
Reviews of Evidence Regarding Interventions to Increase Use of Child Safety Seats

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Background: In 1998, nearly 600 child occupants of motor vehicles aged younger than 4 years died in motor vehicle crashes. Yet approximately 29% of children aged 4 years and younger do not ride in appropriate child safety seat restraints, which, when correctly installed and used, reduce the need for hospitalization in this age group by 69% and the risk of death by approximately 70% for infants and by 47% to 54% for toddlers (aged 1 to 4 years).

Methods: The systematic review development team reviewed the scientific evidence of effectiveness for five interventions to increase child safety seat use. For each intervention, changes in the use of child safety seats or injury rates were the outcome measures evaluated to determine the success of the intervention. Database searching was concluded in March 1998. More than 3500 citations were screened; of these citations, 72 met the inclusion criteria for the reviews.

Results: The systematic review process identified strong evidence of effectiveness for child safety seat laws and distribution plus education programs. In addition, community-wide information plus enhanced enforcement campaigns and incentive plus education programs had sufficient evidence of effectiveness. Insufficient evidence was identified for education-only programs aimed at parents, young children, healthcare professionals, or law enforcement personnel.

Conclusions: Evidence is available about the effectiveness of four of the five interventions we reviewed. This scientific evidence, along with the accompanying recommendations of the Task Force elsewhere in this supplement, can be a powerful tool for securing the resources and commitment required to implement these strategies.

Medical Subject Headings (MeSH): accidents, traffic; motor vehicles; wounds and injuries; infant equipment; protective devices; community health services; decision making; evidence-based medicine; economics; preventive health services; public health practice (Am J Prev Med 2001;21(4S):31-47)

Introduction

Motor vehicle crash-related injuries kill more children than any other single cause in the United States.¹ In 1998, a total of 1765 child occupants aged 14 years and younger died in motor vehicle crashes; of those, 33% were children younger than 4 years.¹ In 1999, an estimated 272,000 motor

vehicle occupants aged 14 and younger were injured in crashes.²

For children aged birth to 4 years, child safety seats can be extremely effective. When correctly installed and used, child safety seats reduce the need for hospitalization in this age group by 69%³ and the risk of death by approximately 70% for infants and by 47% to 54% for toddlers (aged 1 to 4 years).⁴ If all child passengers aged 4 years and younger were restrained, each year an additional 162 lives could be saved and 20,000 injuries could be prevented.^{5,6}

Approximately 29% of children aged 4 years and younger do not ride in appropriate restraints, placing them at twice the risk of fatal and nonfatal injuries of those riding restrained.^{2,7,8} In addition, approximately 85% of children riding in child safety seats are improperly restrained.⁹ 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.¹⁰

Some groups of children are more at risk than

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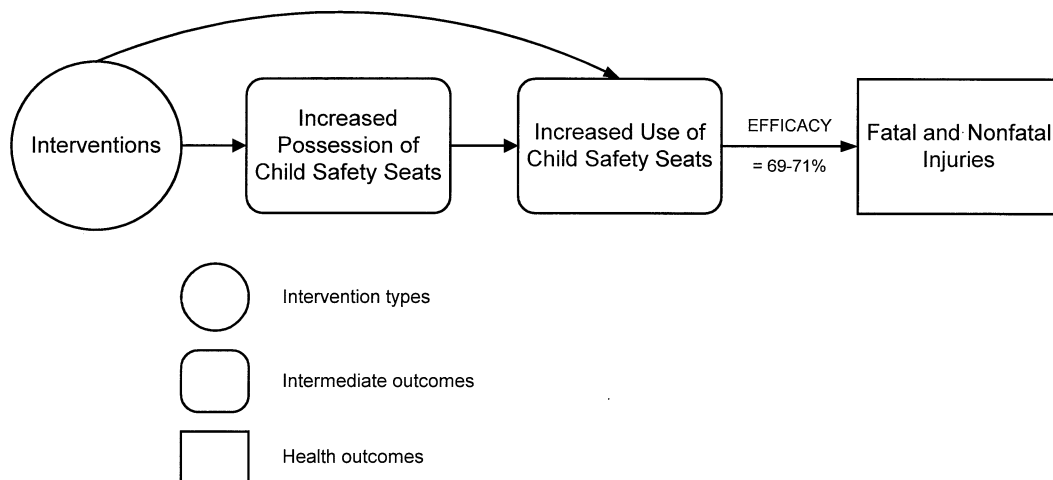


Figure 1. Conceptual approach: interventions to improve child safety seat use.

others. Child safety seat use is lower among rural populations and low-income families.^{8,11-13} Lack of access to affordable child safety seats might contribute to lower usage rates among low-income families. However, when they do own a safety seat, 95% of low-income families use it,^{5,14-16} suggesting that strategies to increase the availability of free or low-cost child safety seats might be effective.

Given the high burden of fatal and nonfatal injury imposed on children by motor vehicle crashes, the effectiveness of child safety seats in reducing those injuries, and the continued low rate of correct use of child safety seats, we sought to identify which population-based interventions among those currently in use or contemplated by the public health community are most effective. As part of the *Guide to Community Preventive Services* (the *Community Guide*), we conducted systematic literature reviews to determine the effectiveness of population-based interventions to improve the use of child safety seats among children aged birth to 4 years.¹⁷⁻¹⁹

Methods

The general methods for conducting systematic reviews for the *Community Guide* have been described in detail elsewhere.^{17,20,21} The specific methods for conducting reviews of interventions to reduce motor vehicle occupant injuries are also described in detail elsewhere in this issue.¹⁸ This section briefly describes the specific methods to define the conceptual approach, search strategy, intervention selection, and outcome determination for interventions to improve the use of child safety seats.

The general conceptual model used to evaluate the effectiveness of interventions to improve the use of child safety seats is shown in Figure 1. Interventions are designed to increase the possession and correct use of child safety seats. In turn, increased use of child safety seats reduces fatal and nonfatal injuries.

The systematic review development team (see author list and Consultation Team, in Acknowledgments) reviewed the scientific evidence of effectiveness for five interventions: child safety seat laws, community-wide information and enhanced enforcement campaigns, distribution and education programs, incentive and education programs, and education-only programs. For each of these interventions, changes in the use of child safety seats or injury rates were the outcome measures evaluated to determine the success of the intervention. Observed use of child safety seats was the preferred measure and was used when available. Some studies only provided parent-reported use, however. The measure used is specified in the evidence tables, available at the website (www.thecommunityguide.org).

Inclusion criteria for searching the literature are described in the accompanying methods article.¹⁸ These were the first interventions reviewed by the systematic review team, and database searching was concluded in March 1998. More than 3500 citations were screened; approximately 600 studies were retrieved for detailed screening. Of these studies, 72 met the inclusion criteria for the reviews.

Results. Part I. Intervention Effectiveness and Economic Efficiency Child Safety Seat Laws

Child safety seat laws require children traveling in motor vehicles to be restrained in federally approved safety seats appropriate for the child's age and size. Legislation also specifies the children to whom the law applies by age, height, weight, or a combination of these factors.

Although all states currently have child safety seat laws, a better understanding of the evidence about the effectiveness of these laws will help policymakers in their efforts to strengthen these regulations. In addition, differences in effectiveness based on the variability in state laws might bolster efforts to maintain or

Table 1. Child safety seat laws: descriptive information about included papers

	Number of studies
Papers meeting inclusion criteria	25 ²²⁻⁴⁶
Papers excluded, limited execution quality	14 ^{22-26,30-32,35,36,38,39,44,46}
Qualifying papers	11 ^{27-29,33,34,37,40-43,45}
Papers reporting on an already-included study	2 ^{33,45}
Actual number of qualifying papers	9 ^{27-29,34,37,40-43}
Study designs	
Time series with concurrent comparison group	5 ^{28,29,34,41,42}
Time series, no concurrent comparison group	2 ^{37,40}
Before-after with concurrent comparison group	1 ⁴³
Nonparametric modeling	1 ²⁷
Outcomes reported	
Fatal injuries	3 ^{27,41,42}
Fatal and nonfatal injuries (or nonfatal injuries only)	5 ^{28,29,34,37,41}
Child safety seat use	3 ^{40,41,43}

strengthen some state laws and to reduce gaps in coverage and protection for some children.

Reviews of evidence

Effectiveness. Our search identified 25 reports on the effectiveness of child safety seat laws.²²⁻⁴⁶ Descriptive information about the quality, study design, and outcome measures from these reports is provided in Table 1. Details of the nine independent, qualifying studies^{27-29,34,37,40-43} are available at the website (www.thecommunityguide.org).

The nine studies represent evaluations of child safety seat laws in the 50 states (the District of Columbia and Puerto Rico were not studied) that went into effect between 1978 (Tennessee) and 1986 (Alaska). The main characteristics of the laws are:

- **Primary enforcement.** All laws allow for primary enforcement, that is, a driver can be stopped for the sole purpose of being cited and fined for failure to comply with the child safety seat law.
- **Age requirements.** The laws apply to children of various ages (e.g., some apply to children up to the age of 1 year, whereas others apply to children up to the age of 5 years).
- **Seating position.** One study specified that the law applied only to children in the front seat; the remainder of the studies did not specify seating requirements.
- **Penalties.** The various laws allowed for penalties, ranging from an oral warning to a \$25 fine.

None of the studies described activities related to the law such as child safety seat loan programs for low-income families, levels of enforcement, or publicity about the law. Summary effects of the systematic review for each of the outcomes of interest, measured from 1 to 12 years after enactment, are presented in Table 2.

Among the studies that evaluated the laws' effects on injury rates, no differences were observed in the effect size on the basis of the age of children who were required to be in safety seats. Too few studies reported enough information about other requirements of the laws (e.g., seating position, penalties, enforcement provisions) to determine whether decreases in injury rates varied because of these factors. Moreover, there were too few studies from each state to allow us to determine whether specific state laws affected injury rates differently.

Applicability. The same body of evidence was used to evaluate the applicability of these laws in different settings and populations. In these studies, all 50 states were represented, and most studies analyzed data from statewide crash reporting files. Therefore, the evidence of effectiveness should be applicable to most child passengers in the United States. However, none of the studies adequately described the study population in terms of age, gender, race, socioeconomic status, region of the state, or other parameters. In addition, none of the studies described the crash reporting systems in adequate detail to determine the extent to

Table 2. Effectiveness of child safety seat laws on various outcomes: summary effects from the body of evidence

Outcome	Number of outcome measures	Median change	Range
Fatal injuries	3 ^{27,41,42}	35% decrease	25.0%–57.3% decrease
Fatal and nonfatal injuries combined	5 ^{28,29,34,37,41}	17.3% decrease	10.5%–35.9% decrease
Child safety seat use	3 ^{40,41,43}	13.0% increase	5.0%–35.0% increase

Table 3. Community-wide information and enhanced enforcement campaigns: descriptive information about included papers

	Number of studies
Papers meeting inclusion criteria	14 ⁴⁷⁻⁶⁰
Papers excluded, limited execution quality	10 ^{47-49,51,55-60}
Qualifying papers	4 ^{50,52-54}
Study designs	
Nonrandomized group trial	1 ⁵⁰
Time series, no concurrent comparison group	2 ^{53,54}
Before-after, no concurrent comparison group	1 ⁵²
Outcomes reported	
Child safety seat use	4 ^{50,52-54}

which these systems are valid and representative of crashes in their respective state populations. Therefore, differences in effectiveness for various subgroups of the population could not be determined.

Other positive or negative effects. No harms or other beneficial effects of child safety seat laws were identified from the literature.

Economic. No studies were found that met the requirements for inclusion in a *Community Guide* review.¹⁸

Barriers to intervention implementation. Child safety seat laws have been enacted in all 50 states and the District of Columbia. Experts in child passenger safety may encounter political barriers to strengthening the requirements of laws or to implementing or enhancing enforcement of existing laws, especially in the absence of data on how variations in existing laws are related to outcomes.

Conclusion. There is strong evidence of the effectiveness of child safety seat laws to reduce fatal and nonfatal injuries and to increase child safety seat use, according to the rules of evidence used for the *Community Guide*.

Community-Wide Information and Enhanced Enforcement Campaigns

Community-wide information and enhanced enforcement campaigns target information about child safety seats and child automobile safety to an entire community, usually geographic in nature. These campaigns use mass media; information and publicity; safety seat displays in public sites to promote use; and special enforcement strategies such as checkpoints, dedicated law enforcement officials, or alternative penalties (e.g., informational warnings instead of citations). Effective community-wide information and enhanced enforcement campaigns can complement and build on the benefit provided by child safety seat laws.

Reviews of evidence

Effectiveness. Our search identified 14 studies evaluating community-wide information and enhanced en-

forcement campaigns.⁴⁷⁻⁶⁰ Descriptive information is provided in Table 3. Details of the four qualifying studies^{50,52-54} are available at the website (www.thecommunityguide.org).

The informational techniques used in the campaigns studied included 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 of information about the importance and correct use of child safety seats. In three studies conducted in states with existing child safety seat laws,^{50,53,54} enhanced enforcement components included institution of checkpoints, assignment of law enforcement officers dedicated to enforcing the safety seat use law, and alternative penalties instead of citations, for example, informational warnings or vouchers to waive fines if the driver purchases a safety seat. The settings for the four campaigns in this analysis included cities, suburbs, and states. Design and implementation of campaigns involved numerous community organizations and government agencies such as public safety and public health offices, schools, advocacy organizations, and parent groups.

The median difference in safety seat use for these four studies was an increase of 12.3% (range, 3.8% to 20.8% increase) over baseline rates, measured from 1 to 6 months after the program began. The range of effect sizes followed the baseline safety seat use rates among the intervention groups across the four studies. A study with one of the lowest baseline safety seat use rates (13.6%)⁵³ observed the smallest post-intervention effect (3.8% increase); this study was conducted in Tennessee in 1977 and 1978, early in the development of safety seat use improvement programs and in conjunction with enactment of the first mandatory child safety seat use law in the United States. A study with a higher baseline use rate (20.4%)⁵² observed a significant increase in use, to 34.1% (difference, 13.7% increase). Two studies with much higher baseline rates (63.4% and 65.2%, respectively)^{50,54} had post-intervention rates of 76.5% and 86.0%, respectively.

Table 4. Child safety seat distribution and education programs: descriptive information about included papers

	Number of studies
Papers meeting inclusion criteria	17 ^{14,15,61-75}
Papers excluded, limited execution quality	7 ^{15,61,65,66,68,70,73}
Qualifying papers	10 ^{14,62-64,67,69,71,72,74,75}
Study designs	
Randomized controlled trials	2 ^{67,72}
Nonrandomized group trials	2 ^{14,69}
Nonrandomized individual trials	2 ^{63,71}
Time series, no concurrent comparison group	2 ^{62,64}
Before-after, no concurrent comparison group	1 ⁷⁴
Cross-sectional survey	1 ⁷⁵
Outcomes reported^a	
All fatal and nonfatal injuries	1 ⁷⁴
Correct child safety seat use	13 ^{14,62,64,67,69,71,72,74,75}
Possession of child safety seats	7 ^{14,63,75}

^aSome papers reported more than one independent outcome measure.

Three campaigns were implemented in communities with existing child safety seat laws.^{50,53,54} Two of these interventions^{50,54} included messages about enhanced enforcement or the threat of enforcement in their mass media components, and they reported increases in child safety seat use of 13.1% and 20.8%, respectively. The intervention that did not use or publicize enhanced enforcement⁵³ reported a 4.4% increase in safety seat use.

Applicability. The same body of evidence was used to evaluate the applicability of these campaigns in different settings and populations. These four studies were conducted in the United States, Canada, and Australia and involved populations at all socioeconomic levels. Parents of children from birth to 11 years of age were targeted. Two studies^{53,54} were conducted statewide and, although the literature did not clarify the targeted populations, they likely included urban, suburban, and rural populations. No study reported the racial or ethnic makeup of the study population.

Other positive or negative effects. Community-wide information and enhanced enforcement campaigns can increase public awareness of child safety seat laws and the dangers of unrestrained travel. Such awareness might be an important predisposing factor for other interventions. Additional benefits of enhanced enforcement might be increased detection and arrest for alcohol-impaired driving and other offenses. No negative effects of community-wide information and enhanced enforcement campaigns were identified for evaluation in this review.

Economic. No studies were found that met the requirements for inclusion in a *Community Guide* review.¹⁸

Barriers to intervention implementation. Barriers to implementing community-wide information and enhanced enforcement campaigns were not identified in the literature but might include the cost of developing

and disseminating public information and education material; cost of television and radio announcements; as well as enlisting the support and cooperation of the media, police departments, and other community leaders. Training enforcement personnel on the importance of enforcing child-restraint device laws and the additional burden on court systems resulting from increased law enforcement may also be barriers to implementing these programs.

Conclusion. According to the rules of evidence used for the *Community Guide*, there is sufficient scientific evidence to show that community-wide information and enhanced enforcement campaigns are effective in increasing child safety seat use.

Distribution and Education Programs

Distribution and education programs provide child safety seats to parents through a loan, low-cost rental, or giveaway of an approved safety seat. All programs also include an educational component, the intensity of which varies among programs.

Parents with financial hardship or a poor understanding of the importance of acquiring and using a safety seat might be more likely to use child safety seats if they receive financial assistance and safety education. This review sought to determine the effectiveness of providing low-cost or free safety seats to parents as a means of increasing the use of safety seats.

Reviews of evidence

Effectiveness. Our search identified 17 papers on the effectiveness of distribution and education programs.^{14,15,61-75} Descriptive information about these papers is provided in Table 4. Details of the 10 qualifying papers^{14,62-64,67,69,71,72,74,75} are available at the website (www.thecommunityguide.org) and are provided as an example in the Appendix.

These 10 programs provided free loaner child safety

Table 5. Effectiveness of child safety seat distribution and education programs on various outcomes: summary effects from the body of evidence

Outcome	Number of outcome measures	Median change	Range ^a
All fatal or nonfatal injuries	1 ⁷⁴	NA	6.4% decrease
Correct child safety seat use			
Earliest post-intervention assessment (range, birth–2 years)	10 ^{14,62,64,67,69,71,72,74,75}	22.6% increase	4.0%–62.3% increase
Follow-up assessment (range, 1–10 months after first assessment)	3 ^{14,71,72}	6.0% increase	2.1% decrease to 7.0% increase
Possession of child safety seats	5 ^{14,63,71,75}	51.0% increase	16.0%–93.0% increase

^aWhen 7 or more outcome measures were available, an interquartile range is presented. NA, not applicable.

seats, low-cost rentals, or direct giveaways. In addition to providing the safety seats, all programs also gave parents information on proper usage to increase the likelihood that the safety seats would not only be used but also be used correctly. The instructional component varied considerably in terms of content of information, duration and intensity of education, methods used, and the number of methods used. For example, some programs simply provided instruction or written materials (e.g., brochures or pamphlets) on how to use the safety seat, whereas others used various educational and behavioral techniques such as active involvement in discussions, problem solving, safety seat use demonstrations, and rehearsal of skills for correct use of safety seats. Programs were implemented in hospitals, clinics, and homes and through insurance companies and were primarily targeted to parents of infants rather than older children.

Summary effects from the systematic reviews for each outcome of interest are presented in Table 5. Nine of the ten papers reported the effect of these programs on either the correct use or self-reported use of safety seats (Table 5). In addition, one paper⁷⁴ evaluated a giveaway program sponsored by an automobile insurance company and observed a significant decline in injury rates among the children of policyholders (Table 5), and four^{14,63,71,75} evaluated the programs' effects on possession of safety seats (Table 5). Overall, all studies showed either a reduction in fatal and nonfatal injuries or an increase in child safety seat use, or both.

Applicability. The same body of evidence was used to evaluate the applicability of these programs in different settings and populations.^{14,62–64,67,69,71,72,74,75} Distribution programs were effective when implemented in hospitals and clinics, as part of postnatal home visitation, and when provided by an automobile insurance company. In addition, they were effective among urban, suburban, and rural populations and among affluent and poor populations. Studies were conducted in the United States, Canada, Australia, and Sweden with similar results.

Few studies measured baseline use rates before pro-

grams were implemented. Therefore, in populations that already have high rates of safety seat use, the level of effectiveness of distribution and education programs might be lower than the results found in this review. In addition, only three of the nine papers reported the effectiveness of such programs for children older than 9 months; the median increase in safety seat use for these three studies was 2.1% (range, 1.1% to 27.0% increase).^{64,69,74} Moreover, no papers reported race or ethnicity of the study population.

Other positive or negative effects. Because distribution programs increase the number of seats available, these programs might also result in increases in misuse of safety seats, particularly among new users. None of the identified studies measured misuse of safety seats after distribution programs, and our search did not identify any studies that looked at the likelihood of misuse after this intervention or at the issue of defective used seats.

Economic. No studies were found that met the requirements for inclusion in a *Community Guide* review.¹⁸

Barriers to intervention implementation. Several potential barriers to implementing child safety seat distribution and education programs are described in the literature. Implementing organizations need to consider potential liability; the initial expense for purchasing seats; cleaning and storage of child safety seats; and training of personnel to provide education and to distribute child safety seats. In addition, some child safety seats might be incompatible with certain vehicles.

Conclusion. Strong evidence shows the effectiveness of child safety seat distribution and education programs in improving child safety seat use, according to the rules of evidence used for the *Community Guide*. Additional supportive evidence indicates a decline in injury claims made to an insurance agency and increases in possession of child safety seats.

Incentive and Education Programs

Incentive and education programs reward parents for obtaining and correctly using child safety seats or

Table 6. Child safety seat incentive and education programs: descriptive information about included papers

	Number of studies
Papers meeting inclusion criteria	5 ⁷⁶⁻⁸⁰
Papers excluded, limited execution quality	1 ⁷⁷
Qualifying papers	4 ^{76,78-80}
Study designs	
Randomized group trial	1 ⁸⁰
Time series, no concurrent comparison group	3 ^{76,78,79}
Outcomes reported	
Correct child safety seat use	4 ^{76,78-80}

directly reward children for correctly using safety seats. These programs include educational components of varying intensity. If incentives and education programs are effective in increasing use in the short-term, they might also provide the impetus for some parents to continue using safety seats beyond the program.

Reviews of evidence

Effectiveness. Our search identified five reports on the effectiveness of incentive and education programs.⁷⁶⁻⁸⁰ Descriptive information on these studies is provided in Table 6. Details of the four qualifying papers^{76,78-80} are available at the website (www.thecommunityguide.org).

The reward used and the reward distribution method varied in the four studies. Rewards varied from inexpensive trinkets, stickers, or coupons for fast food meals or movies to relatively expensive prizes donated by community merchants. Rewards were contingent on the parent or caregiver's correct use of safety seats at the time of observation. Rewards were distributed constantly over the period of the programs (range of program implementation, 1 to 5 months). In all four programs, rewards were provided to randomly selected eligible participants. In three programs, smaller rewards were also distributed to all eligible participants.⁷⁸⁻⁸⁰

All of the programs included an educational component. This component varied considerably in terms of information content, duration and intensity of education, methods used, and the number of methods used. For example, some programs simply provided information about the reward program itself, whereas others provided information about the effectiveness of safety seats or existing laws mandating safety seat use. Some programs provided limited information (e.g., brochures or pamphlets), whereas others used various educational and behavioral techniques such as reinforcement of desired behaviors, educational videos, feedback on correct use, pledge cards, and information to parents about safety seat use. These studies included programs that were implemented in daycare centers and community-wide.

The median overall difference in safety seat use over time for all of the studies was a 9.9% increase (range, 4.8% to 36.0% increase), measured between 1 and 4.5

months after the intervention was stopped. The effectiveness of incentive programs beyond 4.5 months has not been evaluated. Baseline rates were similarly low in all four studies (median, 25.9%; range, 11.37% to 48.0%).

Applicability. The same body of evidence was used to evaluate the applicability of these programs in different settings and populations. Incentive and education programs were implemented in daycare centers and community-wide among a variety of target populations (children and parents of children aged 6 months to 12 years, all socioeconomic groups, urban and rural populations, white and African-American populations) with similar positive effects.

Other positive or negative effects. None of the identified studies measured safety seat misuse as a result of incentive and education programs in the population, and no other studies of the likelihood of misuse with this intervention were identified in the literature.

Economic. No studies were found that met the requirements for inclusion in a *Community Guide* review.¹⁸

Barriers to intervention implementation. Barriers to implementation of incentive and education programs were not identified in the literature but might include the cost of purchasing incentive rewards; maintaining appropriate schedules of reinforcement; training of personnel to provide the education component; and garnering support of schools, daycare centers, and other sites to sponsor incentive and education programs.

Conclusion. Sufficient scientific evidence exists to conclude that incentive and education programs are effective in increasing child safety seat use in the short term (i.e., 1 to 4 months), according to the rules of evidence used for the *Community Guide*.

Education-Only Programs

Education-only programs provide information about the use of child safety seats and relevant skills to parents, children, or professional groups. Giving information to people provides the basic foundation for moving them toward behavior change such as perform-

ing new skills (e.g., routinely restraining children in safety seats) and enacting new policies (e.g., implementing hospital policies to discharge infants only if the parent uses a child safety seat). Provision of information is a central and necessary component of interventions such as community campaigns, distribution programs, and incentive programs.

Distinction between education-only interventions and counseling. In the *Guide to Clinical Preventive Services*, the U.S. Preventive Services Task Force recommends that clinicians counsel parents and children about the use of motor vehicle child safety seats.⁸¹ To complement this recommendation without overlap, we defined education-only programs for this review as any program designed to provide information about child safety seats other than those involving one-on-one counseling of a patient by a primary care clinician. All of the papers reviewed by the U.S. Preventive Services Task Force were considered for our systematic review; several were subsequently excluded because the intervention was limited to one-on-one clinician counseling of patients. The remaining papers were categorized according to the intervention's primary focus (i.e., educational or distribution program); thus, some papers are included in this review of educational programs,^{82–84} whereas other papers are included in the review of evidence for distribution programs.^{14,71,72}

Reviews of evidence

Effectiveness for different target populations. The effectiveness of education-only programs directed toward parents, children, and professional groups are discussed below.

Education-only programs for parents. Of 11 studies identified,^{36,82–91} three had adequate quality of execution and were included in the body of evidence.^{85–87} One study reported a randomized clinical trial,⁸⁵ one a nonrandomized clinical trial,⁸⁷ and one used a before–after design.⁸⁶ All three studies evaluated how perinatal education-only programs affected the correct use of child safety seats. None of the studies found that these programs significantly increased the proportion of correct use at the time of discharge from the hospital (median, 2.0% increase; range, 2% decrease to 10.9% increase). Baseline safety seat use rates varied considerably among the three studies (median, 63.9%; range, 8% to 94%).

Education-only programs for children. Of four studies identified,^{88,92–94} one had adequate quality of execution and was included in the body of evidence.⁹² This study reported a before–after design that evaluated the effect of the educational program on the use of child safety seats. Arneson et al.⁹² conducted a 5-day educational program, “Riding with Bucklebear,” with children aged 2.5 to 5 years in a preschool setting. Knowledge scores about how to get into a child safety seat and

secure it correctly increased significantly among the children from before to after the intervention ($t=3.6$; $p=0.002$), but safety seat use did not increase significantly (12% increase; $p=0.33$; baseline rate not stated).

Education-only programs for professional groups. Two studies were identified,^{95,96} both with adequate quality of execution. One study reported a nonrandomized group trial,⁹⁵ the other reported a before–after design.⁹⁶ The two studies were done in different professional groups and, therefore, evaluated the effect of professional education on different outcomes. Wolf et al.⁹⁶ evaluated a program that targeted nursing or obstetrical directors at all Nebraska hospitals that offer newborn delivery services; participants were trained to develop policies and interventions for perinatal women about the use of child safety seats. The study found significant increases from before to after the intervention in the proportion of hospitals with written policies for newborns regarding child safety seats (baseline 25.9%; 62.3% increase; $p<0.001$), hospitals with short-term loan programs available (baseline 58.8%; 14.1% increase; $p<0.05$), and hospitals with patient education programs available (baseline 51.2%; 44.1% increase; $p<0.0001$). Lavelle et al.⁹⁵ conducted training for police officers in one community in Colorado and measured rates of enforcement of Colorado's mandatory child safety seat use law compared with rates of enforcement in a comparison community. Officers in the intervention community increased the number of citations issued from 0 to 10 per month to 10 to 20 per month 6 months after the intervention was completed. The number of citations in the comparison community did not change.

Other positive or negative effects. Educational programs for parents might increase their knowledge about child safety seat laws and the effectiveness of safety seats, and improved knowledge might be an important predisposing factor for other interventions. Improper installation of the safety seat in the vehicle, improper harnessing of the child into the safety seat, or improper placement of a rear-facing infant safety seat in a front passenger seat are examples of the safety seat misuse that can occur when parents who have not previously used safety seats receive inadequate education about the devices. No study identified higher rates of misuse between intervention and comparison populations, and no other studies of the likelihood of misuse were identified in the literature.

Educational programs might increase children's knowledge about the benefits of using safety seats or safety belts, and this increased knowledge might be a predisposing factor for other interventions. No study identified increased misuse of child safety seats among people who received the intervention, and none proposed potential harms of educational programs for safety belt use among older children.

Educational programs for professional groups might increase their knowledge about the importance of advocating for safety seat use among children. Their advocacy might, in turn, be a predisposing factor for other interventions. No harms of educational programs for professional groups were proposed in the literature.

Applicability. The body of evidence used to evaluate the applicability of these programs in different settings and populations was the same as that used to evaluate effectiveness. The six studies included in this review were implemented in hospitals, preschools, and work sites. Within these settings, interventions were aimed at specific target populations (parents, children, or professional groups). Educational programs for parents were only directed toward improving safety seat use among infants; none examined the effect of education for parents of older children. Urban and suburban populations of low, middle, and upper socioeconomic status were represented in some of the studies. No studies reported the racial or ethnic makeup of the study populations.

Economic. Evidence about economic effectiveness was not collected for this intervention because effectiveness was not established.

Barriers to intervention implementation. Evidence about barriers was not collected for this intervention because effectiveness was not established.

Conclusion. Available studies provide insufficient evidence to assess the effectiveness of education-only programs in improving knowledge about or use of child safety seats. However, education is a central component of most other effective interventions. Until more and better information becomes available, communities might choose to make decisions about the use of education-only programs on grounds other than evidence of direct effects from available studies.

Results. Part II. Research Issues

Effectiveness

For all five interventions, the team identified key research issues that had not been answered in the systematic review process. These research issues were grouped by the types of evidence sought. The team identified sufficient or strong evidence of effectiveness for four interventions (i.e., child safety seat laws, community-wide information and enhanced enforcement campaigns, distribution programs, and incentive programs). However, several important research issues about the effectiveness of these interventions remain.

1. Does effectiveness of the intervention change when specific elements are changed? For example,

- Does the effectiveness of child safety seat laws vary depending on the requirements of different state laws?

- Does effectiveness of laws vary depending on the intensity and visibility of regular enforcement in the state?
- Would the threat of being charged with contributory negligence if an unrestrained child is killed or injured in a motor vehicle crash change the effectiveness of the law?
- What role does information about laws play in compliance rates?
- Are distribution programs sponsored by medical care organizations more or less effective than programs implemented by other organizations (e.g., insurance companies or community organizations)?
- Are low-cost rental programs any more or less effective than free loan programs?
- Are different incentives needed for different devices (e.g., infant safety seats, child seats, booster seats, safety belts)?
- What is the relative effectiveness of different incentives (e.g., direct rewards related to restraint use vs chances to win prizes)?

2. What is the long-term effectiveness of each intervention? For example,

- How can the effectiveness of a child safety seat law be maintained over time?
- Can incentive programs improve long-term use of child safety seats? If so, what kind of reward schedule and distribution method is necessary to maintain positive effects?

3. How effective are various combinations of these four interventions? For example,

- Does enhanced enforcement provide marginal benefit to that provided by legislation?
- Do hospital discharge policies requiring that newborns be restrained in an approved device increase the effectiveness of distribution programs?

Because the effectiveness of education alone has not been established, basic research questions remain. For example,

- What amount and quality of content are necessary to improve knowledge, attitudes, and behaviors?
- What are appropriate educational contents and methods for delivery to children at various developmental stages?
- What are the appropriate outcomes to measure when educating young children about the use of child safety seats?
- Is education alone effective to:
 - increase parental use of child safety seats?
 - increase children's independent use of child safety seats?
 - increase enforcement of child safety seat laws by law enforcement officials?

—encourage hospital personnel to develop and enforce policies about child safety seat use?

Other Positive and Negative Effects

The studies included in the reviews did not measure other positive and negative effects of the interventions. For all five interventions, research is needed to determine whether each intervention is likely to either increase or reduce misuse of child safety seats. Research is also needed to determine the role of community-wide or individual education in facilitating the effectiveness of other interventions (e.g., legislation, loaner programs).

Applicability

Each of the effective interventions should be applicable in most of the relevant target populations and settings. However, differences in the effectiveness of each intervention for specific subgroups of the population could not be determined. Several questions about the applicability of these interventions in settings and populations other than those studied remain. For example,

- Are these interventions equally effective in all populations within a state (e.g., racial and ethnic minorities, high- and low-income populations, or behavior change-resistant populations)?
- How must the content and methods of the educational components of interventions be altered to work in different populations?
- Are these interventions effective in populations that already have high baseline safety seat use rates?
- Do programs targeted at parents of infants improve the rate at which parents buy or use child safety seats for children older than 1 year?
- Are incentive programs effective in settings other than those studied (e.g., state motor vehicle inspection stations) or when implemented by other organizations (e.g., community groups or local businesses)?

Economic Evaluations

The team did not identify any economic evaluation meeting *Community Guide* standards for these interventions. Thus, basic economic research must still be conducted:

- What is the cost of interventions to increase the use of child safety seats?
- Are interventions to increase the use of child safety seats cost-saving?
- What is the return on investment of interventions to increase child safety seat use?

Discussion

Systematic literature reviews are particularly useful for creating guidelines. The Task Force on Community Preventive Services (the Task Force) has done this by using the evidence from these systematic reviews to make recommendations about the use of the interventions.⁹⁷ Systematic reviews are also useful for identifying gaps in our knowledge base. The research questions provided in this article should be used to guide future research, both by government agencies and foundations in allocating research funding and by academic and other research organizations in determining research priorities.

Dissemination of these findings is ongoing through federal and state government agencies, advocacy organizations, and other groups with missions that include reducing child motor vehicle occupant injuries. Implementation advice for these interventions is available from several organizations, including the National Highway Traffic Safety Administration (www.nhtsa.gov), the National Center for Injury Prevention and Control of the Centers for Disease Control and Prevention (www.cdc.gov/ncipc), and the National SAFE KIDS Campaign (www.safekids.org).

An important implementation issue regarding distribution and education programs has arisen since the studies in this review were conducted. Because the integrity of child safety seats can be compromised in a crash, seats returned to a distribution and education program should not be lent to others because there can be no guarantee that they were not involved in a crash. Therefore, when implementing child safety seat distribution and education programs, only new, unused seats should be provided to all recipients.

These interventions are aimed at children aged birth to 4 years and their parents. All 50 states require children in this age group to be properly restrained while riding in motor vehicles. An accompanying article in this supplement⁹⁸ addresses interventions to improve the use of safety belts among teenagers and adults. A clear gap in these two sets of reviews and in the Task Force's recommendations is for children who are too old or too 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 4 to 8 years).⁹⁹ The literature base regarding the efficacy of booster seats, and particularly for population-based interventions to improve their use, is still emerging. Future updates of these reviews and recommendations should address this vulnerable population.

Systematic reviews are limited to the information published in the existing studies. In the present reviews, for example, no studies discriminated between correct and incorrect use of child safety seats. Although some studies evaluated correct use only, they neither estimated incorrect use nor discussed how to correct

mistakes in child safety seat installation or child restraint. Because estimates of misuse of child safety seats are so high, it is imperative to continue research on how to reduce misuse of child safety seats.¹⁰⁰

Finally, these reviews did not examine positioning of children within the car. Recent evidence has clearly shown a relationship between placement of rearward-facing infant safety seats in the passenger seat of a car with an activated airbag and increased risk of death of the infant if the airbag is deployed.¹⁰¹ None of the studies included in the reviews examined the effect of the interventions on placement of the child safety seat in the rear seat of the car. This problem is due largely to the abundance of studies that predated either the widespread installation of airbags or the recognition of the danger of airbags to infants and children.^{7,102}

Although numerous questions remain, evidence is available about the effectiveness of four of the five strategies we reviewed. This scientific evidence, along with the accompanying recommendations of the Task Force,⁹⁷ can be a powerful tool for securing the resources and commitment required to implement these strategies.

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Appendix: Studies Measuring the Effectiveness of Child Safety Seat Distribution Programs

Author & year (study period) Design suitability: design Quality of execution Evaluation setting	Intervention and comparison elements	Study population description Sample size	Effect measure	Reported baseline	Reported effect	Value used in summary ^a	Follow-up time
Studies measuring the effect on injury rates							
Saalberg, Chapter 5, 1982 (1977-81) ¹ Least: Before-after Good Insurance company	Location: Michigan, USA Components: Child safety seat giveaway Comparison: Pre-program period and families not issued a restraint by the company	Parents of 0-4-year-old children N = 7140 seats distributed to 5776 households	Injuries (record review)	16.3%	10%, p<0.05	-6.3%	0-2 years
Studies measuring the effect on use of safety seats							
Robitaille 1990 (1981-82) ² Greatest: Non-randomized group trial Good Clinic, home visits	Location: Montreal, Canada Components: Loan program, classroom instruction, instructional films, community safety belt/safety seat promotional programs Comparison: Community safety belt/safety seat promotional programs	Mother/infant pairs N = 635 community-wide observations	Self-reported use 3 months 13 month follow-up	Intervention vs comparison 40.8% vs 21.6% [11.5, 26.7] 66.3% vs 54.3%	Intervention vs comparison	+18.2% +2.1%	3 months 10 months
Christopherson 1982 (1981) ³ Greatest: Randomized clinical trial Fair Hospital	Location: Kansas City, Kansas, USA Components: Loan program and demonstration of safety seat use Comparison: Usual discharge instructions (not described)	Mother/infant pairs N = 15 (intervention) N = 15 (comparison)	Correct use (observed) Discharge 4-6 week follow-up	Intervention vs comparison 67% vs 0% (p<0.001) 29% vs 23% (p>0.05)	Intervention vs comparison	+67% +6%	Discharge from hospital 4-6 weeks
Colletti 1986 (1979-84) ⁴ Moderate: Time series Fair Hospitals	Location: Vermont, USA Components: Rental program pamphlets, demonstration, skill rehearsal Comparison: Pre-program period	Mother/infant pairs N = 1846	Correct use (observed)	1979 <21%	1984 82%	+61%	Discharge from hospital
Geddis 1986 (1981-84) ⁵ Moderate: Time series Fair Hospital	Location: Dunedin, New Zealand Components: Rental program, pamphlets, individual education, letters/pamphlets mailed to parents not visited in hospital, monthly public safety campaigns (not described) Comparison: Pre-program period	Observed infants or children in motor vehicles 0-6 months N = 582 6-18 months old N = 471	Correct use (observed) 0-6 months old 6-18 months old	1981 0% 61%	1984 +66% +27%	+66% +27%	0-18 months 0-18 months

Appendix Continued

Author & year (study period) Design suitability: design Quality of execution Evaluation setting	Intervention and comparison elements	Study population description Sample size	Effect measure	Reported baseline	Reported effect	Value used in summary ^a	Follow-up time
Hietko, 1987 (1985) ⁶ Greatest: Randomized clinical trial Fair Hospital	Location: Kalamazoo, Michigan, USA Components: Rental program, interactive video instruction, quizzes, demonstration, reinforcing materials Comparison 1: Individual education, filmstrip, pamphlet Comparison 2: No intervention, community members	Mother/infant pairs N=295 (intervention) N=300 (comparison 1) N=358 (comparison 2)	Correct use (observed)	Intervention vs comparison 1 64.6% vs 63.9%, $X^2 = 1.06$, $p > 0.05$ Intervention plus comparison 1 vs comparison 2 64.3% vs 53.1%, $p < 0.05$	Intervention vs comparison 1 64.6% vs 63.9%, $X^2 = 1.06$, $p > 0.05$ Intervention plus comparison 1 vs comparison 2 64.3% vs 53.1%, $p < 0.05$	+0.7% Not used	4 months
Lindqvist, 1993 (1984-85) ⁷ Greatest: Non-randomized group trial Fair Hospital	Location: Ostergotland, Sweden Components: Loan program, demonstration of use, videotape ("Safety from the Beginning") Comparison: Usual care (not described)	Observed infants in motor vehicles N = 764 (intervention) N = 397 (comparison)	Self-reported use 0-9 months old 9-12 month follow-up	Intervention vs comparison 96.2% vs 49.4% 98.7% vs 97.6%	Intervention vs comparison 96.2% vs 49.4% 98.7% vs 97.6%	+46.8% +1.1%	9 months 6 months
Reisinger, 1978 (1976-77) ⁸ Greatest: Non-randomized clinical trial Fair Hospital	Location: Pittsburgh, Pennsylvania, USA Group 1: Safety seats made easily available for purchase, literature, nurses supportive Group 2: Literature, displays, safety seats made easily available for purchase, demonstration and discussion if purchased Group 3: Literature plus offer of free safety seat; demonstration if purchased; seats NOT readily available for purchase Comparison (Group 4): Safety seats available for purchase in hospital shop	Mother/infant pairs Group 1: N = 271 Group 2: N = 295 Group 3: N = 265 Comparison (Group 4): N = 272	Correct use (observed) at: Discharge from hospital 2-4 month follow-up	Group 1 vs 4 Group 2 vs 4 Group 3 vs 4 Group 1 vs 4 Group 2 vs 4 Group 3 vs 4	Group 1 vs 4 Group 2 vs 4 Group 3 vs 4 Group 1 vs 4 Group 2 vs 4 Group 3 vs 4	Not used Not used +5% Not used Not used +7%	Immediate 2-4 months
Saaleb, Chapter 5, 1982 (1977-81) ¹ Least: Before-after Good Insurance company	Location: Michigan, USA Components: Child safety seat giveaway Comparison: Pre-program period and families not issued a restraint by the company	Parents of 0-4-year-old children N = 7140 seats distributed to 5776 households	Self-reported use	Intervention vs comparison 56.6% vs 16.7%, $p < 0.01$	Intervention vs comparison 56.6% vs 16.7%, $p < 0.01$	+39.9%	0-2 years

Appendix Continued

Author & year (study period) Design suitability: design Quality of execution Evaluation setting	Intervention and comparison elements	Study population description Sample size	Effect measure	Reported Baseline	Reported effect	Value used in summary ^a	Follow-up time
Saalberg, Chapter 8, 1982 (1979-81) Least: Cross-sectional Fair Insurance company	Location: Michigan, USA Components: Safety seat giveaway Comparison: Families not issued a safety seat by the company	Parents of 0-4-year-old children N = 800 households	Self-reported use	Families provided a restraint vs families not provided a restraint 23% vs 22%		+1%	0-2 years
Studies measuring the effect on possession/acquisition of safety seats							
Robitaille 1990 (1981-82) ² Greatest: Non-randomized group trial Good Clinic, home visits	Location: Montreal, Canada Components: Loan program, classroom instruction, instructional films, community safety belt/safety seat promotional programs Comparison: Community safety belt/safety seat promotional programs	Mother/infant pairs N = 635 community-wide observations	Self-reported possession 3 months	Intervention vs comparison 61% vs 39.7% [10.6, 27.5]		+21.3%	3 months
Culler, 1980 (1979) ¹⁰ Greatest: Non-randomized clinical trial Fair Hospital	Location: Chattanooga, Tennessee, USA Group 1: Offered a low-cost rental Group 2: Offered a free loaner Comparison: Encouraged to use own resources to acquire a safety seat	Mother/infant pairs N = 35 (Group 1) N = 40 (Group 2) N = 44 (Comparison)	Self-reported acquisition	Group 1: 51% Group 2: 83% Comparison: 0% X ² = 64.32, p < 0.0001		51% 83%	3-8 weeks 3-8 weeks
Reisinger, 1978 (1976-77) ⁸ Greatest: Non-randomized clinical trial Fair Hospital	Location: Pittsburgh, Pennsylvania, USA Group 1: Safety seats made easily available for purchase, literature, nurses supportive Group 2: Literature, displays, safety seats made easily available for purchase; demonstration and discussion if purchased Group 3: Literature plus offer of free safety seat; demonstration if purchased; seats NOT readily available for purchase Comparison (Group 4): Safety seats available for purchase in hospital shop	Mother/infant pairs Group 1: N = 271 Group 2: N = 295 Group 3: N = 265 Comparison (Group 4): N = 272	In-hospital acquisition	Group 1 vs 4 Group 2 vs 4 Group 3 vs 4	6% vs 1% 11% vs 1% 94% vs 1%	Not used Not used +93%	Immediate

Appendix Continued

Author & year (study period) Design suitability: design Quality of execution Evaluation setting	Intervention and comparison elements	Study population description Sample size	Effect measure	Reported Baseline	Reported effect	Value used in summary ^a	Follow-up time
Saalberg, Chapter 8, 1982 (1979-81) Least: Cross-sectional Fair Insurance company	Location: Michigan, USA Components: Safety seat giveaway Comparison: Families not issued a safety seat by the company	Parents of 0-4-year- old children N = 800 households	Self-reported possession	Families provided a restraint vs families not provided a restraint: 78% vs 62%		+16%	0-2 years

^a This is the value used to summarize the evidence and to develop the recommendation. In some cases, this column reflects values calculated because the effects reported by the authors were not consistent with effect measures used in other studies.

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