in duration. The estimated annual total benefit from alcohol-related crashes averted was $9.2 million (in 1997 U.S. dollars). Estimated annual total costs of the intervention were $1.6 million. The estimated annual net benefit was $7.6 million (in 1997 U.S. dollars), resulting in a benefit-to-cost ratio of $6 per dollar invested.

The second study[274] evaluated a nine-month checkpoint campaign conducted in four California communities (a fifth community served as a comparison group and a sixth implemented roving driving while intoxicated [DWI] patrols). The program consisted of 18 checkpoints per community plus publicity campaigns and education programs. Total aggregated benefits of $3.86 million (in 1997 U.S. dollars) came from societal savings realized through avoided injuries and fatalities. Total costs of the intervention (aggregated for four communities) were $164,552. The aggregated net benefit was $3.7 million, resulting in a benefit-to-cost ratio of $23 per dollar invested.

In summary, from a societal viewpoint, the economic benefits of these interventions exceed the costs.

Random Breath Testing Checkpoints. The first study[278] was conducted three years after statewide RBT checkpoints were introduced in New South Wales, Australia. Annual total benefits were $228 million (in 1997 U.S. dollars). Annual total program costs were $4 million. The annual net benefit reported in the study was $224 million, resulting in a benefit-to-cost ratio of $57 per dollar invested.

The second study[302] modeled a proposed nationwide RBT checkpoint intervention in the Netherlands. The proposed intervention included a publicity component and incorporated a more efficient method of transporting offenders to police stations. Annual total benefits from cost savings in the reduction of alcohol-related injury and property damage were estimated at $31.4 million (in 1997 U.S. dollars). Annual total costs including materials and publicity were estimated at $15.6 million. The annual net benefit of the intervention was estimated to be $15.8 million, resulting in a benefit-to-cost ratio of $2 per dollar invested.

Although the U.S. Supreme Court allows SBT checkpoints,[300] their prohibition by some state courts presents a serious barrier to implementation. Where checkpoints are permitted, another important barrier is the concern police have over the low arrest rates.[291] Providing police officers with regular

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feedback on how checkpoints help reduce alcohol-related crashes may decrease their concerns.

In conclusion, the Task Force recommends the use of sobriety checkpoints on the basis of strong evidence of their effectiveness in reducing fatal and nonfatal crash injuries and in reducing alcohol-impaired driving and alcohol-related crashes. These findings should be applicable to all drivers in areas where sobriety checkpoints can be conducted.

Lower Blood Alcohol Concentration Laws for Young or Inexperienced Drivers: Recommended (Sufficient Evidence of Effectiveness)

Drinking and driving is especially dangerous for young people. A study of fatal crashes in the United States[303] estimated that 16–20-year-old male drivers with blood alcohol concentrations (BACs) between 0.08% and 0.10% were 24 times more likely to die in a motor vehicle crash than those who had not been drinking. Laws restricting the BAC of young drivers (under 21 years of age in the United States) to lower levels than those for adult drivers aim to prevent injury or death for these drivers, their passengers, and others using the road. As of July 1998, all 50 states had enacted lower BAC laws for young drivers. These laws are commonly referred to as *zero tolerance* laws.

Lower BAC laws may also be useful in populations other than young drivers. For example, the Centers for Disease Control and Prevention recommends that states consider enacting lower BAC laws for all drivers who transport children.[304]

Effectiveness

- Lower BAC laws are effective in reducing fatal crashes by approximately 17%.
- These laws are also effective in reducing fatal and nonfatal crashes (reported together) by approximately 10%.

Applicability

- Our findings should be applicable to all drivers affected by these laws (in the United States, those under 21 years of age).

Other Effects

- Lower BAC laws can result in underage drinking drivers with high BACs receiving only zero tolerance citations rather than being arrested for alcohol-impaired driving (as would drinking drivers over 20 years of age).

The findings of our systematic review of lower BAC laws for young or inexperienced drivers are based on six studies.[243,305–309] An additional three studies were identified but did not meet our quality criteria and were excluded

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from the review.[310–312] Two additional studies provided information on a study already included in our review.[313,314] The reviewed studies evaluated the number of motor vehicle crashes from 1 to 15 years after enactment of lower BAC laws (median 22 months) using the information in police reports. All six studies reported reductions in crashes. Three studies examined fatal crashes and reported declines of 24%, 17%, and 9%. Two studies examined fatal and nonfatal injury crashes and reported declines of 17% and 3.8%. One study examined crashes in which the investigating police officers believed that the driver had been drinking alcohol and reported a decline of 11%. These results show that lower BAC laws for young or inexperienced drivers are effective in reducing both fatal and nonfatal crashes.

These results should be applicable to all young and inexperienced drivers covered by lower BAC laws. This review did not address the effectiveness of lower BAC laws directed to other specific groups of drivers, such as commercial truck drivers and people convicted of driving while impaired. The states studied are geographically diverse, with both urban and rural populations represented.

A potential harm is that U.S. drivers under the age of 21 with high BACs could receive only zero tolerance citations for violating the lower BAC law, whereas adults with the same BAC would be arrested for the more serious offense of driving under the influence of alcohol (DUI). A study of California's 1994 lower BAC law[309] showed that about half of the potential DUI arrests among underage drivers were converted to less serious zero tolerance citations.

The findings of our systematic review of economic evaluations are based on one study.[315] The study, a cost–benefit analysis, applied previously published crash costs and used effectiveness data from other previously published studies to illustrate how these costs could be applied to lower BAC laws in the United States. The benefits from a reduction in alcohol-related crashes were estimated using the assumption that lower BAC laws reduce young drivers' alcohol-related crashes by 20%. The estimated benefit-to-cost ratio for lower BAC laws was $11 per dollar invested when violators received a six-month license suspension.

All U.S. states currently have lower BAC laws for drivers under 21 years of age, but several potential barriers to full enforcement of these laws exist.[309] Because young people are less likely than adults to drink in bars, police patrols that target bar neighborhoods are likely to miss underage drinking drivers. Also, officers may have difficulty identifying underage drinking drivers with low BACs because they may not show obvious signs of impairment. Fi-

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nally, because of ambiguities, some state laws prohibit police officers from testing the BAC of an underage driver unless there is probable cause to believe that the driver's BAC is above the legal limit for adults.

In conclusion, the Task Force recommends maintaining or implementing lower BAC laws for young or inexperienced drivers on the basis of sufficient evidence of the effectiveness of the laws in reducing both fatal and nonfatal crashes. These findings should be applicable to all drivers affected by the laws (in the United States, all drivers under 21 years of age).

Intervention Training Programs for Servers of Alcoholic Beverages: Recommended Under Certain Conditions (Sufficient Evidence of Effectiveness)

People often drive after consuming alcohol in bars, clubs, and restaurants. Therefore, teaching bartenders and other servers of alcoholic beverages ways to prevent intoxication among their patrons may help to reduce alcohol-impaired driving.

Server intervention training programs can include teaching servers to offer patrons food with drinks, delay service to rapid drinkers, refuse service to intoxicated or underage patrons, and discourage intoxicated patrons from driving. These programs vary widely in terms of the content covered, instructional time, and the training method (e.g., face-to-face vs. videotaped). Some programs are offered in classroom settings by professional trainers, whereas others consist only of a video or written material that employees are encouraged to use on their own.[316] This training may be supplemented by role playing. Generally, the programs also involve education about alcohol beverage control (ABC) laws and identifying the signs of intoxication. Some programs also evaluate the alcohol serving policies of a drinking establishment and recommend changes to reduce intoxication, such as eliminating drink promotions, serving a variety of nonalcoholic beverages, or increasing the availability of food.[317]

As of January 1, 2000, 11 states had established mandatory server training programs for all licensed establishments and 10 states provided liability protection to establishments that voluntarily implemented server training.[318]

Factors other than server training can influence serving practices in licensed establishments. These factors include enforcement of existing ABC laws,[319] server liability (or dram shop) laws,[320] high-profile server liability cases,[320] and community coalitions to encourage responsible serving practices.[321] These factors can influence the degree of management support for server training and improvements in serving practices, which is thought to be essential for changing server behavior.[316,322–324]

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Effectiveness

- This intervention is effective in reducing the level of intoxication in patrons when servers have received intensive, high-quality, face-to-face server training accompanied by strong and active management support.

Applicability

- The applicability of our findings is limited to the kinds of intensive, face-to-face, management-supported programs described here.
- Server training may not work when delivered by less intensive methods or in settings lacking strong management support.

Other Effects

- Decreased levels of intoxication may reduce other alcohol-related injuries, violence, and crime.

The findings of our systematic review of server intervention training programs are based on five studies.[323,325–328] Three additional studies were identified but did not meet our quality criteria and were excluded from the review.[329–331] Four additional reports provided information on studies already included in the review.[332–335]

The five studies in our review evaluated the effect of server training on server behaviors, patrons' BACs, and crash outcomes. Two studies looked at changes in server behaviors after relatively intensive (4½- to 6-hour) training programs and found significant improvements in appropriate serving practices. Three studies that evaluated patrons' BACs found that server training led to decreased intoxication. In one study, none of the pseudopatrons (research assistants posing as patrons) of trained servers reached BAC levels of 0.10%, but 45% of pseudopatrons of untrained servers did. A second study with less intensive server training (one to two hours) found decreases in the rate of intoxication of patrons leaving participating premises of 17% at a two-week follow-up and of 28% after three months; one establishment in this study had an unusually supportive manager, which may have accounted for much of this success. In a third study, conducted at a Navy enlisted club, an intensive 18-hour training course was supplemented by other policy changes, such as eliminating the sale of pitchers of drinks, resulting in a 33% decrease in the percentage of patrons with estimated BACs of 0.10% or greater. Although overall alcohol consumption did not substantially decrease, the rate of consumption did, suggesting that patrons drank more slowly but stayed in the establishment longer. A study that evaluated the effect of a statewide one-day mandatory server training program found that the training resulted in a decrease of 23% in single-vehicle nighttime injury crashes. Overall, these results show that intensive, high-quality, face-to-face training programs for

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servers of alcoholic beverages can be effective in reducing patron intoxication. It should not be assumed, however, that all kinds of training are effective.

Consistency of server training programs is essential to their effectiveness. Given the high employee turnover rate for servers, it is important to go beyond a *demonstration* training program. Training sessions should be offered on a continuing basis, and their quality should be consistent. Problems in staffing and scheduling training sessions can result in decreased quality of implementation.[327] Although less intensive server training programs (e.g., video-based) are easier and less expensive to implement, their effectiveness is not known.

The applicability of these results should be viewed with caution. Except for the study on mandatory server training,[326] all of the studies looked at drinking establishments whose managers volunteered to participate in the training programs. The managers who chose to participate may have been unusually supportive of the programs (and this may not be typical of managers). Three of the five programs evaluated were conducted in a small number of drinking establishments, were relatively time-intensive (longer than four hours), involved face-to-face training, and covered a broad curriculum including specific intervention practices. This contrasts with the types of training programs generally in use, which vary widely in intensity, mode of delivery, and content. Thus, the reviewed studies may reflect the best possible outcomes of server training. It is not clear that these findings are applicable to larger-scale community-wide programs, to programs with substantially different training methods or content, or to programs that do not recruit supportive managers. Additionally, follow-up periods were generally less than three months, so that long-term effects cannot be estimated.

The desirable effect of reduced alcohol-impaired driving can only be maintained if the affected patrons stop drinking or drink only in relatively safe environments after leaving the drinking establishment.[322] Ideally, servers at all drinking establishments within a community should receive training. In our review, only two studies evaluated community-wide server training programs. Thus, further research is needed on the fundamental question of whether server intervention training programs delivered community-wide are effective in decreasing intoxication and, ultimately, alcohol-impaired driving.

By reducing levels of intoxication, improved server practices may also provide the benefit of reducing the risk of other alcohol-related injuries, violence, and crime. Trained servers may also find that they get larger tips than before training. No negative effects of server training programs were noted.

We did not find any economic evaluations of server intervention training programs.

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Resistance to server training by managers of drinking establishments is a potential barrier to effectively implementing this intervention. Although many managers of drinking establishments like the *concept* of server training,[331] they may also be concerned about a reduction in profits following training. This can erode crucial management support for improved server practices.[335] Although one study that examined gross receipts in bars found no noticeable reduction in profits following server training, this study was conducted at a Navy base enlisted club, and results may not be applicable to other types of drinking establishments. In addition to being concerned about profits, some managers also react negatively to the idea of "policing" their customers.[335]

Management support for server training programs could be increased by offering positive incentives (e.g., insurance discounts) to establishments that improve serving practices,[336] by strengthening or highlighting disincentives for irresponsible practices (e.g., stronger enforcement of ABC laws),[319] and by building broad community support for such programs.[331]

In conclusion, the Task Force recommends intensive, high-quality, face-to-face training for servers of alcoholic beverages when accompanied by strong and active management support, on the basis of sufficient evidence of the effectiveness of this kind of training in reducing the level of patron intoxication. These findings are limited to the intensive programs described here, and applicability to other situations should not be assumed.

Mass Media Campaigns: Recommended Under Certain Conditions (Strong Evidence of Effectiveness)

Mass media campaigns are typically carried out in conjunction with other programs and policies to prevent alcohol-impaired driving. Where adequate local resources can support a mass media campaign that is carefully planned, well executed, attains adequate audience exposure, and is supported by other prevention activities, this combination of activities can be effective in reducing alcohol-impaired driving.

Effectiveness

- Mass media campaigns can be effective in decreasing all crashes by approximately 13%.
- Campaigns can also be effective in decreasing injury crashes by approximately 10%.

Applicability

- These findings should be applicable to most people of driving age.

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Mass media campaigns to deter alcohol-impaired driving are generally intended either to persuade people to avoid drinking and driving themselves or to motivate them to prevent others from drinking and driving. Key factors in the design of mass media campaigns are related to both the *content* and the *delivery* of the messages used. In terms of content, several themes are commonly used to motivate people, such as fear of arrest; fear of harming oneself, others, or property; a positive social norm in which drinking and driving don't mix; and portraying people who drink and drive as irresponsible and dangerous. Another aspect of content involves the actions suggested by the media campaign, including abstaining from or drinking in moderation when driving, using a designated driver, or taking the keys from someone who has had too much to drink. Content considerations also include how much anxiety the campaign should create: although arousing some anxiety is a good way to get people's attention, arousing too much anxiety or fear may cause people to stop listening to the message. The best combination may be arousing a degree of anxiety while providing solutions that people can use to protect themselves.

Optimal delivery of messages to the intended audience requires both control over when and where the ads appear and control over the quality of the ads themselves. To maximize exposure of target audiences to the message of the campaign, placement of ads is vital, and purchasing advertising space or time ensures control over placement; relying on free public service announcements leaves the scheduling of ads to media personnel who may not be concerned with the goals of the campaign. The messages to be delivered should be tested before the campaign is launched (*pretested*) to see which themes or concepts are most appropriate for target audiences. Conducting a campaign with untested messages can result in a diluted message, or the wrong message, being received.

The findings of our systematic review are based on eight studies (reported in six papers) that evaluated the effectiveness of mass media campaigns on fatal crashes, fatal and nonfatal injury crashes combined, crashes that damage property, and drivers' BACs.[337–342] Two additional studies were identified but did not meet our quality criteria and were excluded from the review.[343,344] Most of the reviewed campaigns pretested their messages, had high levels of audience exposure (achieved by using paid advertising), and conducted their mass media campaigns in conjunction with other local prevention efforts (e.g., enhanced law enforcement). The specific content of the messages varied.

We classified studies as focusing primarily on either the *legal consequences* or the *social and health consequences* of drinking and driving. Three of the evaluated campaigns focused on making the public aware of law enforcement activities and the legal consequences of drinking and driving. The re-

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maining five studies focused on the social and health consequences of alcohol-impaired driving. Overall, the evaluated studies showed median decreases of 13% (interquartile range, 6% to 14%) in overall crashes and 10% (interquartile range, 6% to 15%) in injury crashes. We found no obvious difference in effect whether campaign messages focused on the legal consequences or the social and health consequences of drinking and driving, although it is conceivable that certain messages and modes of delivery may be more effective with one audience than another. Overall, these results show that mass media campaigns, under the conditions described here, can be effective in decreasing injury crashes.

These findings should be applicable to carefully planned and pretested mass media campaigns, with ads that reach the intended audience often enough, implemented in an environment with other ongoing prevention activities (e.g., grassroots activities, enhanced law enforcement efforts), and targeted to any audience of driving age.

Mass media campaigns may also raise awareness of the dangers that drinking and driving pose for a community, thereby helping to generate an interest in strengthening legislation. Some authors[345–347] believe that mass media campaigns may have greater impact when their goal is to change public policy rather than individual behavior.

The findings of our systematic review of economic evaluations of mass media campaigns are based on cost–benefit analyses conducted for two of the campaigns evaluated in this review.[341,348] The results have been adjusted to 1997 U.S. dollars. An analysis of the first 23 months of a campaign in Victoria, Australia, indicated that it cost US$403,174 per month for advertisement development, supporting media, media placement, and concept research.[349] Estimated savings from medical costs, productivity losses, pain and suffering, and property damage were US$8,324,532 per month, with US$3,214,096 of these savings accruing from averted medical costs.

A second analysis indicated that six-month campaigns in Wichita (using paid media) and Kansas City, Kansas (using public service announcements) had total costs of $454,060 and $322,660, respectively.[350] Costs for planning and evaluation research, message production, and media scheduling were included. Total savings from averted costs of insurance administration, premature funeral, legal and court, medical payments, property damage, rehabilitation, and employers' losses were estimated at $3,431,305 for the Wichita campaign and $3,676,399 in Kansas City.

In all three sites evaluated, the estimated societal benefits substantially exceeded the costs of developing and airing the campaign messages.

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Those thinking about implementing a mass media campaign to reduce alcohol-related crashes are cautioned to do so only if the necessary resources and supports are in place. Campaigns implemented without adequate planning, pretesting of messages, ad placement, and support activities cannot be expected to reduce alcohol-related crashes.

In conclusion, on the basis of strong evidence of effectiveness in reducing alcohol-related crashes, injuries, and deaths, the Task Force recommends mass media campaigns that are carefully planned, well executed, attain adequate audience exposure, and are implemented in conjunction with other ongoing prevention activities. The findings of this review should be applicable to most people of driving age.

REDUCING INJURY TO MOTOR VEHICLE OCCUPANTS THROUGH USE OF THESE RECOMMENDATIONS

The recommendations in this chapter can be used in many ways to reduce injuries to motor vehicle occupants. States and communities can compare their current motor vehicle injury prevention activities with these recommendations, take steps to ensure that existing interventions are adequately implemented and funded, and consider implementing other recommended interventions.

These recommendations can be used to support or expand child safety seat distribution programs, bolster the use of incentives, and employ enhanced enforcement campaigns, all in conjunction with community-wide education efforts. For example, based on the recommendations, a community might concentrate on distribution of low-cost or no-cost child safety seats in low-income neighborhoods or seek local sponsorship to defray the costs of seats distributed to low-income families.

A comprehensive community program to reduce motor vehicle occupant injuries should include several interventions, such as legislation, enforcement, public education, training, and other community-oriented strategies. It is often useful to involve other partners in efforts to develop such a program. Potential partners include each state's Governor's Office of Highway Safety, directors of state injury control programs in health departments (www.stipda.org), local chapters of the National SAFE KIDS Campaign (www.safekids.org), the National Safety Council (www.nsc.org), and Mothers Against Drunk Driving (www.madd.org).

The Task Force recommended six state public health laws. Not all recommended laws are in effect in all states. Forty-nine states have laws requiring use of safety belts (New Hampshire has no such law), but only 20 states (plus

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Washington, DC and Puerto Rico) had primary enforcement laws as of December 2003. As of December 2003, 45 states, plus Washington, DC and Puerto Rico, had enacted 0.08% BAC laws. Efforts such as those of the U.S. Congress, which included a provision in the 2001 Department of Transportation and Related Agencies Appropriations Act[213] requiring states to implement 0.08% BAC laws by October 2003 or risk losing federal highway construction funds, are major factors in getting such laws on the books. The Task Force recommendations can support efforts to adopt, maintain, or strengthen state or national laws or regulations. State injury control program directors can use the recommendations to develop testimony about the effectiveness of various traffic safety laws. State legislators can use the recommendations as they draft, debate, and vote on new or amended legislation. Advocacy and community groups, both local and national, can use the information to develop position statements for pending legislation. Health agencies can help educate the community about the importance and effectiveness of the laws and their enforcement. Health plans can publicize these findings among the populations they care for, and can apply them in their work with communities and in the work of their foundations.

CONCLUSION

This chapter summarizes Task Force conclusions and recommendations on interventions to reduce injuries to motor vehicle occupants. To increase proper use of child safety seats, the Task Force recommends child safety seat laws, distribution and education programs, incentive and education programs, and community-wide information and enhanced enforcement campaigns; insufficient evidence exists to determine the effectiveness of education programs when used alone in increasing the use of child safety seats. To increase the use of safety belts, the Task Force recommends safety belt laws, upgrading secondary to primary enforcement laws, and implementing enhanced enforcement efforts. To reduce alcohol-impaired driving, the Task Force recommends 0.08% blood alcohol concentration (BAC) laws, minimum legal drinking age laws (maintaining at 21 years of age), sobriety checkpoints, lower BAC for young or inexperienced drivers, intervention training programs for servers of alcoholic beverages under certain conditions, and mass media campaigns under certain conditions. Details of these reviews have been published[351–357] and these articles, along with additional information about the reviews, are available at www.thecommunityguide.org/mvoi.

Acknowledgments

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