The Children's Hospital of Philadelphia®
RESEARCH INSTITUTE

The American Academy of Pediatrics

UPDATED CHILD PASSENGER SAFETY RECOMMENDATIONS

Summary of the Evidence & Practical Implications

Presenter

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CPS Policy Redefined

- The American Academy of Pediatrics (AAP) Child Passenger Safety Policy Statement
  - ~ First issued in 2002, reaffirmed in 2007
- Dynamic change in Child Passenger Safety over the past decade:
  - ~ Scientific evidence has grown
  - ~ Legislation and regulation has expanded
  - ~ Restraint use has dramatically increased
  - ~ Automotive & restraint system design has changed
- AAP released revised CPS Policy Statement in April 2011 issue of *Pediatrics*
- Policy statement and Technical Report authors:
  - ~ AAP's Committee on Injury, Violence, and Poison Prevention

What You Will Learn Today

- The evidence behind the revised recommendations
- What is different
- Why they changed

Too Many Affected

The burden of motor vehicle crashes is great.

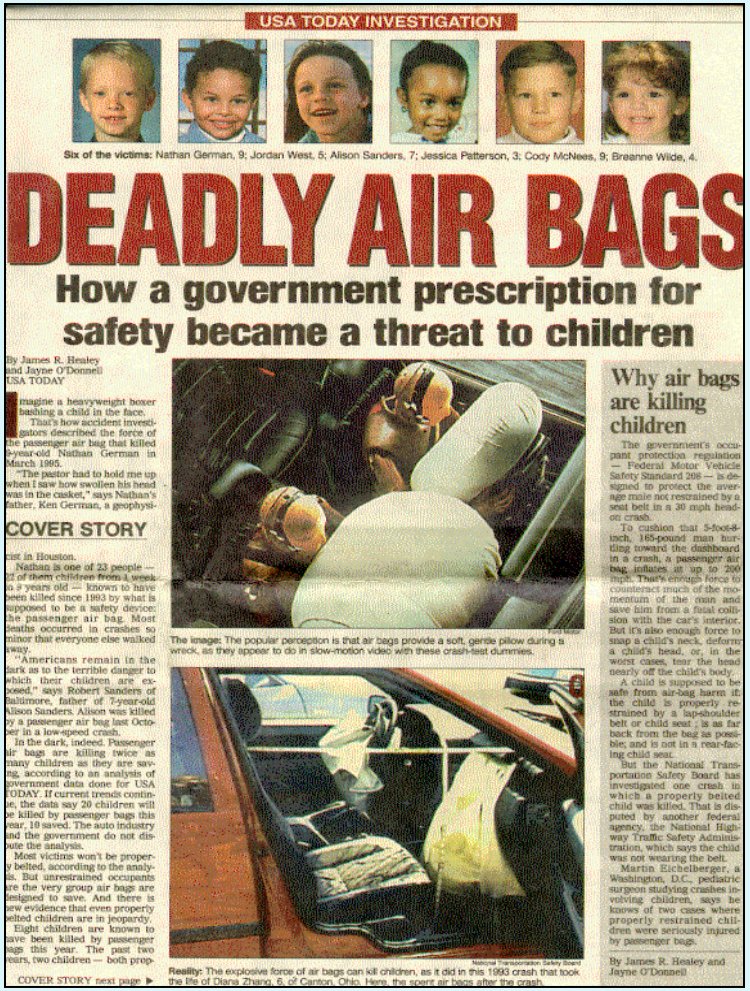
- Leading cause of death for children ages 4 and above
- Result in more than 5,000 deaths each year to those under age 21
  - ~ This number comprises 15 percent of all crash fatalities.
- For each fatality, 400 more children and youth receive medical treatment for injuries.

Leading Causes of Death

	Age (years)				
Rank	<1	1-4	5-9	10-14	15-24
1	Unintentional Suffocation 959	Unintentional Drowning 458	Unintentional MV Traffic 456	Unintentional MV Traffic 696	Unintentional MV Traffic 10,272
2	Homicide Unspecified 174	Unintentional MV Traffic 428	Unintentional Fire/Burn 136	Homicide Firearm 154	Homicide Firearm 4,669
3	Unintentional MV Traffic 122	Unintentional Fire/Burn 204	Unintentional Drowning 122	Suicide Suffocation 119	Unintentional Poisoning 3,159
4	Homicide Other Spec., classifiable 86	Homicide Unspecified 174	Homicide Firearm 47	Unintentional Drowning 102	Suicide Firearm 1,900
5	Unintentional Drowning 57	Unintentional Suffocation 149	Unintentional Suffocation 42	Unintentional Other Land Transport 80	Suicide Suffocation 1,533
6	Unintentional Fire/Burn 39	Unintentional Pedestrian, Other 124	Unintentional Other Land Transport 40	Unintentional Fire/Burn 78	Unintentional Drowning 630
7	Undetermined Suffocation 34	Homicide Other Spec., classifiable 61	Unintentional Pedestrian, Other 32	Unintentional Poisoning 69	Homicide Cut/pierce 444
8	Homicide Suffocation 30	Homicide Firearm 48	Homicide Suffocation 21	Unintentional Suffocation 60	Undetermined Poisoning 365
9	Undetermined Unspecified 28	Unintentional Struck by or Against 44	Unintentional Firearm 20	Suicide Firearm 53	Suicide Poisoning 362
10	Unintentional Fall 24	Unintentional Fall 36	Unintentional Struck by or Against 20	Unintentional Firearm 26	Unintentional Other Land Transport 310

Source: Centers for Disease Control and Prevention, 2007

The Modern Era of CPS



USA TODAY INVESTIGATION

Six of the victims: Nathan German, 9; Jordan West, 5; Alison Sanders, 7; Jessica Patterson, 3; Cody McNees, 9; Breanne Wilde, 4.

DEADLY AIR BAGS

How a government prescription for safety became a threat to children

By James R. Healey and Jayne O'Donnell
USA TODAY

Imagine a heavyweight boxer bashing a child in the face.

That's how accident investigators described the force of the passenger air bag that killed 9-year-old Nathan German in March 1995.

"The pastor had to hold me up when I saw how swollen his head was in the casket," says Nathan's father, Ken German, a geophysi-

COVER STORY

cist in Houston.

Nathan is one of 23 people — 12 of them children from 1 week to 9 years old — known to have been killed since 1993 by what is supposed to be a safety device: the passenger air bag. Most deaths occurred in crashes so minor that everyone else walked away.

"Americans remain in the dark as to the terrible danger to which their children are exposed," says Robert Sanders of Baltimore, father of 7-year-old Alison Sanders. Alison was killed by a passenger air bag last October in a low-speed crash.

In the dark, indeed. Passenger air bags are killing twice as many children as they are saving, according to an analysis of government data done for USA TODAY. If current trends continue, the data say 20 children will be killed by passenger bags this year, 10 saved. The auto industry and the government do not dispute the analysis.

Most victims won't be properly belted, according to the analysis. But unrestrained occupants are the very group air bags are designed to save. And there is new evidence that even properly belted children are in jeopardy.

Eight children are known to have been killed by passenger bags this year. The past two years, two children — both prep-

COVER STORY next page ▶

The image: The popular perception is that air bags provide a soft, gentle pillow during a wreck, as they appear to do in slow-motion video with these crash-test dummies.

Ford Motor

Reality: The explosive force of air bags can kill children, as it did in this 1993 crash that took the life of Diana Zhang, 6, of Canton, Ohio. Here, the spent air bags after the crash.

National Transportation Safety Board

Why air bags are killing children

The government's occupant protection regulation — Federal Motor Vehicle Safety Standard 208 — is designed to protect the average male not restrained by a seat belt in a 30 mph head-on crash.

To cushion that 5-foot-8-inch, 165-pound man hurtling toward the dashboard in a crash, a passenger air bag inflates at up to 200 mph. That's enough force to counteract much of the momentum of the man and save him from a fatal collision with the car's interior. But it's also enough force to snap a child's neck, deform a child's head, or, in the worst cases, tear the head nearly off the child's body.

A child is supposed to be safe from air-bag harm if the child is properly restrained by a lap-shoulder belt or child seat; is as far back from the bag as possible; and is not in a rear-facing child seat.

But the National Transportation Safety Board has investigated one crash in which a properly belted child was killed. That is disputed by another federal agency, the National Highway Traffic Safety Administration, which says the child was not wearing the belt.

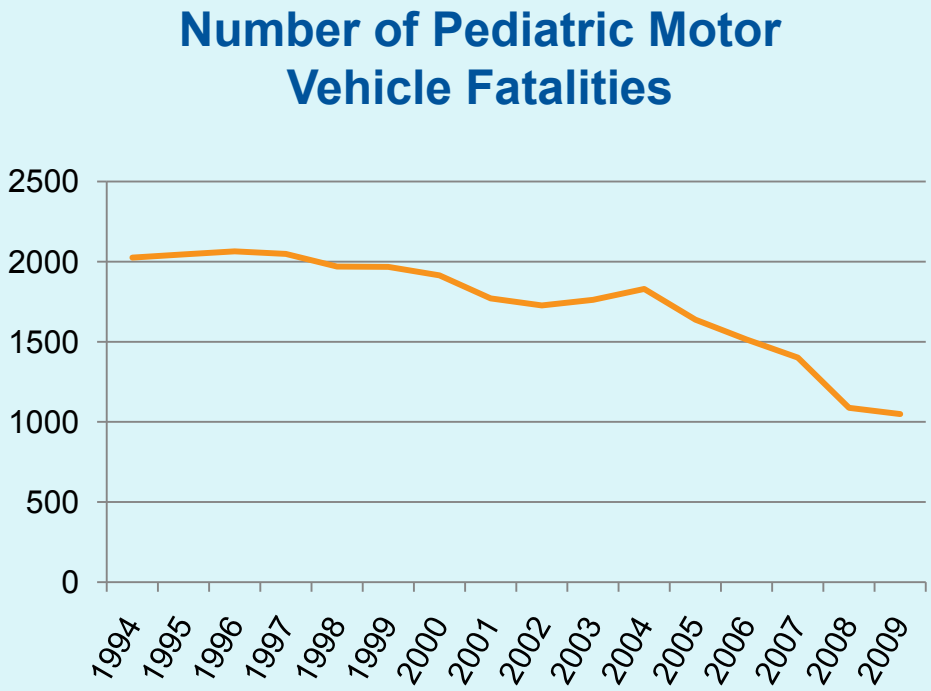
Martin Eichelberger, a Washington, D.C., pediatric surgeon studying crashes involving children, says he knows of two cases where properly restrained children were seriously injured by passenger bags.

By James R. Healey and Jayne O'Donnell

- July 8, 1996: *USA Today* publishes article describing how children are killed by passenger air bags
- Education and laws increase
  - ~ Rear seating for children
  - ~ Use of age-appropriate restraints

The Modern Era of CPS

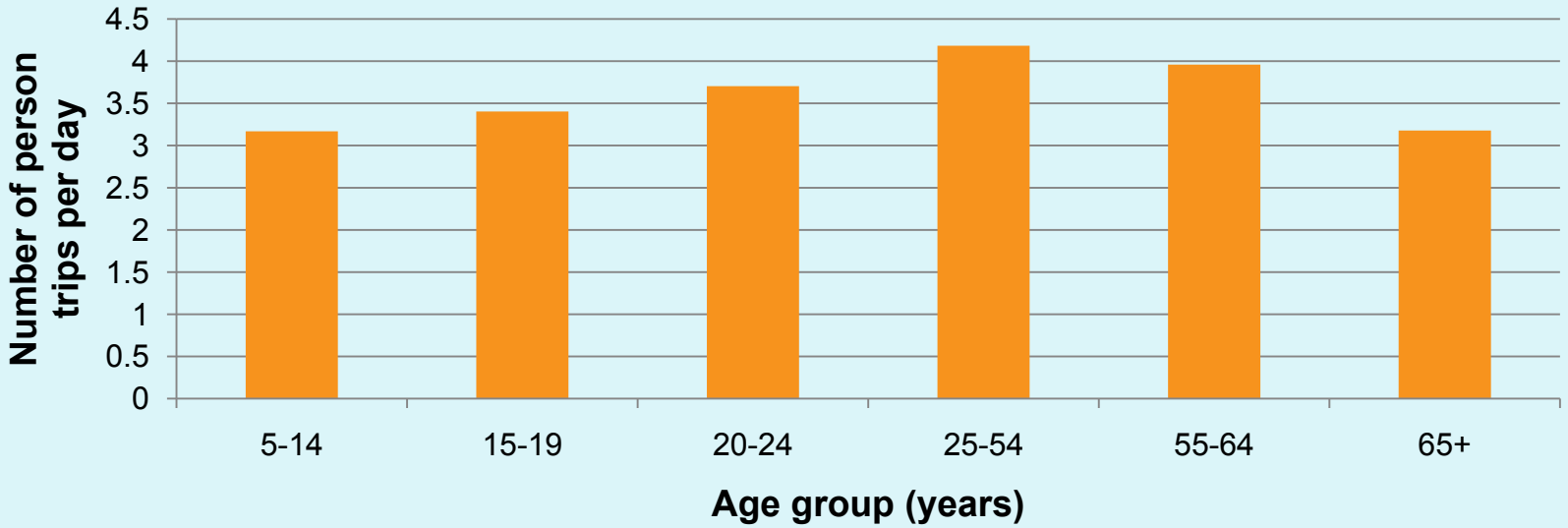
- The number of crash-related deaths declines 45 percent between 1997 and 2009 for those under age 16.
- The lives of approximately 4,800 children have been saved since 1997 due to improvements in child passenger safety.



The Modern Era of CPS

- Children under age 16 spend nearly as much time in motor vehicles as adults.
  - ~ Average: 3.4 trips / 45-50 minutes per day
- The more time spent in motor vehicles corresponds to increased crash exposure.
  - ~ Age-appropriate restraint use on all trips is so important.

Exposure of Children to Motor Vehicle Travel



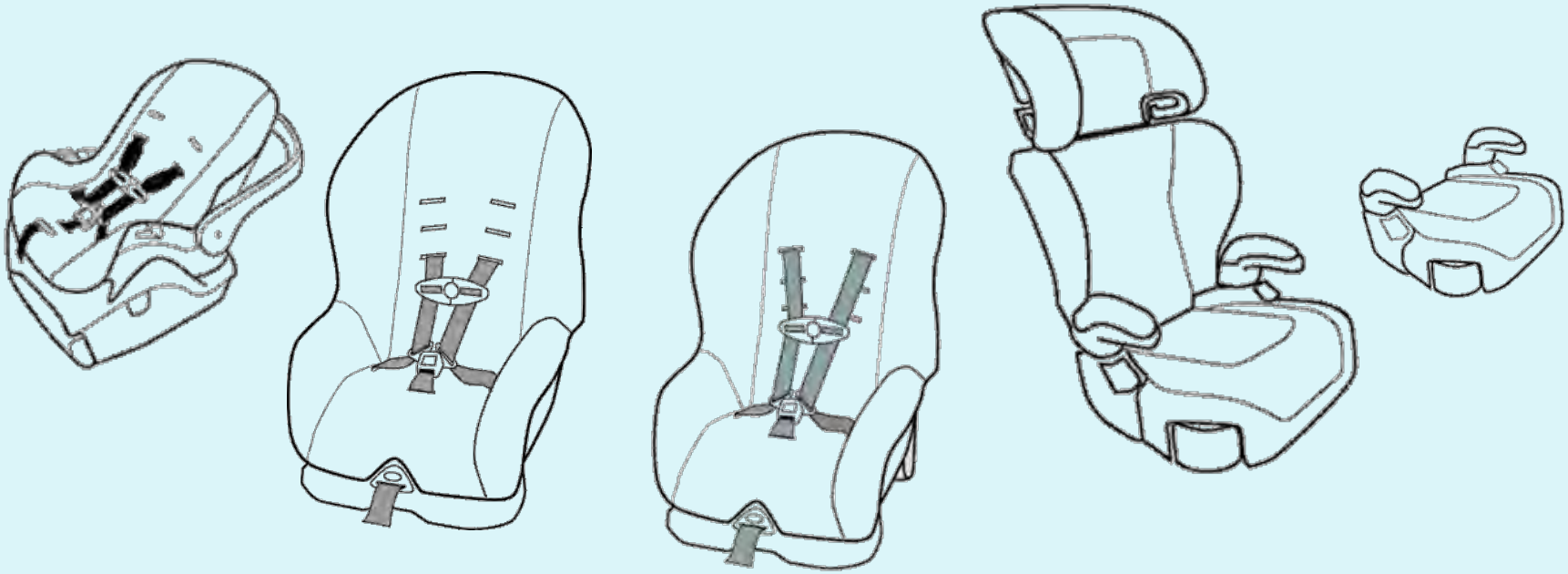
Source: National Household Transportation Survey, 2009

RESTRAINTS – HOW THEY WORK

- Restraints are designed to:
  - ~ Reduce the risk of being ejected during a crash
  - ~ Distribute energy load to bones rather than soft tissue
  - ~ Limit crash forces by prolonging deceleration

6-year-old children in 35 mph frontal impact crash

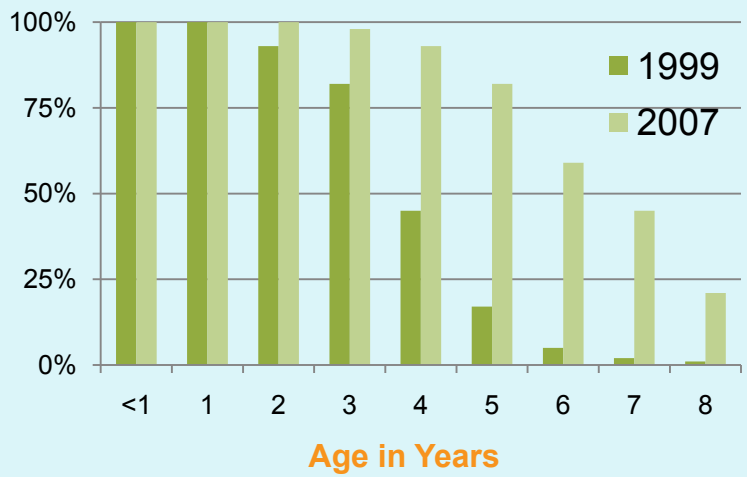
RESTRAINTS – HOW THEY WORK



- Types of Restraints
  - ~ Vehicle restraints: air bags, seat belts
  - ~ Add-on restraints: child restraint systems (CRS)

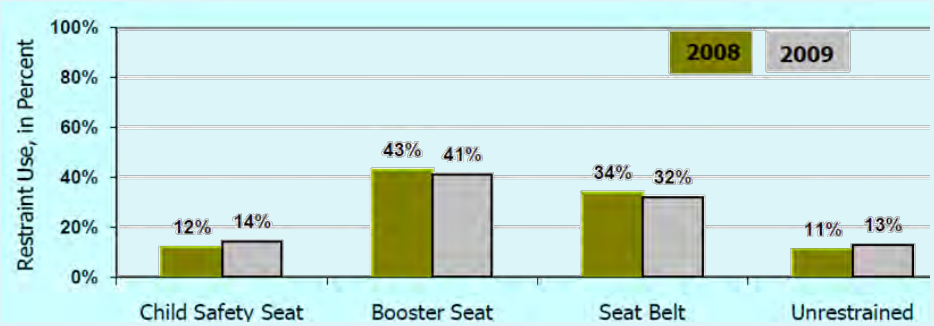
Prevalence of Use By Age

Child restraint use has significantly increased over the past decade



Source: PCPS Fact and Trend Report, 2008

- From 1999 to 2007, restraint use for 6- to 8-year-olds in crashes increased significantly; however, in 2007, 57% were still improperly restrained.

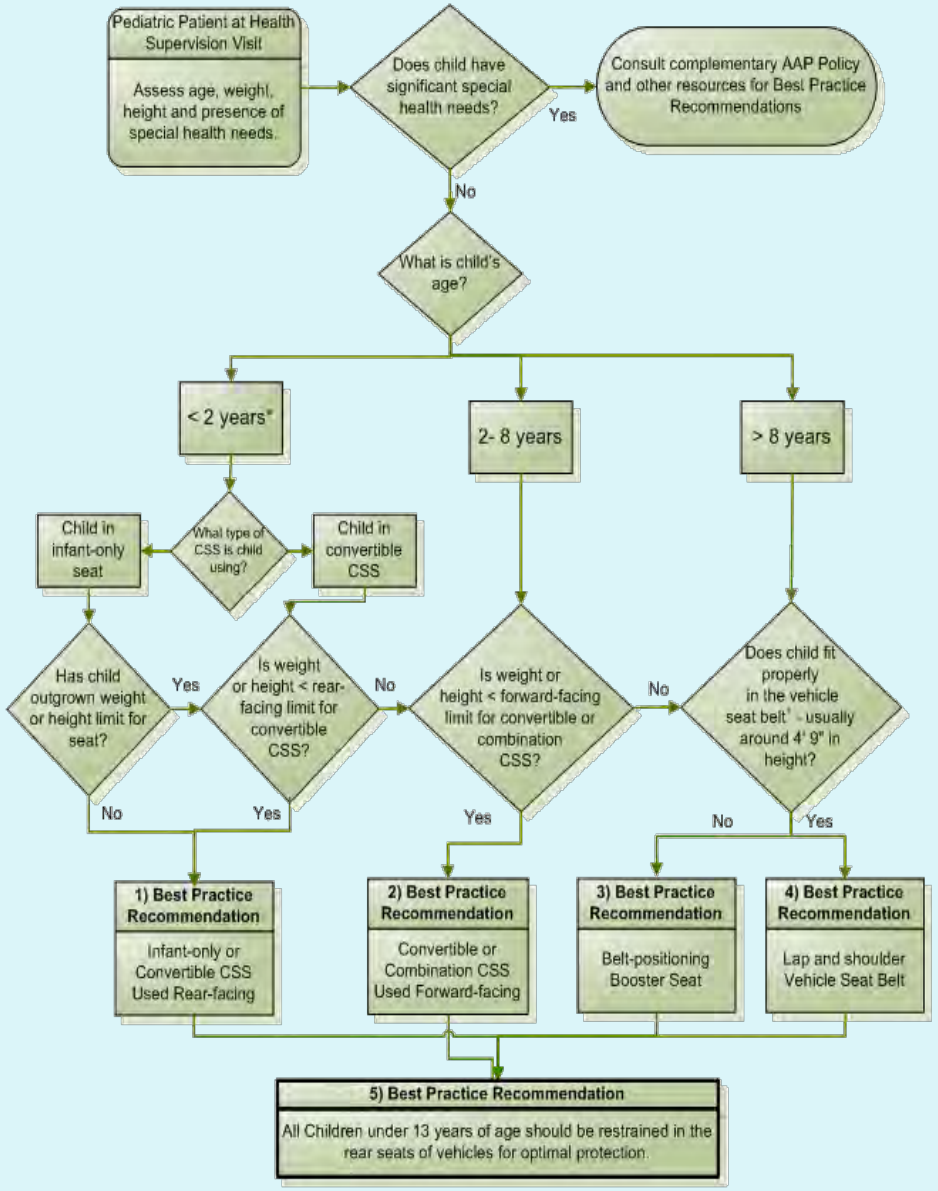


Source: 2009 National Survey of the Use of Booster Seats. DOT HS 811-377. NHTSA, 2010

- In 2009, 89% of children in the United States under age 13 were restrained.
  - ~ 55% of 4- to 7-year-olds were in child restraint systems.

Best Practice Recommendations

New Algorithm for Pediatricians to Use with Families



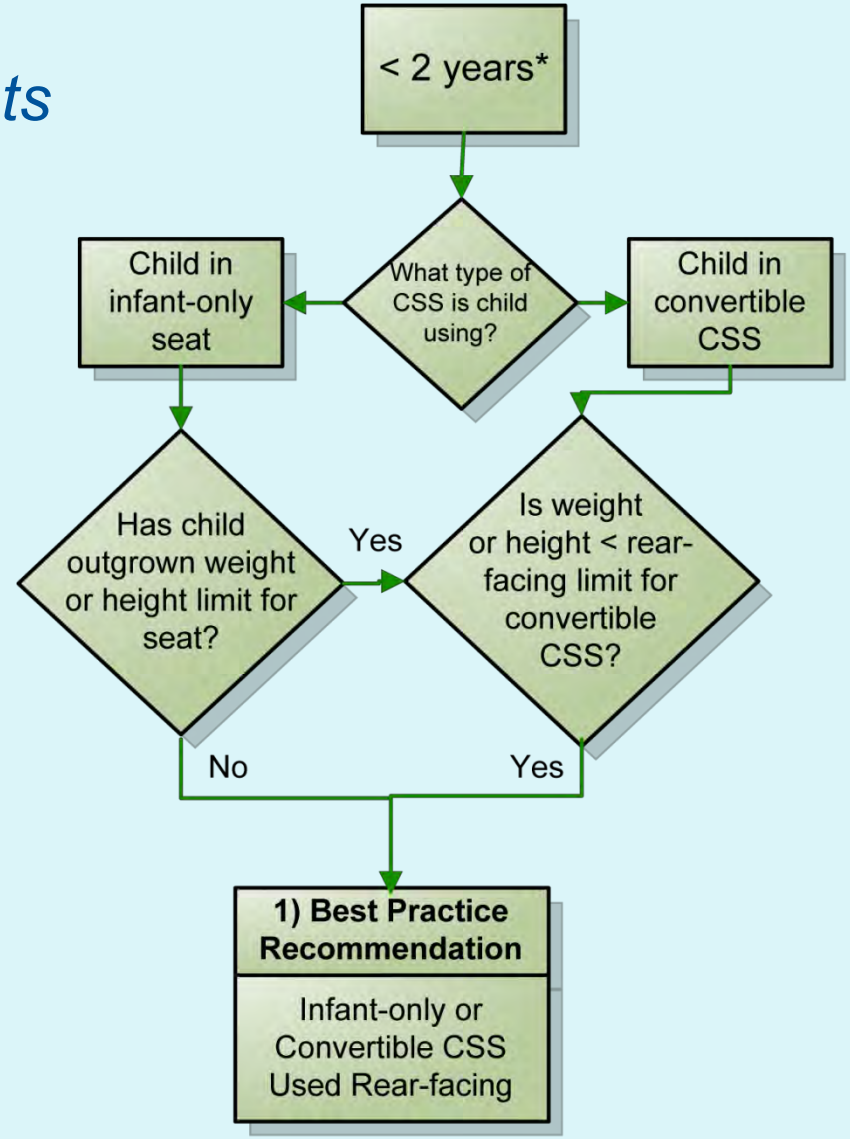
Children with Special Health Needs

- Children with certain physical and behavioral conditions may require specialized restraint systems.
  - ~ These include premature infants, those with cerebral palsy, skeletal or muscle tone abnormalities, tracheostomy, or fractures needing spica casts, as well as those in wheelchairs
- The AAP has a separate policy statement for transport of children with special health needs. It is available at:
  - ~ aappolicy.aappublications.org

RECOMMENDATION 1

Rear Facing Car Safety Seats

"All infants and toddlers should ride in a Rear Facing Car Safety Seat until they are 2 years of age or until they reach the highest weight or height allowed by their car safety seat's manufacturer."



Rear Facing Car Safety Seats

Situation

- Because infants' spines are developing and their heads are proportionally large for their bodies, injury to their head or spine may occur if not properly restrained.
- 21% of U.S. infants less than age 1 or 20 lbs are incorrectly seated in forward facing seats.

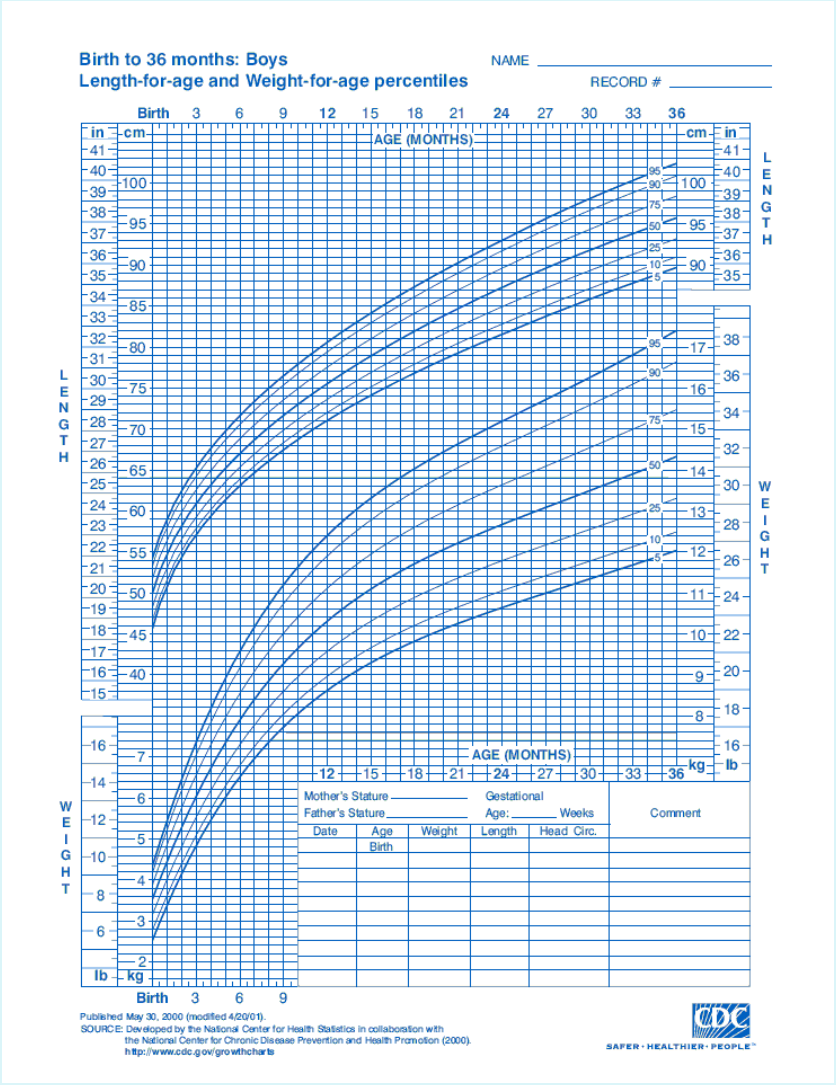
Rear Facing Car Safety Seats

Confirmatory Evidence

- Children up to age 2 placed in forward facing car safety seats (FFCSS) are 1.8 times more likely to be seriously injured than children up to age 2 in RFCSS.
  - ~ Applies for all crash types (frontal, side) and age groups (0 to 23 months)
- This safety benefit from RFCSS applies up to age 2.
  - ~ Forward facing children ages 12 to 23 months were over five times as likely to be injured when compared to rear facing children of the same age.

Pediatric Obesity & Child Passenger Safety

- 34% of U.S. children are “obese” (BMI >=95th%) or “overweight” (BMI >=85th% to <95th%).
- To accommodate this changing population, more child restraints with higher weight and height limits are available.
  - ~ 30 of the 35 convertible seats now available can accommodate up to 35 lbs rear facing (BMI >95th% for 24 months).

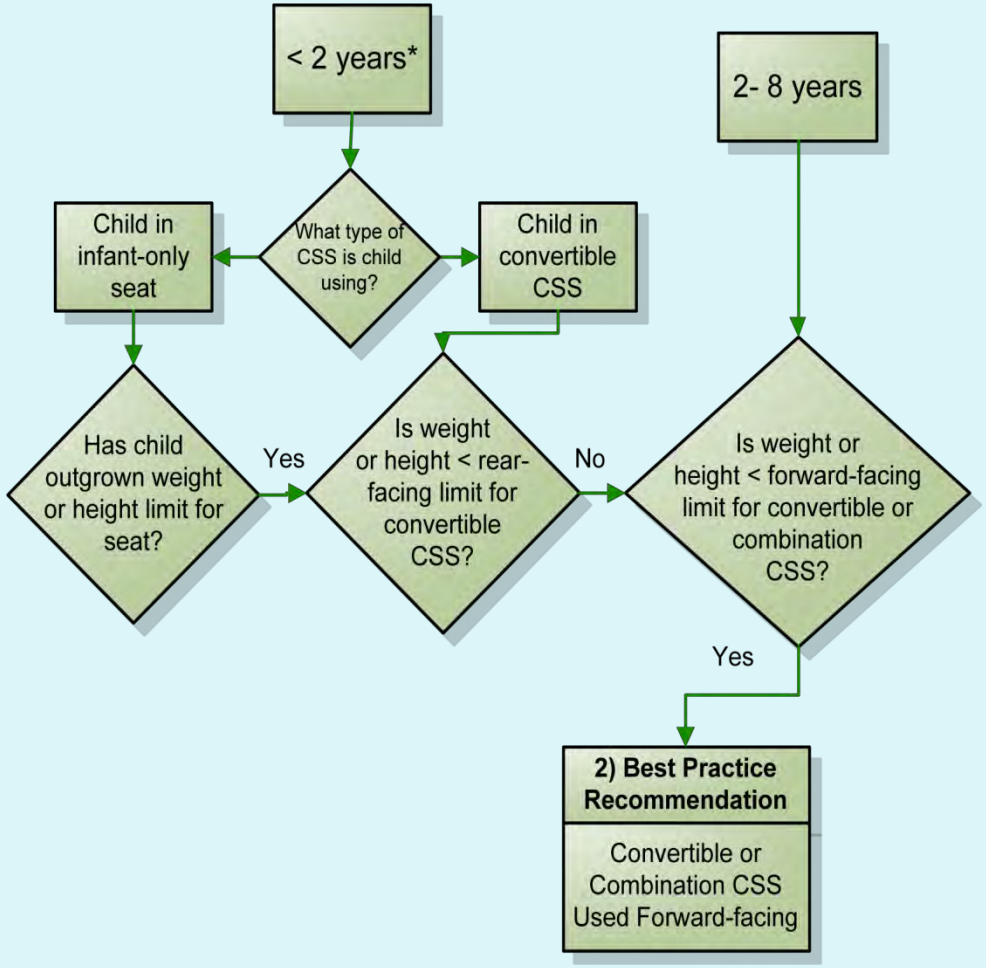


Source: Centers for Disease Control and Prevention, 2000

RECOMMENDATION 2

Forward Facing Car Safety Seats

"All children 2 years or older, or those younger than 2 who have outgrown the rear facing weight or height limit of their car safety seat should use a Forward Facing Car Safety Seat with a harness for as long as possible, up to the highest weight or height allowed by their car safety seat's manufacturer."



Forward Facing Car Safety Seats

Confirmatory Evidence

Prevention of Deaths

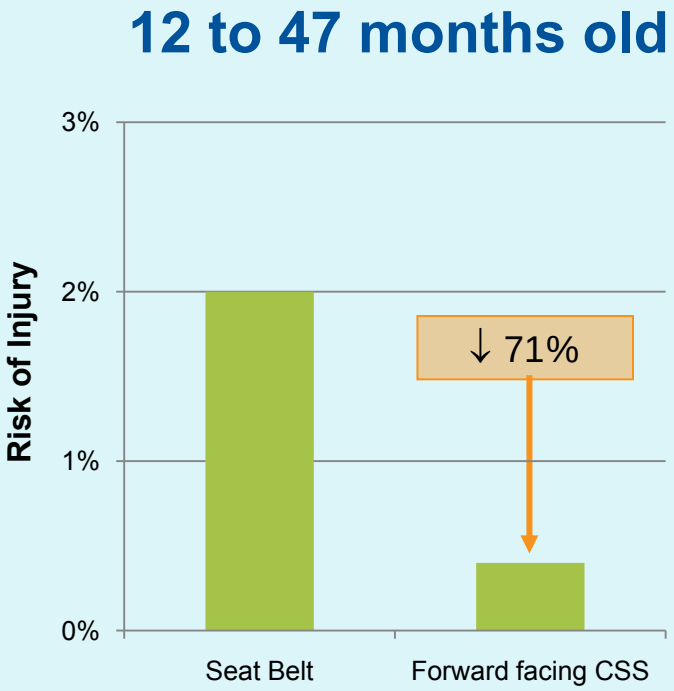
- FFCSS vs. unrestrained children
  - ~ Over a 6-year period (1988-1994), 1- to 4-year-olds placed in forward facing restraints reduced their risk of dying in a crash 54%.
- FFCSS vs. seat belt-restrained children
  - ~ 2- to 6-year-olds placed in forward facing restraints reduced their fatality risk by 22%.
    - – 17% reduced risk even with gross CRS misuse

Forward Facing Car Safety Seats

Confirmatory Evidence

Prevention of Injuries

- When correctly placed in a FFCSS vs. a seat belt alone, children ages 1 to 4 have a 71% reduction in serious injury risk.

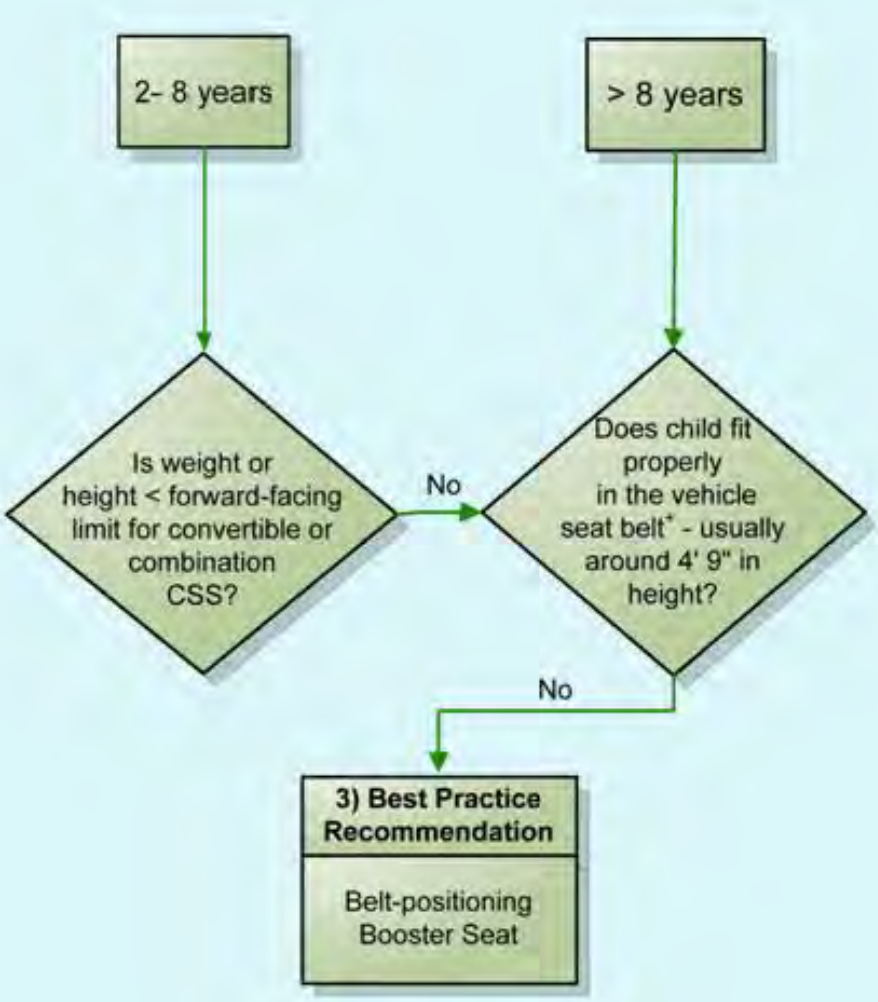


Source: Accident Analysis and Prevention, 2004

RECOMMENDATION 3

Belt-Positioning Booster Seats

"All children whose weight or height is above the forward-facing limit for their car safety seat should use a Belt-Positioning Booster Seat until the vehicle seat belt fits properly, typically when they have reached 4 feet 9 inches in height and are between 8 and 12 years of age."



Belt-Positioning Booster Seats

Situation

- Most vehicle seat belts do not fit children until they are 4’ 9” tall and 8 to 12 years old.
- For the lap and shoulder belt to fit correctly:
  - ~ The shoulder belt should lie across the center of the chest and shoulder, not the neck or face.
  - ~ The lap belt should sit low across the hips and pelvis, not on the abdomen.
  - ~ A child should be tall enough to sit against the seatback with knees bent and not slouching.

6-YEAR-OLD CHILD IN 35 MPH CRASH

Correct restraint:
Belt-positioning booster with lap/shoulder belt

Incorrect restraint:
Adult lap/shoulder belt

Seat Belt Syndrome

- During serious crashes, incorrect belt fit is associated with injuries to the spine and abdomen.
- This occurs because:
  - ~ The developing pediatric pelvis cannot hold the lap belt in place.
  - ~ Children tend to slouch, with their knees bending comfortably at the edge of the seat, causing the lap belt to ride up.
  - ~ The belt compresses the abdominal organs directly against the spinal column, causing high tension forces in the lumber spine.

Belt-Positioning Booster Seats

Confirmatory Evidence

Source: *Rice et al 2009*

Prevention of Deaths

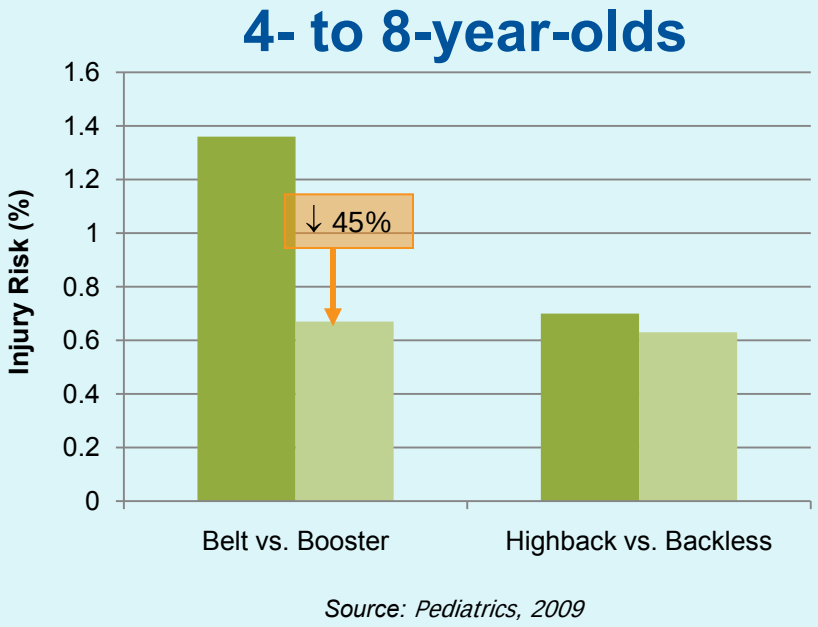
- Booster seats vs. unrestrained children:
  - ~ 67% reduced fatality risk for ages 4 to 5
  - ~ 55% reduced fatality risk for ages 6 to 8
- Booster seats vs. seat belts alone
  - ~ Booster seats do not appear to offer additional protection against fatal injuries in severe crashes as compared to seat belts alone. They do, however, provide additional protection against non-fatal injuries.

Belt-positioning Booster Seats

Confirmatory Evidence

Prevention of Injuries

- Children ages 4 to 8 placed in belt-positioning booster seats are 45% less likely to sustain non-fatal injuries than those placed in seat belts alone.
  - ~ No significant difference between highback and backless boosters
- Only 1% of children ages 4 to 7 are injured in crashes when placed in booster seats, as compared to 1.5% placed in lap/shoulder belts and 7% for unrestrained children.

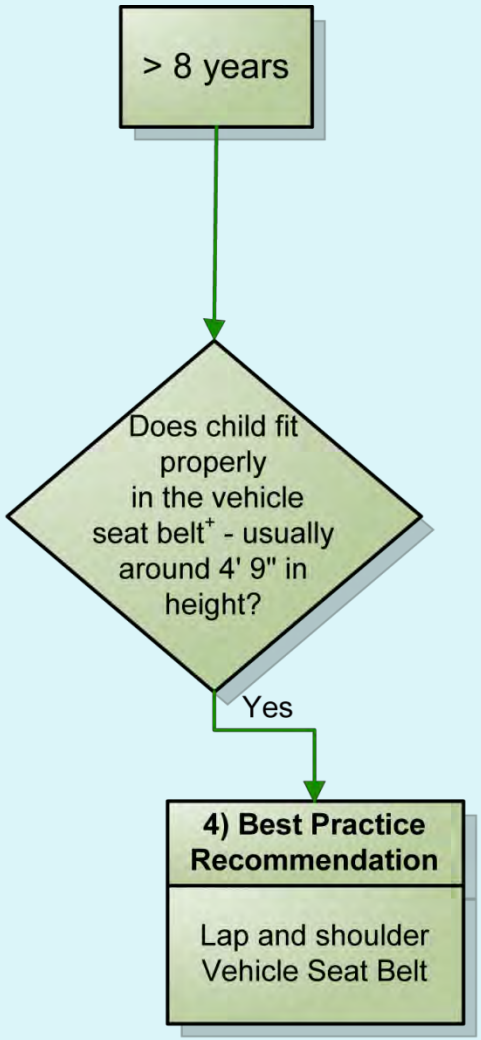


Source: Pediatrics, 2009

RECOMMENDATION 4

Lap and Shoulder Belts

"When children are old enough and large enough to use the vehicle seat belt alone, they should always use Lap and Shoulder Seat Belts for optimal protection."



Lap and Shoulder Belts

Situation

- Since 1989, lap and shoulder belts are required in rear outboard seating positions.
- Since 2005, lap and shoulder belts are required in center rear seating positions.

Lap and Shoulder Belts

Confirmatory Evidence

Lap and shoulder belt vs. unrestrained

- Seat belts reduce the risk of serious injury or death by 40% for 4- to 14-year-olds.
- If all passengers ages 8 to 15 were restrained by lap and shoulder belts (vs. 72% currently):
  - ~ 45% less deaths would occur
  - ~ 32% less hospitalizations would occur

Lap and shoulder belt vs. lap only belt

- For children placed in the center rear, 81% less risk of injury with lap and shoulder belt vs. lap belt only
  - ~ The greatest reduction is seen in abdominal injuries.

RECOMMENDATION 5

Children in the Rear Seats of Vehicles

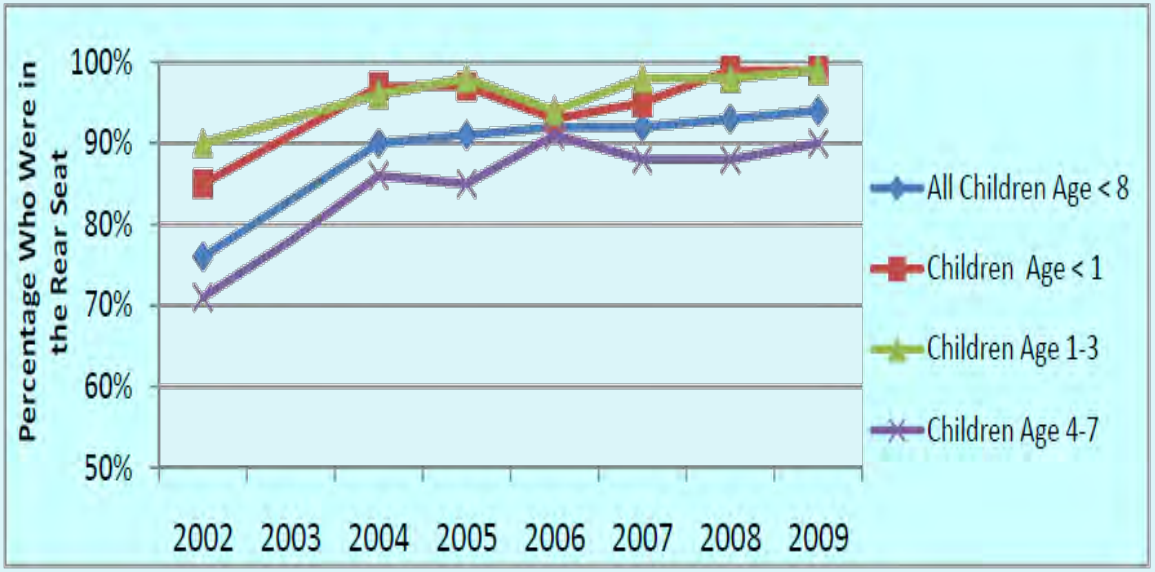
"All children younger than 13 years should be restrained in the rear seats of vehicles for optimal protection."

5) Best Practice Recommendation
All Children under 13 years of age should be restrained in the rear seats of vehicles for optimal protection.

Children in the Rear Seats of Vehicles

Situation

- Since the mid-90s there has been a significant increase in placing children in the rear seat.
- Children are more likely to ride in front if the driver is male, not a parent, or if there is no frontal air bag.



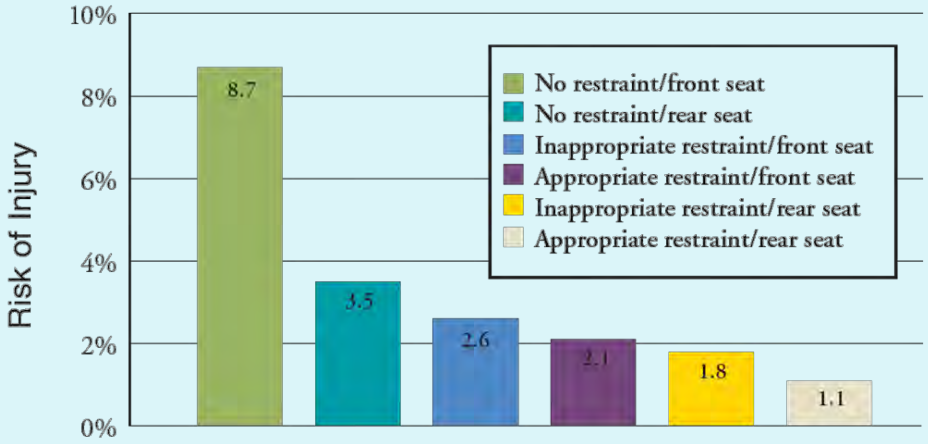
Source: *Occupant Restraint Use in 2009—Results From the National Occupant Protection Use Survey Controlled Intersection Study*

Children in the Rear Seats of Vehicles

Confirmatory Evidence

- Children riding in the front seat are 40 to 70% more likely to be injured than children riding in the rear.
- This rear seat benefit extends to side impact crashes:
  - ~ 62% less likely to be injured in rear seat

Injury Risk for 0 to 12-year-olds by Row and Restraint Type



Source: Pediatrics, 2005

SPECIAL CONSIDERATIONS

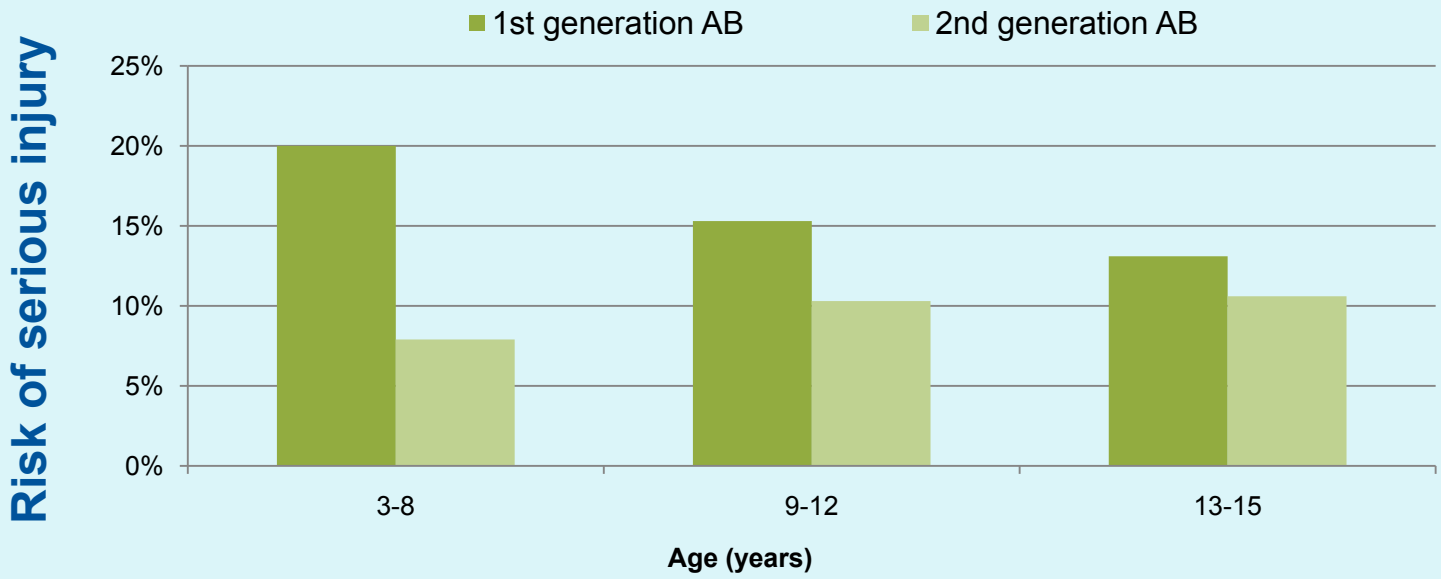
Children & Air Bags

- Air bags were originally installed in the late 80s to prevent serious injuries to unrestrained adults when crashes occur.
- Air bags have saved thousands of lives; but, in certain cases involving young children seated in front of them, they can be extremely dangerous:
  - ~ First report: 8 children died due to contact with deploying air bags in otherwise survivable crashes. (Nov. 1995, MMWR)
- Mechanism of injury resulting in these deaths:
  - ~ Rear-facing infant: Air bag contact with rear surface of restraint (posterior skull and brain injuries)
  - ~ Belt-restrained or unrestrained child: Vehicle deceleration places child's head in path of air bag during deployment (Atlanto-occipital fracture, brain stem injury, diffuse axonal injury)
- How the National Highway Traffic Safety Administration (NHTSA) responded to child fatalities:
  - ~ Recommended all children, from birth to age 13, sit in the rear
  - ~ Changed regulation FMVSS 208 to encourage development of air bags that deploy with lesser force (2nd generation)

SPECIAL CONSIDERATIONS

Frontal Air Bags

- Second generation air bags (vehicle year 1998+):
  - ~ Reduce crash fatality risk 29% in children ages 6 to 12 vs. no air bag
  - ~ Serious injury rate of 14.9% for seat belt restrained children ages 3 to 15 involved in crashes with first generation air bags; injury rate drops to 9.9% with second generation air bags



Source: *Archives of Pediatric & Adolescent Medicine, 2005*

Special Considerations

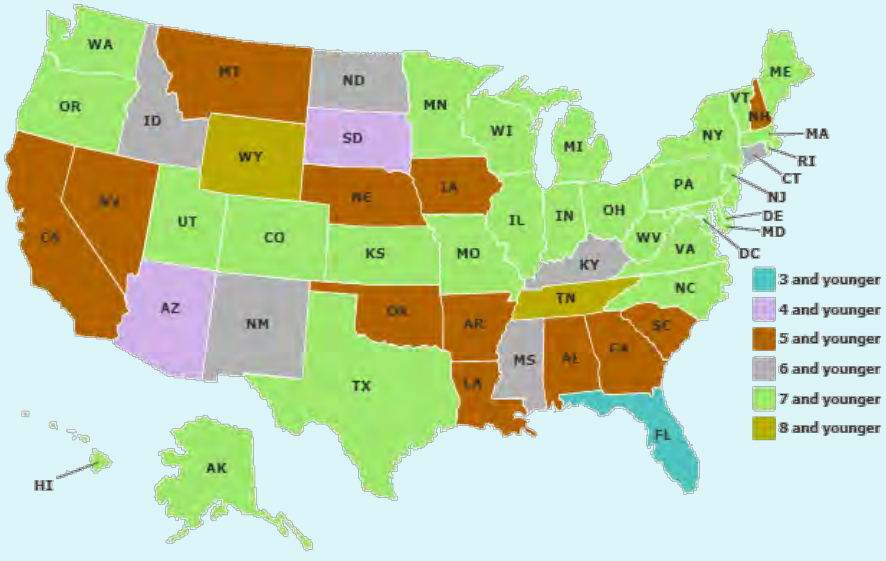
Side Air Bags

- 92% of 2011 model cars, 94% of SUVs, and 56% of pickups have standard head and torso side air bags.
- Side air bags reduce struck-side fatalities by 18% for all occupants and also protect the thorax in adults.
- 2.7% of children in side impact crashes were exposed to side air bag deployment.
  - ~ 10.6% sustained AIS 2+ injury to the head or upper extremities.
- There is no evidence that side air bags increase the risk of significant injury or death.

What You Should Know About

Child Restraint Laws

- Although all states instituted some form of child restraint law by 1984, most state laws do not comply with Best Practice recommendations.
- Passage of booster seat laws increased child restraint use 39% among 4- to 7-year-olds.
- Older children (ages 5 to 15) are not covered by the gap between child and adult restraint laws in several states.
- Restraint use among 13- to 15-year-olds is 7.2% higher in states with primary enforcement laws.



What Else You Should Know About

Other Considerations

- Children left in or around vehicles have an elevated risk of injury/death from back-overs, hyperthermia, or power window entrapment.
  - ~ Children should never be left unattended in or around parked cars.
- Children in compact extended cab pickup trucks are four times as likely to be injured than in other vehicles.
  - ~ Children should never ride in the cargo area of a pickup truck.
- Although children less than 2 are not required to have their own airplane seat, it is recommended that they use their car safety seat when flying.
- Consult the AAP's Child Passenger Safety Technical Report for more details at aappolicy.aappublications.org.

Wrap-Up

- Please type questions in Q&A text box
- Tape of webinar, copy of slides available from www.chop.edu/carseat
  - ~ Wait about 2 weeks
  - ~ Full citation of sources available from printed version
- Questions about AAP recommendations
  - ~ Bonnie Kozial, Bkozial@aap.org

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Rear Facing Car Safety Seats (Slides 13-16)

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Belt-Positioning Booster Seats (Slides 20-25)

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