



CPS Issue Report

Second in an occasional series on child passenger safety issues

May 2005

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In collaboration with



This simulation depicts a 35 mph frontal crash with an unrestrained 6-year-old in the front seat versus a properly restrained 6-year-old in the rear seat. The child in front would have suffered serious or fatal injuries while the child seated in rear would have suffered less serious, if any, injuries.

“Dad, when can I sit up front?”

Motor vehicle crashes are the number one killer of children over age 1. In 2003, 1,794 children under age 16 were killed in crashes and many more children were injured — approximately 241,000. Nearly one-third of the children who sustained fatal injuries were seated in the front seat and more than half were unrestrained. Rear seating and age- or size-appropriate restraints could have prevented many of these tragedies.

As children get older, they may want to take on “grown-up” behaviors like sitting in the front seat of the car. Troy Parker, a father of girls ages 7 and 10 years, feels the pressure of his children’s burgeoning independence.

Story continues on page 3.

CPS Issue Report: Safe Seating for Children is the second in an occasional series of reports published by Partners for Child Passenger Safety, a research partnership of The Children's Hospital of Philadelphia and State Farm® that is the largest study of children in crashes. Since 1997, more than 300,000 State Farm customers have shared their crash experiences with Children's Hospital researchers who are then able to determine the best ways to protect the nation's children in motor vehicles.

PCPS has heard from colleagues in primary care pediatrics that a frequent concern among patient families regards the safest seating positions for their children. This report compiles recent research from Partners for Child Passenger Safety and others who have looked at the effects of seating position on risk of injury to children and offers evidence-based general guidelines.

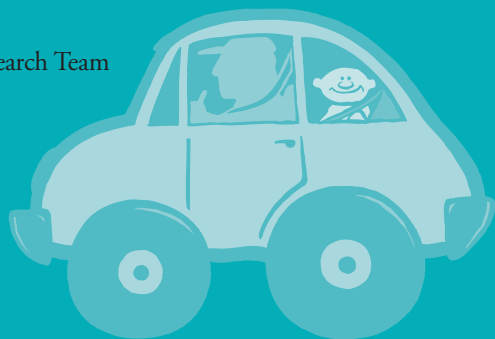
We appreciate our collaborative relationship with the American Academy of Pediatrics, which allows us to distribute this report to thousands of pediatric clinicians who interact daily with families dealing with child passenger safety issues.

Current research on safe seating for children has been distilled into just eight pages of the most pertinent information physicians and health educators need for anticipatory guidance counseling. Please refer to the "Data Sources" if you want a more in-depth look at the issue. Links to many of the article abstracts that were authored by PCPS researchers are available from traumalink.chop.edu.

PCPS has also developed English and Spanish-language Web sites available at www.chop.edu/carseat that provide short videos and comprehensive information to help parents protect children of all ages when they ride in vehicles — from installing child safety seats to reinforcing safe driving habits for teens.

We appreciate your comments. If you would like to receive future *CPS Issue Reports*, please e-mail your mailing address to Suzanne Hill, advocacy and outreach manager for PCPS, at hillsu@email.chop.edu. Reports can be downloaded from traumalink.chop.edu.

Sincerely,
the PCPS Research Team



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* Sources are in order in which they are first referenced.

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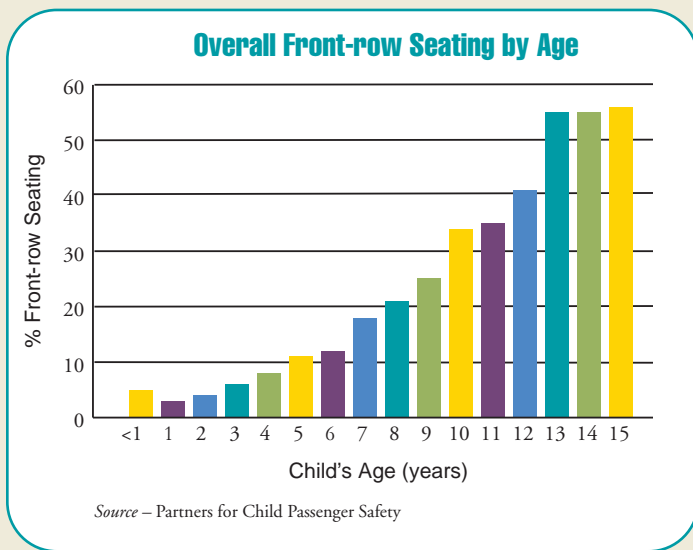
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“When Can I Sit Up Front?” *continued from page 1*

“Tyra and Tori see their friends riding in the front seat,” says Mr. Parker. “However, until my children can make mature decisions regarding their safety, I need to insist on proper restraint use in the car.” Both girls sit in the rear seat and Tyra still uses her booster seat.

Mr. Parker is not the only parent wrestling with safety concerns. Pediatricians and child passenger safety practitioners report that parents frequently ask them, “What is the safest seating position for my child?” Current research can now offer some guidance on safe seating decisions for the whole family.

“The single most important life-saving decision parents can make for their child is to use the rear seat and age- and size-appropriate restraint on every trip, every time,” says Laura K. Winston, M.D., Ph.D., F.A.A.P. Dr. Winston is the scientific director of TraumaLink at The Children’s Hospital of Philadelphia and the principal investigator of Partners for Child Passenger Safety (PCPS). Research findings from the PCPS study demonstrate that, for children under age 13, there is a significant reduction in injury risk if they are in the back seat as compared to risk in the front seat, regardless of restraint type. (See article, Page 4.)



Most new parents do understand the dangers of placing a rear-facing infant in front of an airbag — a message that is reinforced through several channels to first-time parents. However, as children get older, their likelihood of sitting up front increases (see chart above).

For children who are the sole passengers at the time of a crash, a substantial portion of 4- to 8-year-olds (30 percent) and the majority of 9- to 12-year-olds (73 percent) are riding up front. Parents appear to be forgetting the importance of rear seating for their children when they grow out of child safety seats.

Dr. Winston and her fellow researchers believe that consistent public health messaging is required to reinforce the importance of rear seating and appropriate restraint use. Physicians rank high on parents’ lists of credible sources of child safety information. Thus, clinicians should revisit safe-seating messages throughout a child’s life. “New parents are born every day who may not pay attention to safety information relevant to older children,” says Dr. Winston.

New Automotive Safety Technologies

It seems like new safety technologies are born every day as well. The “safe seating” message can be confusing for parents due to the tremendous variety of safety features in today’s vehicles. As of 2002, more than 80 percent of all passenger vehicles in the PCPS study were equipped with passenger airbags. Among those vehicles with airbags, there are three generations of frontal airbags and one to two generations of various types of side airbags. While newer generation airbags appear less injurious, front seating for children under 13 still elevates their risk of injury by 40 percent overall compared to rear seating. (See article, Page 4.)

Today, many new vehicles come with standard and optional restraint technologies in the front seat such as seat belt pre-tensioners, which anchor the lap belt in position just prior to impact in order to optimize the synchronicity of the airbag and seat belt. These devices are regarded as major safety advances that have made the front seat a safer place for adults.

Improved seat belt geometry and the introduction of lap-and-shoulder belts in the center rear seat appear to have improved safe-seating options for children as well. (See article on Page 5.) Still, the marketing of these new technologies may confuse parents who drive older vehicles as well as parents looking to purchase a family-friendly vehicle.

Side airbags and side impact protection for adults have been receiving much attention. Because side airbags are relatively new, researchers still need to determine if they increase risk or enhance safety for child passengers in crashes. So far, anecdotal case surveillance has shown no negative outcomes. However, laboratory results indicate that children leaning against the side of the vehicle may be at risk of serious injury from side airbag deployment. The automotive industry and the National Highway Traffic Safety Administration (NHTSA) have taken steps to minimize this risk and are monitoring side airbag deployment and child injury.

Amid all these technology options and variations, many parents are still faced with the challenge of determining seating positions for multiple child occupants. There are tens of thousands of certified child passenger safety technicians located in communities across the United States who can talk to parents individually about different seating configurations and provide hands-on installation services.

What can you do?

Establish relationships with local certified technicians so that your patient families have access to personal expert advice. To locate technicians in your community, use this online resource:

www.nhtsa.dot.gov/people/injury/childps/Contacts

Three Generations of Airbags

When used in conjunction with seat belts, airbags have saved thousands of lives. However, because airbags were designed to protect an average-size adult male, they may pose a serious risk to children seated in front of them.

Automakers started installing driver airbags in the 1980s and added them to the passenger side by the mid-1990s. Beginning in the 1990s, crash investigators and trauma centers reported child deaths associated with airbag deployments in relatively minor crashes. This caused industry and regulatory agencies to focus their attention on the unique needs of children in automotive safety.

Researchers from the Insurance Institute for Highway Safety found that, while passenger airbags reduced adult occupant fatalities by 18 percent in frontal crashes and by 11 percent in all crashes, exposure to airbags increased the risk of death for children less than 10 years of age by 34 percent.

Through cases seen at The Children’s Hospital of Philadelphia, Dr. Winston and her team identified two distinct mechanisms for fatal injury: an airbag deploying into a rear-facing safety seat at the level of the infant’s head and neck, and older unrestrained children who were thrust forward into the path of the deploying airbag. They also quantified a two-fold increase in nonfatal injury risk to children in the right front seat who were exposed to a deploying airbag as compared with children in similar crashes without airbag exposure.

NHTSA and industry responded with the development of improved frontal airbags. Recent PCPS findings demonstrate that children exposed to these second-generation systems sustain fewer injuries than those exposed to first-generation airbags — a 41 percent reduction in serious injury. There were fewer injuries to all body regions, except the abdomen, for the second-generation group. Despite this improvement, children in the front were still at a higher risk of injury than those seated in the rear. Although newer airbags were less risky for children riding in passenger cars and minivans, PCPS data did not show a reduction in injuries to children in sport utility vehicles (SUV).

Vehicles featuring third-generation advanced technology airbags are now entering the marketplace. Although each vehicle’s airbag design is unique, when a front-end crash occurs, advanced airbags may inflate differently according to the seriousness of the crash, the size and posture of the passenger, the passenger’s belt use and/or how close he is to the airbag. Sensors note these conditions and automatically deploy the airbag at a higher or lower force or even suppress airbag deployment.

“While airbag design is headed in the appropriate direction, clinicians offering anticipatory guidance should continue to emphasize rear seating for children,” says Kristy Arbogast, Ph.D., director of Field Engineering for PCPS and lead author on this body of research. “Crash conditions are variable and the older designs will remain in the U.S. vehicle fleet for another 15 years.”

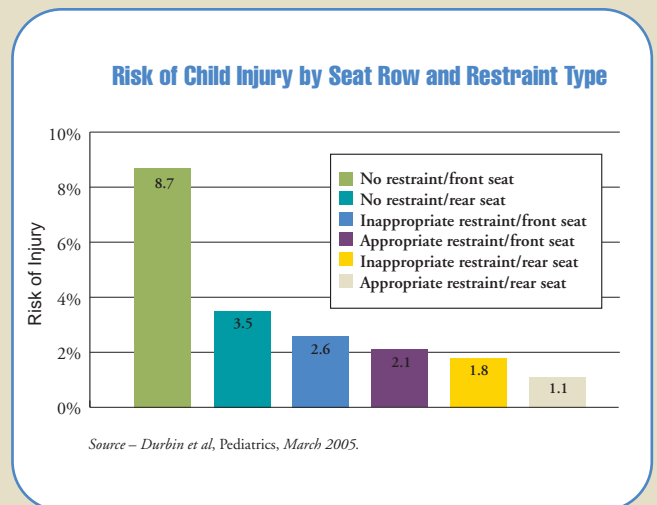
Front Seat versus Back Seat

Age- and size-appropriate restraint and rear seating provide the best protection for all children in motor vehicle crashes. While age-appropriate restraint may provide more safety benefits than rear seating, considerable benefits are realized with rear seating for children through age 12, according to a PCPS study published in the March 2005 issue of *Pediatrics*.

Across all age groups through age 15, unrestrained children in the front seat had the highest risk of injury while optimally restrained children in the rear were always at the lowest risk. Children in the front seat were 40 percent more likely to be injured compared to rear-seated children. For appropriately restrained 13- to 15-year-olds, there was no additional risk when they were seated in the front row as compared to the rear row.

“The message for families is that children younger than 13 are much safer in the rear seat in their age- and size-appropriate restraint,” says Dennis Durbin, M.D., M.S.C.E., F.A.A.P., PCPS co-principal investigator and a pediatric emergency physician at The Children’s Hospital of Philadelphia. “It’s generally appropriate for teens to ride up front, but only if they are using a lap-and-shoulder seat belt correctly.”

Dr. Durbin and his team determined that if all children under 16 years of age had been in age-appropriate restraints in the rear, more than 1,000 of the 3,665 serious injuries that occurred in the study sample would have been prevented.



Buying a Safer Car

Parents in the market to buy a new family vehicle need to choose one with safety in mind.

“All else being equal, you’re safer traveling in a vehicle that’s larger and heavier than in one that is smaller and lighter,” states Susan Ferguson, Ph.D., senior vice president for research at the Insurance Institute for Highway Safety (IIHS). IIHS provides information on frontal and side crash test performance by vehicle make and model. While IIHS does not evaluate child safety specifically, vehicles that are safer for adults should also be safer for children. PCPS data support this guideline for choosing a safe family vehicle — but with several caveats to consider.

Passenger cars are the most common passenger vehicles, accounting for 63 percent of household vehicles, yet they vary widely in size and crashworthiness. According to PCPS, vehicle weight is a predictor for injury risk for child passengers.

Of all passenger car classifications, large and luxury cars are the heaviest car groups and featured the lowest injury risk. On the other hand, sports cars had the highest injury risk for child occupants, despite heavier average weight than mid-size or small cars. “The safety performance of these vehicles may also be affected by the way in which they are driven,” says Dr. Durbin.

With 24 percent of the market share in 2003, SUVs are the fastest-growing segment of the passenger vehicle fleet. As with cars, size matters for SUVs. In an analysis of weight-based SUV classifications, midsize SUVs and small SUVs had similar injury rates, which were two times higher than large SUVs.

Pickup trucks present a unique risk for children. While the risk of riding in the cargo areas of these trucks is well-known, PCPS found that children riding inside compact extended-cab pickup trucks are three times more likely to suffer injury than children riding in any other vehicle type. When riding in the rear seat, these children are five times more likely to suffer injury than children in the rear seats of all other vehicles.

“The injuries we saw in our study were primarily caused by contact with the truck’s interior, which lacks space and sufficient padding and often lacks shoulder belts,” says lead author Dr. Winston. “We encourage families who own compact extended-cab pickups to avoid transporting children in them and to find alternative forms of transportation.”

While U.S. households own more SUVs and pickup trucks than minivans, minivans appear to offer measurable safety benefits for children. In an analysis that looked at abdominal injury risk, PCPS researchers found that, for 4- to 8-year-olds, the risk of abdominal organ injury was six times higher in passenger cars and 11 times higher in SUVs as compared to minivans.

“This is one age group and one body region,” cautions Dr. Arbogast. “Yet the vehicle seat and seat-belt geometry in the rear row of minivans, which help to reduce abdominal injury risk for this age group, suggest overall safety benefits in these vehicles.” More research is needed, says Dr. Arbogast.

Ideally, a safe family car has enough rear-row seat positions with lap-and-shoulder belts for every child under 13 that requires them and enough remaining rear-row positions to install child safety seats for infants and toddlers.

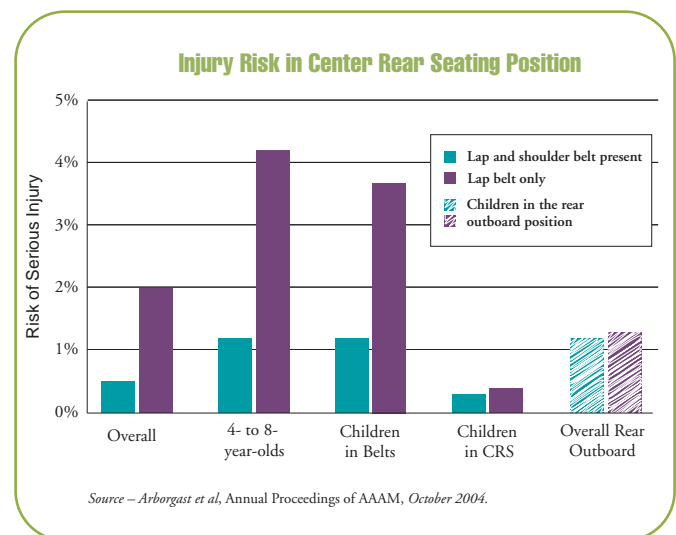
Center versus Outboard Seating

As of December 2004, 23 percent of new passenger cars and 51 percent of new vans and light trucks (SUVs and pickup trucks) were equipped with only lap belts for use by rear-center passengers. The majority of older vehicles are equipped similarly. Because the rear-center seating position is furthest from crash impact, many parents prefer to restrain children there. However, lap-only belts should be used only for installing child safety seats with internal harnesses. Lap-only belts are not optimal for older children using seat belts and must never be used with belt-positioning boosters, which require a lap-and-shoulder seat belt.

NHTSA recently ruled that rear-center seats in all new vehicles must be equipped with lap-and-shoulder seat belts by 2008. PCPS evaluated the use patterns and performance of the center rear seat lap-and-shoulder belt systems relative to the more common lap-only belts. They found that the new lap-and-shoulder seat belts provided an overall 81 percent reduction in injury risk compared to lap-only belts. In this study sample, one-third of 4- to 8-year-olds and 15 percent of 9- to 12-year-olds were seated in the center rear regardless of seat belt type.

The analysis also compared the performance of the center rear seat position versus the outboard, or rear side, positions. In vehicles equipped with lap-and-shoulder belts in the center rear, the center rear had similar injury risk to the outboard positions. In older vehicles with lap-only belts in the center rear, the rear outboard positions were the safer positions.

“Parents with lap-only belts in the center rear should reserve that position for installing child safety seats with harnesses,” recommends Dr. Arbogast. “Children using booster seats or seat belts alone should be restrained in positions that have a lap and shoulder seat belt.”

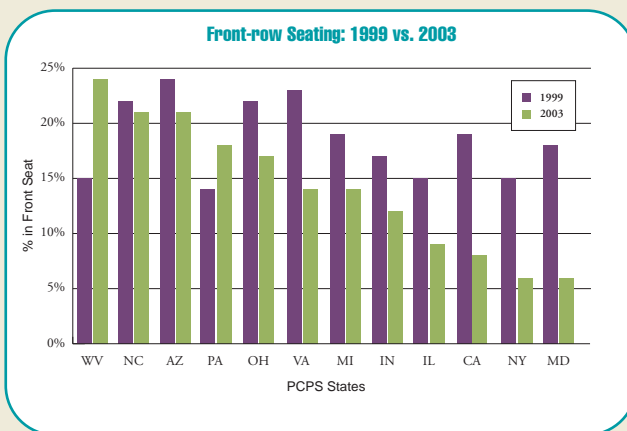


Selling the “Rear Seat for Kids” Message

The movement of children to the rear seat has been credited with helping to dramatically reduce the number of child airbag-related deaths and child deaths overall. The Air Bag and Seat Belt Safety Campaign estimates that the lives of 1,700 children were saved between 1996 and 2002 solely because they were seated in the rear.

How do you convince today’s children and their parents of the importance of rear seating in preventing injuries and fatalities? A combination of public policy and education is considered the most effective approach.

In 1997, the National Transportation Safety Board recommended that all states enact legislation to require the transport of children under age 13 in the rear seat of a passenger vehicle, if a rear seat position is available. This recommendation was supported by the American Academy of Pediatrics (AAP) and NHTSA. Current research reinforces the need for such a requirement in state laws, yet only 20 states have a current provision and most only go to the age of 6.



In a 2001 joint study from the Harvard School of Public Health and the Education Development Center Inc. (EDC), researchers evaluated the effectiveness of a Rhode Island law that requires children under age 6 to be seated in the rear. They found that the percentage of children under age 6 seated in the front seat dropped from 23 percent to 16 percent one year after the law was enacted, demonstrating a moderate but positive impact. In order to achieve full compliance, say the researchers, vigorous enforcement (which had not occurred) might be necessary. With today’s knowledge of the safety benefits of rear seating, any new legislation should include a provision that children who are less than 13 years old should ride in the rear seat.

PCPS supports targeted interventions for specific high-risk groups. In a study to determine factors for front-row seating published in *Epidemiology* in 2004, PCPS looked at children who were the sole passengers and, therefore, free to sit in any passenger seat in the vehicle.

Non-parent drivers were more likely than parents to have children riding in the front seat. Teen drivers had the highest proportion of child occupants in the front seat.

“Consideration should be given to provisions in graduated driver license programs that require teens to restrain their child passengers in the rear,” states Dr. Durbin.

Recent research from Harvard and EDC looked at the effectiveness of an intervention program that coupled an incentive program with community-wide education in a predominantly low-income Hispanic community in Massachusetts. Rear-seated children observed at publicized community locations received low-cost incentives such as mugs and raffle tickets. Motorists aware of the program were more likely to seat their children in the rear as compared to those who were unaware (76 percent versus 53 percent).

Community awareness strategies supplemented the incentive program. Strategies employed were the distribution of activity books and educational brochures by schools, healthcare providers and community events; public service announcements (PSAs); and a community coalition. In the intervention city, observed rear seating increased from one-third to one-half over a two-year period. The control cities saw a more modest increase in rear seating likely due to national campaigns (i.e. Ford’s “Boost America” and Daimler Chrysler’s “The Back is Where It’s At”), NHTSA activities and other local awareness efforts that occurred during the intervention period.

“Positive incentives and exposure to program messages across multiple channels seem to have the greatest effect,” says Julie Ross, M.P.H., a study author. “However, we feel that community-based intervention combined with enforced legislation would yield even stronger results.”

Currently, the majority of vehicles in the PCPS study are equipped with first-generation airbags, which PCPS has shown are associated with increased risk of injury for children. “These older vehicles will continue to transport children, particularly those from economically disadvantaged families,” says Carol Berkowitz, M.D., F.A.A.P., president of the AAP. “Reintroducing messages that children are safer in the rear seat, regardless of airbag type, is warranted for all populations and especially for less well-off and less educated families.”

Recommended online resources:

www.chop.edu/carseat

Car seat installation videos and information

www.aap.org

Car Safety Seats: A Guide for Families 2005

Lists all child restraint models

www.highwaysafety.org

State-by-state list of child restraint laws, vehicle safety ratings

www.safercar.gov

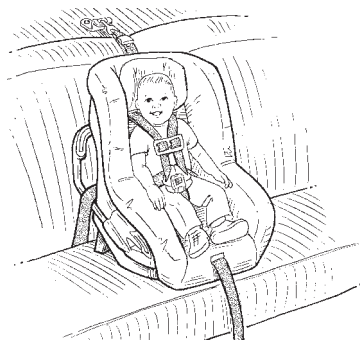
Buying a Safer Car for Children 2005

Lists vehicles with child safety features

FOR YOUR family

Safe Seating Position for Children: Tips to make your child safer in a crash

Choose a child safety seat that fits your child's age and size



- A rear-facing seat until your child is at least 1 year *and* at least 20 pounds.
- A forward-facing seat with harness until your child is too tall or too heavy for the seat. This is usually when the ears reach the top of the seat or the child weighs 40 pounds — check the seat instructions to be sure.
- A belt-positioning booster seat until an adult seat belt fits properly. This means the shoulder belt lies across the chest, the lap belt lies on the upper thighs, and the child is tall enough to sit against the vehicle seat back with legs bent at the knees and feet hanging down — usually around 4 foot 9 inches.
- A lap-and-shoulder seat belt once the adult seat belt fits properly.

Place your child in a safe spot

- Plan ahead. Never transport more children than there are seat belts in your vehicle.
- *Never* place an infant in a rear-facing seat in the front seat with an active airbag.
- If an older child must ride in the front seat, move the vehicle seat back as far as it can go, away from the airbag. Pick the child who is most likely to sit in the proper position; this may be a child in a forward-facing child safety seat. Be sure the child is in the right safety seat or booster seat for his age and size.

Use of belts and tethers

- Use lap-and-shoulder belts for children in booster seats and for older children using the seat belt alone. These belts can also be used to install a child safety seat.
- The rear center seat may have a lap-only belt. A lap-only belt can be used for a child safety seat but *never* for a belt-positioning booster seat and preferably not for children big enough to use the seat belt alone.
- If your vehicle has LATCH (Lower Anchors and Tethers for Children), you may want to use it to install your child safety seat. LATCH is usually in the rear side seats.
- Always use the top tether of a forward-facing safety seat.

Things to think about when buying a family car

- What type and how many safety seats or seat belts will you need?
- Will your safety seats fit in the car? Not all safety seats fit in all vehicles and all seating positions.
- Is it a safe car for families? Compact pickup trucks and sports cars are not good family cars.
- Does the vehicle have safety features such as lap-and-shoulder seat belts in the rear-center seat, adjustable shoulder belts in the rear side seats, built-in child safety seats or LATCH?
- Is there an airbag on/off switch? A child with special healthcare needs who must ride in the front seat for medical reasons needs a vehicle with an airbag on/off switch set in the “off” position.
- Read the car owner's manual to learn about its safety features — especially for used cars.



The safest place for all infants and children younger than 13 years is in the back seat.

The information contained in this publication should not be used as a substitute for medical care and advice of your family's physician. There may be variations in treatment that your family's physician may recommend based on individual facts and circumstances. Artwork provided by the Transportation Safety Training Center, Virginia Commonwealth University.

- ▶ Detachable Teaching Tool
 - ▶ Intervention and Public Policy
 - ▶ Current Research
 - ▶ Buying a Safer Car
- Safe Seating for Children**
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ISSUE No. 2, MAY 2005

Partners for Child Passenger Safety
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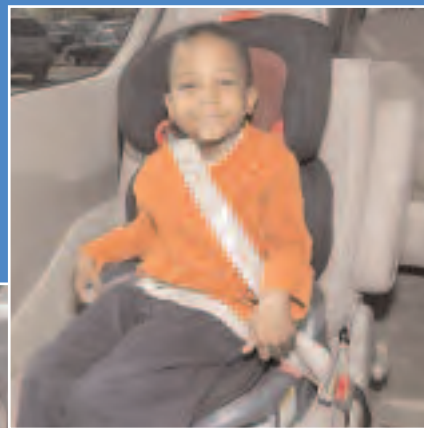
CPS Issue Report

SAVE LIVES Prevent Injuries

The current research tells us that use of age- and size-appropriate restraints combined with rear seating provide optimal protection against the number one killer of children.



▶ Rear-facing for babies



▶ Belt-positioning booster seats for elementary school age



▶ Forward-facing for toddlers



▶ Lap/shoulder belt for life