

## Transportation of infants and children in motor vehicles



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Motor vehicle collisions remain the leading cause of death in Canadian children (1,2). In 2006, 16% of Canadian motor vehicle traffic collision fatalities and 19% of injuries occurred among children and adolescents (zero to 19 years of age) (3). Despite all 10 provinces and three territories having laws requiring the use of child safety seats, many injuries and deaths are directly attributed to nonuse or misuse of child restraints (4-10). The Canadian Paediatric Society (CPS) believes that many of these unfortunate outcomes can be prevented with increased public education and clinician advocacy. Parents and caregivers need to understand the current legislation in their province or territory, as well as how to properly install and use child restraint systems. One step toward educating the public is to ensure paediatricians and family physicians have an accurate knowledge of the current recommendations for transportation of children in motor vehicles. The necessity for such a position statement has been substantiated by the recent work of Rothenstein et al (11), who identified community paediatricians as having a lack of knowledge for the proper use of child restraints in motor vehicles. In 2004, Transport Canada conducted an environmental scan of educational initiatives aimed at increasing physicians' understanding of child passenger safety, which identified paediatricians as having a lack of understanding for the appropriate seating of children in motor vehicles. The present statement will outline the current recommendations based on provincial legislation and peer-review literature available at the time of publication. These recommendations parallel the American Academy of Pediatrics' (AAP) policy statement, *Selecting and using the most appropriate car safety seats for growing children: Guidelines for counseling parents* (1), with specific Canadian content. The statement will also provide clinicians with essential knowledge for discussing safe travel with parents, and will identify opportunities for clinician advocacy for enhancing child passenger legislation in Canada.

Child seats, when used correctly, reduce the risk of fatal injury by 71%, and the risk of serious injury by 67% (12). Using a booster seat instead of a seat belt alone reduces the risk of injury by 59% (13). According to the National Child Restraint Survey 2006 (14), the highest restraint use for children in Canada is among children nine to 14 years of age (98.9% seat belt use), with 63% of travelling infants being restrained in an infant seat, and only 28% of children four to eight years of age properly using a forward-facing seat or booster seat. More than 53% of Canadian parents incorrectly believe that their children are ready to use a seat belt exclusively by

six years of age (15). Premature graduation from the appropriate car seat or booster seat is a major hazard to safe transportation of newborns, infants and children (16,17). Compounding the problem of car seat selection are the tremendous misuse rates. Across Canada, misuse rates range from 44% to 81% for car seats, and 30% to 50% for booster seats (6,9,15,18,19). Enforcement of demerit point deductions and fines may occur for failing to use child car seats or for using them incorrectly under the provincial/territorial highway traffic laws (15).

### COMMON INFANT/CHILD CAR SEAT ERRORS OR MISUSES

Not using the correct seat for the weight and/or height of the child, mostly in the form of premature graduation, is the most prevalent form of misuse. Thereafter, the following errors are most common:

#### The top three errors (20)

- Seat not tightly secured to the vehicle (moves more than 2.5 cm [1 inch] in any direction);
- Harness not snug (more than one finger width fits between the harness strap and the child); and
- Chest clip not at armpit level.

#### Other common errors (9,20,21)

- Not anchoring the tether strap for forward-facing child seats;
- Placing a rear-facing infant seat in front of an air bag;
- Wrong angle of infant seats (should be at a 45 degree angle for head and neck support);
- Not using a locking clip on the vehicle seat belt when necessary, according to the vehicle manual;
- Routing the seat belt through an incorrect path of the infant/child restraint;
- Routing the harness straps through incorrect slots of the infant/child restraint;
- Using recalled or otherwise unsafe seats (restraints older than 10 years or beyond the manufacturer's expiry date, or previously in a vehicle at the time of a crash); and
- Failing to restrain the child.

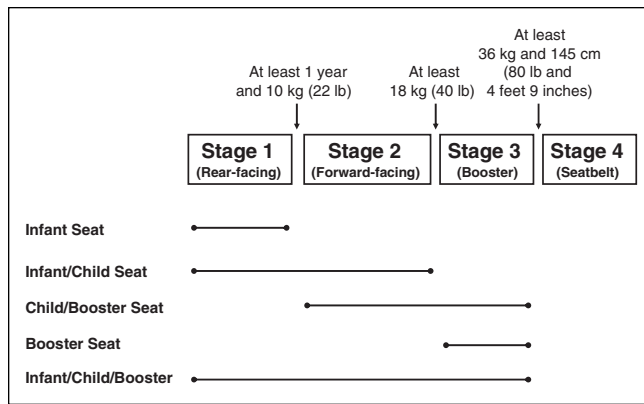


Figure 1) Appropriate restraint selection – stages versus car seats

### SEAT SELECTION

Transport Canada describes four stages of child restraints to assist families in selecting the appropriate mode of restraint (18,19,22). A variety of types of seats can be used at each stage (Figure 1). A summary of child restraints available in Canada, and their weight and height specifications is available at <www.sickkids.ca/safekidscanada>.

#### Stage 1: Rear-facing car seats (Figure 2)

Rear-facing car seats should be used until children weigh at least 10 kg (22 lb), and are at least one year of age and able to walk (2,23) (personal communication, Transport Canada). This can be achieved by using an infant-only rear-facing seat or a convertible (infant/child) seat which can be used rear-facing for infants and forward-facing for older children. When the weight or height limits have been exceeded for an infant-only seat, parents should choose an infant/child seat, which can be used for higher weights and/or heights in the rear-facing position. Infants who weigh less than 10 kg at one year of age should continue to ride in the rear-facing position. Rear-facing infant/child restraints may continue to be used beyond 10 kg and one year of age, in accordance with the manufacturer’s instructions for height and weight limitations; parents should be encouraged to continue to use a rear-facing seat as long as the height and weight limitations allow. All rear-facing car seats must be secured to the vehicle with the vehicle seat belt or the universal anchorage system (UAS), also referred to as the LATCH system in American literature.

#### Stage 2: Forward-facing car seats (Figure 2)

Forward-facing infant/child, child/booster and infant/child/booster car seats may be used for children between 10 kg and 22 kg (between 22 lbs and 48 lbs), and up to 122 cm (48 inches) in height, depending on the manufacturer’s specifications. However, as of May 1, 2007, an interim order issued by the Minister of Transport allowed manufacturers and importers to offer child restraint systems in Canada that incorporate an internal harness and a tether strap for children up to 30 kg (65 lbs), and, thereby, increasing the capacity of the restraint systems (the use of

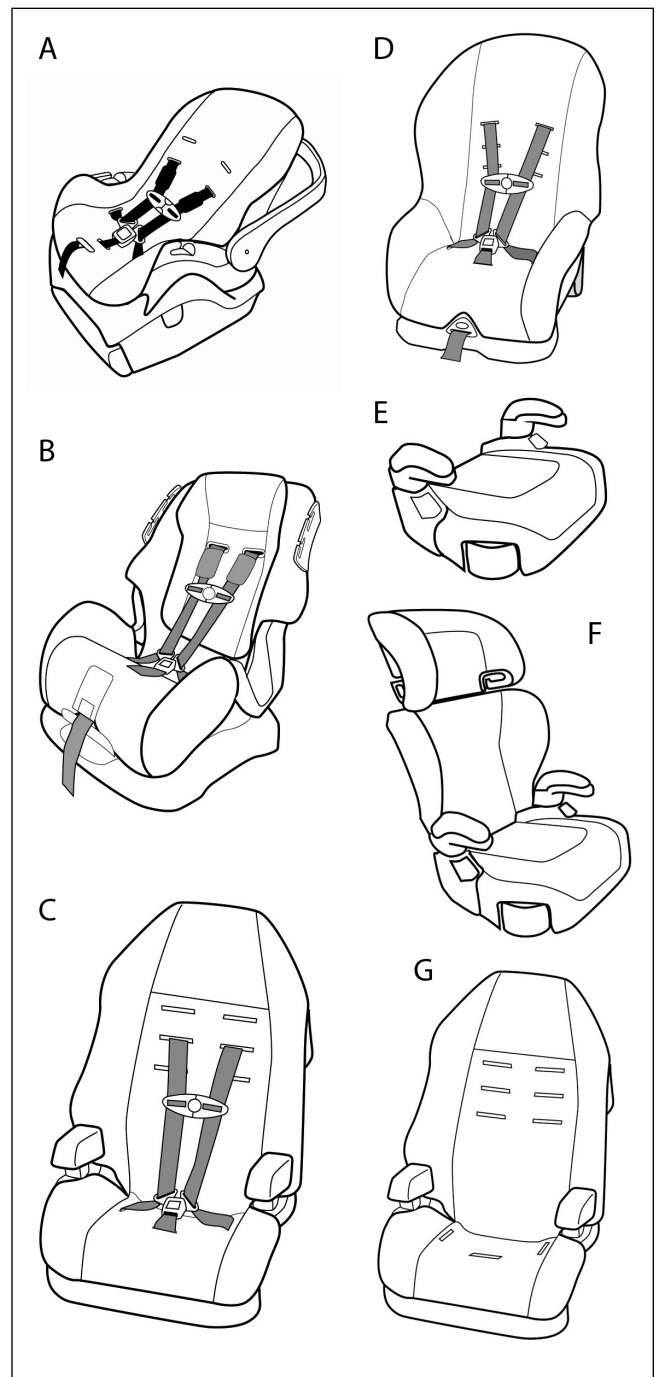


Figure 2) A Infant seat with base. B ‘3-in-1’ convertible seat – infant/child/booster seat. C Infant/child/booster seat. D Child/booster seat. E Backless booster seat. F High-back booster seat. G Combination (child/booster) seat – belt-positioning booster seat mode. Reproduced from reference 35

children’s restraint systems fall under provincial/territorial jurisdiction). This changes the definition of ‘child’, where restraint systems are concerned, to mean a person whose weight is not less than 9 kg (20 lbs) and not more than 30 kg (65 lbs). All forward-facing seats must be secured to the vehicle with a tether strap, as well as the vehicle seat belt or the UAS, also referred to as the LATCH system in American literature.

**Stage 3: Booster seats**

Booster seats should be used for children who have exceeded the weight and/or height limits of their forward-facing car seat and weigh at least 18 kg (40 lb). Booster seats should be used until children are at least 36 kg (80 lb). Some models accommodate children up to 45 kg (100 lb). Always check the label for the lower and upper weight and height limits because they vary depending on the model.

**Stage 4: Seat belts**

Seat belts (lap and shoulder) may be used for children who are heavier than 36 kg (80 lb), are at least eight years of age and who properly fit the adult restraint in the vehicle (refer to specific seating instructions under the 'placement of the child in the seat' section). Conventional seat belts are designed for persons taller than 145 cm (4 feet 9 inches). However, not all children 145 cm (4 feet 9 inches) or taller are ready to use an adult seat belt, but rather may be ready depending on the way the child fits the adult seat belt. Therefore, parents need to assess the way the adult seat belt fits first before deciding that a booster seat is no longer required. Booster seat legislation in some provinces specifies minimum weight, age, and standing and seated height requirements for seat belt use.

Because children's growth patterns, and weight and/or height proportions vary widely, age should only be used as a guideline. Physical measurements are much truer markers of appropriate seating needs. Developmental abilities must also be considered.

Premature and small infants should use restraints that do not have shields, abdominal pads or arm rests, that could cause injury to the child's neck or face during an impact (13,18). This is also true for other infants, but is especially referenced here for the purposes of highlighting the importance of size. Ensure that the seat allows for an infant weighing 2.27 kg (5 lb) or under. For specific information relating to transportation of premature and low-birth weight infants, refer to the AAP policy statement, Safe transportation of premature and low birth weight infants (17), and Transport Canada guidelines, Transporting infants and children with special needs in personal vehicles: A best practices guide for healthcare practitioners (24).

Integrated (built-in) car safety seats are an optional equipment item in some vehicles for forward-facing riders who weigh at least 9 kg (20 lb). This may be an option for parents to consider when purchasing a new vehicle. These restraints must also meet Transport Canada standards. Additionally, some integrated seats convert to booster seats for older children (9).

**TYPES OF BOOSTER SEATS (15) (FIGURE 2)****High-back belt-positioning booster**

This type of booster provides head and neck support for children seated in vehicles without head restraints, and must be used with a lap and shoulder seat belt assembly.

**Infant/child/booster and child/booster seats (also known as combination car seats or '3-in-1' or '2-in-1' car seats)**

These are rear- and/or forward-facing car seats with five-point harness systems which, when the harness is removed, converts to booster seat to be used with the vehicle's seat belt assembly. Certain manufacturers recommend continued use of the tether strap after the restraint system is converted to a booster seat. These seats are first used as rear- and/or forward-facing car seats with an internal harness and tether strap for forward-facing, and then as booster seats by removing the harness and tether strap when applicable.

**Low-back/backless belt-positioning booster**

This type of booster is designed for vehicles with an adjustable head restraint where the child is seated. The chosen seating position must have a shoulder and lap belt, as well as an adjustable head restraint.

**Abdominal shield booster**

This type of booster, designed for use with a lap belt only, is no longer available in Canada.

**BOOSTER SEAT LEGISLATION ADVOCACY**

The CPS supports booster seat legislation. Booster seat legislation is crucial to closing the gap for children who are too big for car seats and too small for the vehicle's seat belt assembly. Between 1997 and 2001, the death rate due to motor vehicle collisions dropped by 52% among children younger than five years of age, and by 25% among children 10 to 14 years of age, but did not drop at all for children five to nine years of age – those in the booster seat age group (15). Additionally, a recent two-year Canadian Paediatric Surveillance Program study (25) of lap-belt syndrome (a medical term for the pattern of injuries to a child's internal organs and spine caused by an ill-fitting seat belt), identified that 12 of the 28 confirmed cases occurred in children younger than eight years of age, with only one child restrained in a booster seat wearing only a lap belt. Almost one-third (30%) of children wearing a seat belt or a three-point restraint at the time of their motor vehicle crash suffered from lap-belt syndrome, with spinal fractures and permanent cord lesions occurring 43% and 25% of the time, respectively. The province of Quebec was the first to implement booster seat legislation in June 2002. Ontario, Nova Scotia, British Columbia, Newfoundland & Labrador, Prince Edward Island and New Brunswick recently passed booster seat laws. The new Ontario booster seat law came into effect on September 1, 2005, Nova Scotia's legislation on January 1, 2007, British Columbia's on July 1, 2008, Newfoundland & Labrador on July 1, 2008, Prince Edward Island on January 1, 2008, and New Brunswick on May 1, 2008. The remaining Canadian provinces and territories are either without specific booster seat legislation, or have pending legislation. Clinicians can advocate that every jurisdiction update their provincial/territorial highway traffic acts to make booster seat use mandatory (15).

## SALES TAX EXEMPTION FOR CHILD PASSENGER RESTRAINTS

The CPS supports sales tax exemptions for proven child and youth safety devices, including car and booster seats. The province of Ontario recently removed sales tax requirements from booster seats, thereby making all child passenger restraints tax exempt. Clinicians can advocate that car and booster seats should be exempt from all federal and provincial/territorial sales tax.

## AFTERMARKET PRODUCTS AND DEVICES

There are a number of aftermarket products and devices marketed as safety products that claim to correct the problem of poorly fitting seat belts. However, they are not regulated by the Canadian Motor Vehicle Safety Standards established by Transport Canada and, therefore, should not be used. Their design may increase the risk of lap-belt syndrome, by pulling the lap belt up and over the mid-abdomen and, thereby, increasing the likelihood of serious abdominal injuries (1). These products are not endorsed by the CPS or Transport Canada. Only a booster seat should be used to ensure proper seat belt fit.

Children with special health care needs also need appropriate restraint systems for transportation. For specific information refer to the AAP policy statements, Transporting children with special health care needs (26) and Safe transportation of children with special needs: A guide for families (27), as well as the Transport Canada guidelines, Transporting infant and children with special needs in personal vehicles: A best practices guide for healthcare practitioners (24).

## SEATING POSITION

- The rear vehicle seat is the safest place for any passenger, especially children, to ride (1,2,15,18). Rear seat positioning has been estimated to decrease the risk of death by 36% for children involved in fatal collisions, independent of restraint use (28). Children positioned in the rear seat of a vehicle are 1.7 times less likely to incur a fatal or severe injury than front seat travellers (29). Additionally, the rear middle position vehicle seat is the most protective for a single occupant (2), placing the passenger at the furthest possible distance from side impacts, as well as side air bags.
- Front passenger air bags can cause death or can severely harm children seated in the front passenger seat of a vehicle. Children should be seated in the rear seat of a vehicle until they are 13 years of age.

An important exception to these protective seating recommendations is compact extended cab pick-up trucks, where the reverse is true. In this particular type of vehicle, children seated in the front row are safer than those in the second row (risk of injury 2.8% and 13%, respectively). This is the only exception to the rear-centre position being

the most protective for children, with the proviso that rear-facing infant seats should never be installed in front of an airbag (21).

## SEAT INSTALLATION

- Parents should always read the vehicle owner's manual and restraint system's instructions thoroughly and carefully before installing the restraint system. Once a restraint system is installed in the vehicle, it should be tested regularly to ensure a safe and snug fit. This may reduce any potential safety concerns among the restraint system, vehicle seat and seat belt assembly (1,2,30,31).
- Rear-facing restraint systems must never be placed in the front passenger seat of any vehicle equipped with a front passenger air bag (1,16,17). The impact of an air bag against the back of a rear-facing restraint system can cause death or serious harm to its occupant.
- Transport Canada developed the UAS for restraint systems in vehicles, which was improved on and accepted by the International Organization for Standardization. This new system, outfitted in all vehicle models manufactured after September 1, 2002, may simplify restraint system installation for some vehicle models and child restraint systems by eliminating the need for using seat belts. UAS attachments on restraint systems are secured to anchors in a UAS-equipped vehicle. Parents should be aware that if used correctly, the UAS method and seat belt assembly method of installation are equally safe in securing a car seat to the vehicle. Therefore, parents should choose the one that best fits their individual vehicle and the one they find easiest to use.
- All rear-facing and forward-facing restraint systems should be installed tightly, allowing no more than 2.5 cm (1 inch) of movement in either direction when pulled on at the anchor point or at the edge of the routing point. (Note: rear-facing car seats will have some movement along the back of the seat, the part of the seat that is farthest from the anchor point. They are specifically designed to allow for this; it does not indicate improper installation.)
- A rear-facing restraint system should be positioned at approximately a 45 degree angle to prevent ejection in a collision, and also to prevent head and neck positioning that may cause airway obstruction (1,10,20). This angle may be difficult to obtain in some vehicles due to the vehicle seat slope. If a rear-facing restraint does not feature an angular adjustment mechanism, then a firm roll of cloth or a 'pool noodle' can be placed under the restraint system to achieve this angle (1,17,19,32). Accommodating the system in this way still requires testing for tightness of fit.



- Forward-facing car seats require the use of a tether strap. The tether strap attaches to an anchor point in the vehicle (see vehicle owner's manual), and helps to limit the amount of forward head movement in a sudden stop or crash.
- Side air bags are installed in the rear seat position of a number of newer vehicles. While little is understood with respect to their effectiveness for child occupants, Transport Canada has identified serious injury potentials in tests using out-of-position three- and six-year-old dummies (33). Therefore, the safest approach remains to have child occupants seated in the middle rear seat position, thereby farthest away from side airbags, until more is understood about their utility and safety profile.

#### PLACEMENT OF THE CHILD IN THE SEAT

- For rear-facing restraint systems, the shoulder harness should be threaded through the slots at or below the infant's shoulders, and the harness should be snug, not allowing more than one finger insertion between the collar bone and the harness, and the restraint system chest clip should be placed at the level of the infant's armpit (1,18).
- The harness should always be secured when an infant is positioned in a restraint system, even when moving the child from the car to another location and when using the seat outside of the vehicle.
- An infant should not be placed to sleep in a restraint system outside of the vehicle – infants should be placed to sleep supine in a crib, which meets the current Canadian regulations under the Hazardous Products Act (18,19). Parents should not place an infant car seat with a child occupant on an elevated surface (ie, countertop or table) because the car seat may fall from the surface and cause serious injury. Always place car seats on the ground to eliminate the risk of fall injuries.
- For forward-facing restraint systems, the harness should be threaded through the seat at or above the level of the child's shoulders, the harness should be snug, not allowing more than one finger insertion between the collar bone (or chest if the seat requires harnesses to be in the top slots) and the harness, and the chest clip should be placed at the level of the child's armpit (1,18).
- For booster seats, the shoulder portion of the vehicle's seat belt assembly should be positioned so that it does not come in contact with the child's neck, but rather keeps the shoulder belt over the middle of the child's clavicle and chest, and the lap belt of the seat belt assembly should be over the child's pelvic bones and away from (below) the abdomen (15,18). In addition, the child must be able to bend his/her knees comfortably over the edge of the vehicle seat while sitting up straight (15,21). Ensuring appropriate seating in this way will prevent the child from slouching to become comfortable and, thereby, causing the lap belt to rise and rest on the abdomen (2,34).
- For older children, the vehicle's seat belt assembly should fit the child so that the shoulder portion of the seat belt assembly system sits over the mid-clavicle and the mid-chest, and the lap portion of the seat belt assembly system sits low on the pelvis. The child should not slouch and the knees should bend naturally over the vehicle seat edge. If the child must slouch to do this, then the child should be in a booster seat (1,10,18). The shoulder belt should never be placed behind the child's back.
- A child should never be left unattended in a restraint system in or out of the vehicle.

#### SUMMARY

We are fortunate to have products manufactured for the purposes of improving the safe transportation of our nation's children, and those around the world. However, available devices are not enough if not used properly, or not used at all. Parents rely on health care providers, specifically paediatricians and family physicians, to provide them with accurate information for the safe transportation of their children. While these recommendations reflect the most current knowledge of literature and legislation for the appropriate transportation of infants and children in motor vehicles, we recognize that new products are continually being developed for safer transportation. However, any new device should only be used if it meets Transport Canada standards. Physicians can make use of various publications available from Transport Canada, Safe Kids Canada and the AAP for advising their patients. Physicians should also remember that road safety guidance begins at the hospital and must be done at all stages and ages, throughout a child's growth and development. Figure 1 in the present statement provides an easy, quick reference for selecting the appropriate type of restraint. Parents should be encouraged to properly install and learn the correct use of their child's safety seats, thereby only making use of the free child safety seat clinics offered in their community by certified technicians to assist with problems that cannot be solved by instructions given in the manufacturer's manual. Provincial and territorial governments should be encouraged to pass legislation that encourages the proper use of child restraints – including introducing and harmonizing child restraint and booster seat legislation across Canada – to prevent injury and to reduce the risks of disability and death to our child passengers.

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## RESOURCES

- Transport Canada  
Keep kids safe: Car time 1-2-3-4.  
<[www.tc.gc.ca/roadsafety/tp/tp13511/intro.htm](http://www.tc.gc.ca/roadsafety/tp/tp13511/intro.htm)>  
(Version current at February 26, 2008)
- Safe Kids Canada  
1-888-SAFE-TIPS (1-888-723-3847)  
<[www.sickkids.ca/safekidscanada](http://www.sickkids.ca/safekidscanada)> (Version current at February 26, 2008)
- American Academy of Pediatrics  
Car safety seats and transportation safety. <[www.aap.org/family/cps.htm](http://www.aap.org/family/cps.htm)> (Version current at February 15, 2008)

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The recommendations in this statement do not indicate an exclusive course of treatment or procedure to be followed. Variations, taking into account individual circumstances, may be appropriate. Internet addresses are current at time of publication.