



## IMPACT

In 1997, The Children's Hospital of Philadelphia and State Farm Mutual Automobile Insurance Company chose to address an alarming national trend: the fact that motor vehicle crashes are the leading cause of death and disability in children over age 1 in the United States. Through a unique research partnership called Partners for Child Passenger Safety (PCPS), these two organizations began to (1) **conduct surveillance** of children in crashes to determine how and why children are injured or killed. This research (2) **identifies key issues** in child passenger safety (CPS), which leads PCPS researchers to a more (3) **in-depth study** of injury patterns.

Important findings from PCPS are (4) **published in peer-reviewed journals**. Unwilling to end outreach with scientific journal publications, PCPS seeks to impact parent behavior and safety design pertaining to child passenger safety through consistent (5) **communication with targeted audiences**, including medical providers, automobile and restraint manufacturers, public policy makers, advocates and parents.

Already, through ongoing surveillance of children in crashes, PCPS has (6) **measured the impact** of increased child passenger safety advocacy. Between 1998 and 2000, booster seat use among 4-year-old children increased from 14 percent to 34 percent. This discovery highlights an encouraging and rapid rise in booster seat use.

PCPS will continue to share new findings with target groups, who can use this information as a springboard for action to protect child passengers.

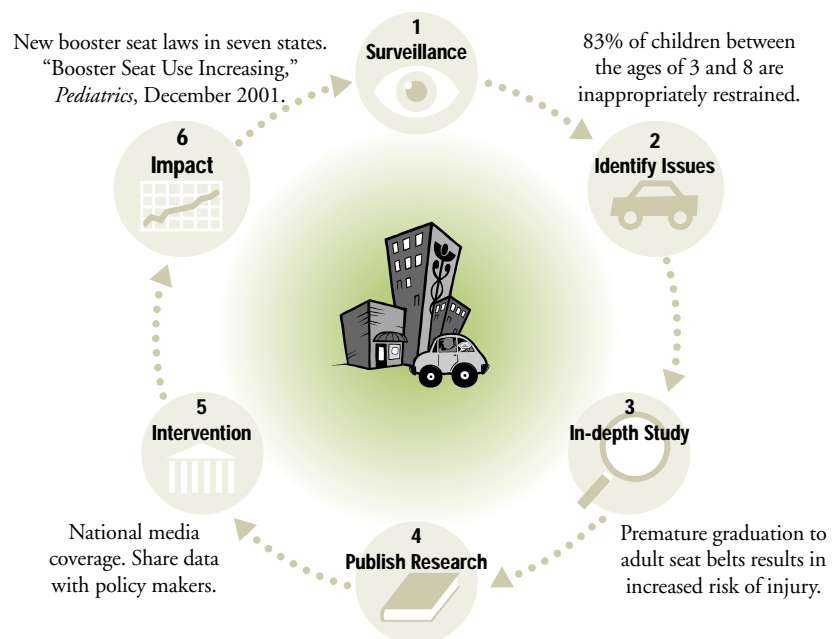
### INSIDE

PCPS: A Quick Review	2
Research Findings 2001-2002	3
Intervention and Impact	6
Research Review	8

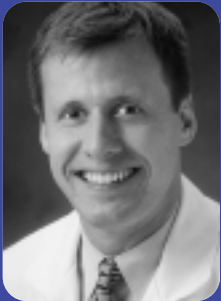


Jennifer Renner with daughter, Rebecca  
story on page 7

### Research-to-Action Cycle (Example: Inappropriate restraint finding)



# PCPS: A Quick Review



## Research Team

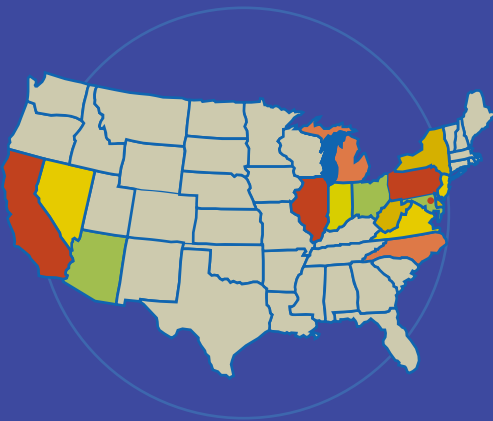
The Partners for Child Passenger Safety (PCPS) study is led by a multidisciplinary research team of internationally recognized experts in medicine, biomechanics, engineering, health education, advocacy and behavioral science. Flaura Koplin Winston, M.D., Ph.D., serves as principal investigator; Dennis R. Durbin, M.D., M.S.C.E., is co-principal investigator. Both physician/scientists are from The Children's Hospital of Philadelphia and the University of Pennsylvania School of Medicine and are considered leaders in the field of child occupant protection.

## Study Design

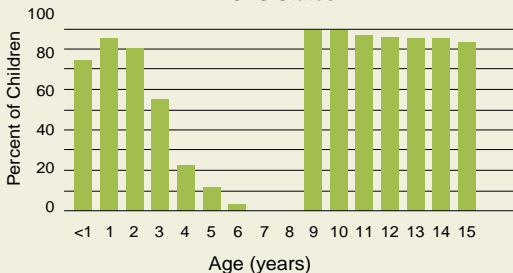
Each day, the PCPS research team collects information, with privacy safeguards, from State Farm Mutual Automobile Insurance Company on nearly 200 children involved in crashes in 15 states (AZ, CA, DE, IL, IN, MD, MI, NC, NJ, NV, NY, OH, PA, VA and WV) and the District of Columbia. This claims information represents State Farm insured children under age 16 who are involved in crashes in vehicles of model year 1990 or newer.

After policyholder consent is obtained, information is forwarded electronically from State Farm headquarters to the research team at Children's Hospital. Cases are manually selected for on-site crash investigations and automatically selected for detailed telephone interviews. Detailed crash investigations conducted by Dynamic Science, Inc. provide the research team with information to form hypotheses on injury mechanisms to children in crashes. In-depth telephone interviews conducted by RoperASW give researchers a comprehensive view of the range of crash and injury severity.

During its first three years, the PCPS study has collected information on nearly 150,000 crashes involving more than 220,000 children.



Children in the Recommended Restraint for their Age  
All PCPS States



## Major Findings 2000

In 2000, the PCPS team released a key finding: 83 percent of children between the ages of 3 and 8 (who should be using car seats or belt-positioning booster seats) are being inappropriately graduated to the adult seat belt. In addition, the PCPS team found that children ages 2 to 5 who are inappropriately restrained are 3.5 times more likely to suffer significant injuries, particularly head injuries, than children who are appropriately restrained. Data from the PCPS study show that an overwhelming number of children continue to be inappropriately restrained in vehicles. These findings set the stage for further research and outreach initiatives conducted in 2001-2002.

“Findings from our PCPS team have given parents information to make better decisions about properly restraining their children. We believe that PCPS has greatly contributed to measured increases in booster seat usage, and lives have been saved. This is encouraging – we want to further challenge parents, legislators, automakers and child seat manufacturers to continue this progress in protecting even more of our children.”

Steve Stockton, Vice President, State Farm Mutual Automobile Insurance Company

# Research Findings 2001-2002

## Booster Seat Trends

This paper assessed current trends in booster seat use to determine the effectiveness of public education initiatives, which emphasize the importance of booster seats.

### KEY FINDINGS:

- Over a two-year period, booster seat use among the booster seat-age population (children ages 4 to 8) increased 74 percent per year. In 1998, only 4.6 percent of children enrolled in the study were restrained in a booster seat at the time of a crash. In 2000, the percentage of children restrained in booster seats had risen to 13 percent.
- The 4-year-old age group saw the largest increase – from 14 percent in 1998 to 34 percent in 2000. This translates to an 80 percent increase per year of the study.
- The rapid increase over a short period of time indicates a heightened awareness among parents regarding optimal restraint for children.

“Trends in Booster Seat Use Among Children in Crashes,” *Pediatrics*, December 2001

To download abstract: [traumalink.chop.edu](http://traumalink.chop.edu). Click on publications.

## Side-impact Collisions

In-depth crash investigations were used to identify injury mechanisms to children in side-impact collisions. Ninety-three children in 55 side-impact crashes were studied. Twenty-three percent of the children evaluated received serious injuries. In these 22 children, 40 percent suffered head injury, 23 percent suffered extremity injury and 21 percent suffered abdominal injury.

### KEY FINDINGS:

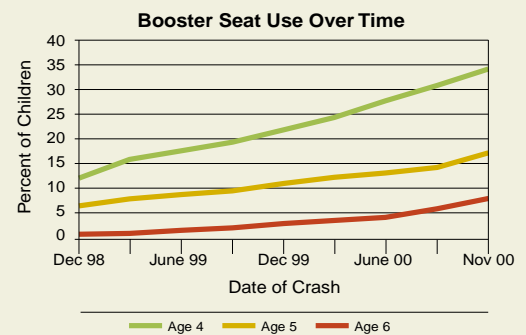
- This study identified a changing pattern of injury with age that is specific to side impact collisions. As children age, head and extremity injuries become more common, while injuries to the thorax and abdomen decrease in frequency.
- Children interact differently with vehicles in a side-impact crash than adults. Biomechanical differences between a child and an adult, such as smaller stature and lower sitting height, result in different injury patterns.
- Children who were properly restrained suffered less severe injuries than children not properly restrained.

“Factors Influencing Pediatric Injury in Side Impact Collisions,” *Journal of Trauma*, October 2001.

To download abstract: [traumalink.chop.edu](http://traumalink.chop.edu). Click on publications.

## Recommendations :

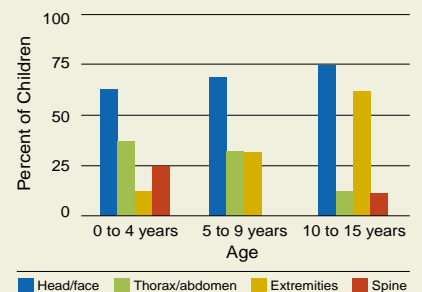
- Media and educational efforts should continue to target children ages 4 to 8 and encourage use of belt-positioning booster seats. Surveillance systems, such as PCPS, should monitor effectiveness of such efforts.
- State legislators and federal policy makers should take notice that parents are receptive to booster seat legislation and other educational efforts.



## Recommendation :

- Incorporate pediatric-specific injury mechanisms, identified through evidenced-based research like PCPS, into side-impact test procedures and safety criteria.

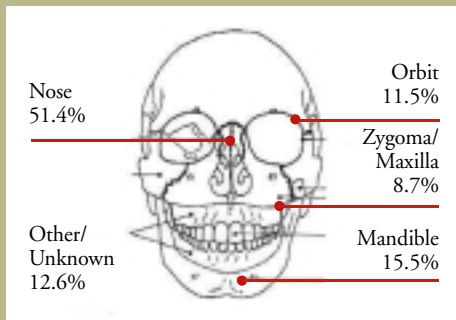
**Pediatric Injuries from Side Impact Collision**



# Research Findings 2001-2002

## Recommendations :

- Stress the importance of age appropriate restraint in the rear seat in all public education curriculum in order to prevent facial fractures.
- Consider revision of federal safety standards to account for vehicle interior structures typically contacted by child occupants and enhancement of pediatric dummies to measure facial impact forces.



## Recommendations :

- Families with choice of vehicles should avoid transporting children in compact extended-cab pickup trucks.
- Testing for occupant protection in interior impact is not currently required by federal regulation for side-facing auxiliary jump seats. Since data suggest that these seats are being used as common seating positions for child passengers, this exemption should be reconsidered.



## Facial Fractures in Children in Car Crashes

Incidence of facial fracture was estimated using PCPS surveillance data. Mechanisms of injury were explored with cases involving in-depth crash investigation.

### KEY FINDINGS:

- Inappropriately restrained children were almost twice as likely to suffer a facial fracture than those appropriately restrained due to increased forward head movement.
- Nasal fractures were the most common injury, followed by orbital fractures, mid-face fractures and jaw fractures.
- Data suggest that these children's injuries resulted from high-energy impact with the vehicle's interior.
- The most frequent source of injury for those seated in the rear was contact with the rear of the front seat; for those in the front, contact with the instrument panel.
- The combination of rear-seating with age-appropriate restraint provided the best protection against serious facial injuries.

"Facial Fractures in Children in Car Crashes," *Journal of Trauma*, April 2002

"Pediatric Facial Fractures: Implications For Regulation," *Society Of Automotive Engineers World Congress Proceedings*, March 2002.

To download abstracts: [traumalink.chop.edu](http://traumalink.chop.edu). Click on publications.



## Risk of Injury in Pickup Trucks

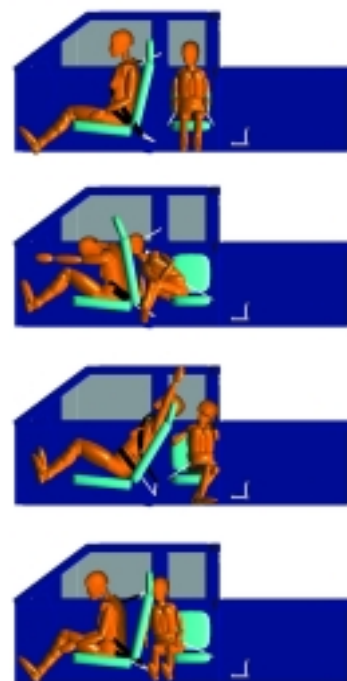
This study evaluated the risk of injury to children in compact extended-cab pickup trucks to determine if any unique hazards exist.

### KEY FINDINGS:

- Children in the rear seat of compact extended-cab pickup trucks were nearly five times as likely to be injured as rear-row seated children in other vehicles.
- The increased risk appears to be caused, at least in part, by contact with the interior of the vehicle at impact. Unique hazards include the relatively small rear occupant compartment, limitations of the two-point (lap belt) restraints, and inadequate vehicle padding.
- IMPLICATION: Compact extended-cab pickup trucks are not optimal transport for families with children.

"Risk of Injury to Child Passengers in Compact Extended-cab Pickup Trucks," *Journal of American Medical Association*, March 2002

To download abstract: [traumalink.chop.edu](http://traumalink.chop.edu). Click on publications.



This simulation depicts a 6-year-old child in a compact extended-cab pickup truck. Note the head impact as a result of a 35 mph frontal crash.

*“As a physician and a policy maker, I appreciate the research on children in real-world car crashes provided by Partners for Child Passenger Safety. This valuable resource helps NHTSA to shape policy according to sound peer-reviewed science.”*

Jeff Runge, M.D., Administrator, National Highway Traffic Safety Administration  
(United States Department of Transportation)



## Seat Belt Syndrome in Children

Seat belt syndrome is a pattern of intra-abdominal and spinal injuries caused by improper fit of seat belts. PCPS researchers presented an exemplary case of seat belt syndrome involving a 4-year-old boy and reviewed the current knowledge on this mechanism of injury.

### KEY FINDINGS:

- One percent of children who seek medical attention following a car crash suffer from seat belt syndrome.
- Children between the ages of 3 and 9 years are at greatest risk for seat belt syndrome, due to the improper fit of both the lap and shoulder portions of the belt.

“Seat Belt Syndrome in Children,” *Pediatric Emergency Care*, December 2001.

To download abstract: [traumalink.chop.edu](http://traumalink.chop.edu). Click on publications.

## Related Research

### Premature Graduation to Safety Belts

This qualitative study by researchers at The Children’s Hospital of Philadelphia for the National Highway Traffic Safety Administration (NHTSA) explored reasons for booster seat use and non-use. Methods employed included parent and child focus groups, in-depth interviews and a review of existing CPS literature and programs.

### KEY FINDINGS:

- Premature graduation of children from child safety seats to seat belts occurs for a variety of reasons, including parents’ low-risk perception of crash occurrence and/or child injury and parents’ lack of knowledge regarding best practices for CPS and the potential consequences of inappropriate restraint.
- Barriers to booster seat use included situational circumstances (i.e. extra person in vehicle), child behavior, child discomfort, state laws, availability of booster seats, cost and convenience/ease of use.

“The Premature Graduation of Children from Child Restraints To Vehicle Safety Belts,”  
National Highway Traffic Safety Administration, July 2001.

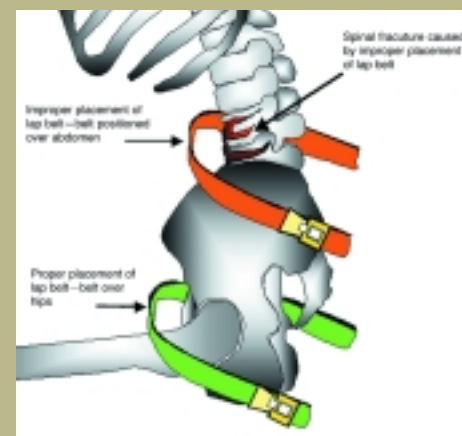
To order a copy of this report: <http://www.nhtsa.dot.gov/people/outreach/traftech/TT253.htm>



### Recommendation :

Children need to be restrained appropriately according to their age and size on every ride to reduce their risk of serious injuries (such as seat belt syndrome injuries) in a car crash.

Improper vs Proper Positioning of a Lap Belt



### Recommendations :

- Targeted educational campaigns are needed to teach parents about booster seat use.
- Comprehensive child restraint laws, which are in closer alignment with best practice, would help eliminate parents’ confusion.

While 2001 was an exciting period to increase awareness of child passenger safety, 2002 may prove to be a watershed year for improved state laws and federal regulations pertaining to the safety of children in motor vehicles. Advocates, legislators and regulators have used PCPS findings to help shape laws and regulations according to scientific principles.

# Intervention & Impact

## Federal Policy Based on Science

- In April 2001, The Children's Hospital of Philadelphia and State Farm Mutual Insurance Automobile Company co-sponsored a meeting of international experts in occupant restraint science in Washington, D.C. "Booster Seats for Children: Closing the Gap Between Science and Public Policy," hosted by the Association for the Advancement of Automotive Medicine, generated a set of recommendations for public policy based on sound science.
- In April 2001, Flaura Winston, M.D., Ph.D., offered testimony on booster seats before the U.S. Senate Committee on Commerce, Science and Transportation. Testimony from this hearing was utilized by Senator Peter G. Fitzgerald (R-Ill.) to draft Anton's Law.
- PCPS researchers have collaborated regularly with National Highway Traffic Safety Administration on various concerns related to child passenger safety, including the NHTSA Booster Seat Education Plan. In July, Dr. Winston presented findings before a public hearing on the topic.

## Sharing Findings with Local Communities

**STATE FACT SHEETS** In 2001, PCPS data were analyzed at the state level to create easy-to-read educational fact sheets. The initiative was the first to provide legislators and advocates with real-world crash data for 11 specific states. The fact sheets address where children are sitting, how they are restrained and how they are injured.

Fact sheets for California, Illinois, Indiana, Maryland, Michigan, North Carolina, New Jersey, New York, Ohio, Pennsylvania, and Virginia are available at [traumalink.chop.edu](http://traumalink.chop.edu) to download as pdf files. A comprehensive fact sheet for all states in the PCPS study is also available.

**PRESENTATIONS & RESOURCES** Since April 2001, the PCPS research team has presented findings at more than 50 conferences and meetings – targeting medical professionals, engineers, health educators and public policy makers, as well as the media. Most recently, PCPS presented findings and made presentation materials available to the National Association of Children's Hospitals and Related Institutions (NACHRI) via a Web-based teleconference. NACHRI members, as well as National Safe Kids Coalition members, are using these Web-based materials to educate legislators, medical professionals and parents in their respective states.

**MODEL LAW** State Farm has spearheaded a movement among key advocates and child passenger safety experts to develop a model child restraint law that will be shared with legislators who are attempting to improve child restraint laws in their own states. The model law is based on current peer-reviewed science, primarily data from PCPS.

**STATE FARM EDUCATIONAL MATERIALS** With assistance from PCPS researchers, State Farm has developed an array of collateral materials for education called **Best Practices for Child Passenger Safety**. Materials include brochures and posters that are available in English and Spanish and a booster seat education curriculum directed at booster age children that includes an activities book, *Safe Cruisin' With the Good Neighbor Bear*. Also available is a video incorporating elements from State Farm's CPS public service announcement and video news release, as well as PCPS's animated crash models.

State-specific fact sheets for California, Indiana, New Jersey and Virginia.



*“Through involvement with the Partners for Child Passenger Safety (PCPS), our product designers have been educated in the critical issues related to children in automotive crashes. As a direct result, the research data provided by PCPS has had a major impact on our product development and performance. This would not have happened without the research conducted by PCPS.”*

Craig White, Chief Technical Officer, Breed Technologies

## State Farm Child Safety Day

Prompted by the PCPS finding that 83 percent of children between the ages of 3 and 8 are incorrectly restrained in adult seat belts (instead of child restraints or belt-positioning booster seats), State Farm sponsored its first annual Child Safety Day on May 12, 2001. Nearly 3,000 State Farm associates and community volunteers hosted free child safety seat checkpoints at more than 200 locations across the United States.

Certified child passenger safety technicians checked and installed more than 8,000 car and booster seats. This event to promote child passenger safety was such a success that State Farm plans to hold its second annual Child Safety Day on May 18, 2002.

For more information or to volunteer, contact Jason Kercher at [jason.kercher.ltl@statefarm.com](mailto:jason.kercher.ltl@statefarm.com)

## Child Safety Seat Check Saves a Baby's Life

Rebecca Renner is living proof that properly installed car seats can save lives. Last summer, at 4 weeks of age, she was sleeping peacefully in the back car seat of her parent's GMC Jimmy when her mother Jennifer became momentarily distracted behind the wheel. Looking up, Jennifer suddenly had to swerve to avoid hitting a trailer in front of her. But it was too late: her sport utility vehicle clipped the trailer and rolled two and half times before landing upside-down, completely totaled.

Suffering a broken wrist and numerous cuts and bruises, Jennifer was frantic to find her daughter. It took a full minute of searching before a volunteer emerged from the wreckage holding a child seat. Rebecca was still firmly strapped inside – sleeping peacefully without a scratch.

Jennifer credits State Farm's child seat safety program for this miracle. Months before Rebecca was even born, Jennifer had attended one of State Farm's Child Safety Day clinics. "I thought I knew how to install a car seat, but I realized I hadn't been doing it right," says Jennifer. She was happy to learn from the technician how to install the car seat tightly. "It was something I did in passing and didn't think anything of it," says Jennifer. "But the car seat safety check saved Rebecca's life."

## Partnering With Industry

PCPS provides data and expertise to members of the automotive and restraint manufacturing community to facilitate product design changes based on findings from real-world crashes. This exchange is conducted in briefings, presentations and scientific meetings.

In December 2001, representatives of the automotive safety industry gathered in Auburn Hills, Michigan, for a briefing by PCPS researchers on current findings and implications from the study. Topics included booster seats, air bags and children, side-impact injury mechanisms and injuries by vehicle type.

Currently, PCPS researchers are working with Breed Technologies and TRW (manufacturers of seat belts and air bags) to better understand how their products interface with child occupants. Future designs will be enhanced by this knowledge.



## STATE BOOSTER SEAT LEGISLATION (AS OF MARCH 2002)

Source: Advocates for Highway and Auto Safety. Visit [www.saferoads.org](http://www.saferoads.org) for more information.

### STATES WITH BOOSTER SEAT LAWS

Arkansas  
California  
New Jersey  
Oregon  
Rhode Island  
South Carolina  
Washington

### STATES WITH UPGRADED CHILD RESTRAINT BILLS PENDING

Colorado	Maine	Ohio
Hawaii	Massachusetts	Oklahoma
Illinois	Minnesota	Vermont
Indiana	Missouri	Virginia
Iowa	Nebraska	District of Columbia
Kansas	New Hampshire	
Kentucky	New York	

# Research Review

## Research Publications (2001-2002)

The Premature Graduation of Children from Child Restraints to Vehicle Safety Belts, U.S. Department of Transportation, National Highway Traffic Safety Administration, July 2001.

Child Occupant Protection: A Summary of Safety Recommendations, *Primary Care Update for Ob/Gyns*, September 2001.

The Effect of Seating Position on Risk of Injury to Children in Side-impact Crashes, *45th Annual Proceedings of AAAM*, September 2001.

Factors Influencing Pediatric Injury in Side-impact Collisions, *Journal of Trauma*, October 2001.

Trends in Booster Seat Use Among Young Children in Crashes, *Pediatrics*, December 2001.

Seat Belt Syndrome in Children, *Pediatric Emergency Care*, December 2001.

Pediatric Facial Fractures: Implications for Regulation, *Society of Automotive Engineers World Congress Proceedings*, March 2002.

Risk of Injury to Child Passengers in Compact Extended-cab Pickup Trucks, *Journal of the American Medical Association*, March 2002.

Facial Fractures in Children in Car Crashes, *Journal of Trauma*, April 2002.

## Key Research Presentations

Child Passenger Safety Testimony to the U.S. Senate Committee on Commerce, Science and Transportation, Washington, D.C., April 2001.

Effectiveness of Booster Seats, Booster Seats for Children: Closing the Gap Between Science and Public Policy International Conference, Washington, D.C., April 2001.

Barriers to Booster Seat Use, Booster Seats for Children: Closing the Gap Between Science and Public Policy International Conference, Washington, D.C., April 2001.

Special Needs Children in Crashes, Pediatric Academic Societies National Meeting, Baltimore, MD, April 2001.

Child Injury Patterns in Side-impact Collisions, Society of Automotive Engineers' Government and Industry Meeting, Washington, D.C., May 2001.

Facial Fractures Among Inappropriately Restrained Children in Crashes, International Center for Injury Prevention's National Child Passenger Safety Conference, Indianapolis, IN, June 2001.

Booster Seats: Evidence to Support an Educational Initiative, NHTSA Five Year Booster Seat Education Planning Meeting, Washington, D.C., July 2001.

Risk of Injury to Child Passengers in Compact Extended-cab Pickup Trucks, American Academy of Pediatrics Annual Meeting, San Francisco CA, October 2001.

Trends in Booster Seat Use, American Academy of Pediatrics Annual Meeting, San Francisco, CA, October 2001.

Child Passenger Safety and Children with Neuromuscular and Orthopedic Disabilities, Safe USA Conference, Atlanta, GA, December 2001.

Partners for Child Passenger Safety State-specific Fact Sheets, Safe USA Conference, Atlanta, GA, December 2001.

Using State-specific Crash Data in Advocating Child Occupant Restraint, National Association of Children's Hospitals and Related Institutions, Advocacy Conference Call Series, January 2002.

## Media Highlights since April 2001

PCPS continues to reach out to broad audiences through the media to reinforce the message of "appropriate restraint for children on every ride." Through consistent publication of new peer-reviewed findings, PCPS has been featured in stories reaching national audiences: CNN and cnn.com, C-Span, Fox News, National Public Radio, *US News & World Report*, *Parenting*, Associated Press, Gannett News Service, Newhouse News Service, Scripps Howard News Service, Federal News Service, *The Washington Post*, *Los Angeles Times*, *New York Daily News*, *Philadelphia Inquirer*, *Boston Herald*, *Detroit News* and *Cleveland Plain Dealer*.

## Partners for Child Passenger Safety Advisory Board

Phyllis Agran, M.D.  
Department of Pediatrics  
University of California, Irvine

Susan Baker, M.Ph., Sc.D.  
The Johns Hopkins Bloomberg School of  
Public Health

Thomas Baloga  
Britax Child Safety, Inc.

Barbara Barlow, M.D.  
Harlem Hospital, Columbia University

Marilynn Bull, M.D.  
Riley Hospital for Children  
Indiana University Medical Center

John Danforth  
Former U.S. Senator (R-Mo.)

Barry Felrice  
Regulatory Affairs, DaimlerChrysler

Susan Ferguson, Ph.D.  
Insurance Institute for Highway Safety

Michael Finkelstein  
Michael Finkelstein and Associates

Michael Griffiths, M.S.E.  
Road Safety Solutions, Australia

C. Everett Koop, M.D. (*Honorary Member*)  
Former U.S. Surgeon General

France Legault, P.E.  
Road Safety and Motor Vehicle Regulation Directorate  
Transport Canada

Harold Mertz, Ph.D.  
General Motors Safety and Restraint Center

James Nichols  
Traffic Safety Programs  
National Highway Traffic Safety Administration

Deborah Stewart  
*Safe Ride News* Publication


Judith Lee Stone  
Advocates for Highway and Auto Safety

Claes Tingvall, Ph.D.  
Swedish National Road Administration  
Traffic Safety Department

Richard Waxweiler, Ph.D.  
National Center for Injury Prevention of Control  
Centers for Disease Control and Prevention

The results presented in this report are the interpretation solely of the Partners for Child Passenger Safety research team at The Children's Hospital of Philadelphia and are not necessarily the views of State Farm Insurance Companies.

Copyright © 2002 by The Children's Hospital of Philadelphia

The Children's Hospital of Philadelphia, the  logo and Kids First are registered marks of The Children's Hospital of Philadelphia.

Produced by

 The Children's Hospital of Philadelphia®  
A pediatric healthcare network

34th Street and Civic Center Boulevard  
Philadelphia, Pa. 19104-4399

1-800-TRY CHOP  
www.chop.edu

Partners for  
Child Passenger Safety

State Farm Insurance Companies  
The Children's Hospital of Philadelphia  
Neighbors working together

