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## Rating child passenger safety laws relative to best practice recommendations for occupant protection

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### ABSTRACT

**Background:** State laws regarding child passenger protection vary substantially.

**Objectives:** The objective of this study was to develop a scoring system to rate child passenger safety laws relative to best practice recommendations for each age of child.

**Methods:** State child passenger safety and seat belt laws were retrieved from the LexisNexis database for the years 2002–2015. Text of the laws was reviewed and compared to current best practice recommendations for child occupant protection for each age of child.

**Results:** A 0–4 scale was developed to rate the strength of the state law relative to current best practice recommendations. A rating of 3 corresponds to a law that requires a restraint that is sufficient to meet best practice, and a rating of 4 is given to a law that specifies several options that would meet best practice. Scores of 0, 1, or 2 are given to laws requiring less than best practice to different degrees. The same scale is used for each age of child despite different restraint recommendations for each age. Legislation that receives a score of 3 requires rear-facing child restraints for children under age 2, forward-facing harnessed child restraints for children aged 2 to 4, booster seats for children 5 to 10, and primary enforcement of seat belt use in all positions for children aged 11–13. Legislation requiring use of a “child restraint system according to instructions” would receive a score of 1 for children under age 2 and a 2 for children aged 2–4 because it would allow premature use of a booster for children weighing more than 13.6 kg (30 lb).

**Conclusions:** The scoring system developed in this study can be used in mathematical models to predict how child passenger safety legislation affects child restraint practices.

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Legislation; child passengers; child restraint; seat belt

### Introduction

Fatalities and injuries to children in motor vehicle crashes have decreased substantially in the last decade, with fatalities among 0- to 12-year-old passengers decreasing by 43% from 2002 to 2011 (Sauber-Schatz et al. 2014). A primary reason for the reduction is increased use of child restraint systems, motivated in large part by improved child passenger safety laws and accompanying educational efforts. Bae et al. (2014) tracked changes in child passenger safety laws from 1978 to 2010. They noted that all states adopted and revised child passenger safety laws in this time period, but legislation requirements vary substantially among states with regard to the applicable child population, exemptions, and penalties. Multiple studies have documented increased use of child restraints and decreased rates of injury or fatality after states have upgraded their child passenger safety laws (Brixey et al. 2011; Eichelberger et al. 2012; Farmer et al. 2009; Gunn et al. 2007; Mannix et al. 2012; Pressley et al. 2009; Staunton et al. 2005; Sun et al. 2010; Winston et al. 2007).

As the number of child fatalities and injuries from motor vehicle crashes continues to decrease, it becomes more important to prioritize future child passenger safety efforts that will have the greatest effect on reducing injury risk to optimize

available injury prevention resources. One element to consider is how injury risk would change if more children were properly restrained in comparison to other safety technologies such as advanced crash avoidance systems in vehicles. This article documents an effort to rate child passenger safety laws from 2002 to 2015 relative to current best practice recommendations so that the effect of legislation can be included in models examining the comparative benefits of different safety technologies and practices.

### Definitions

The term *child restraint system* (CRS) encompasses rear-facing-only harnessed child restraints, convertible child restraints with harnesses that can be used rear-facing or forward-facing, combination child restraints that can be used forward-facing with a harness to a particular weight and then converted for use as a belt-positioning booster, and belt-positioning boosters. Belt-positioning booster seats place the child in a better position to achieve optimal restraint from the vehicle seat belt. *Child safety seat* is a legacy term used in some legislation to refer to a harnessed child restraint but not a booster.

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In some states the seat belt law addresses occupant protection requirements for some children. A primary law means that law enforcement officials can stop the vehicle if the seat belt law is the only apparent violation, whereas secondary laws mean that the driver must be violating another traffic law as well as the seat belt law.

### **Best practice**

In 2011, the American Academy of Pediatrics (AAP) and NHTSA updated their best practice recommendations for child passenger safety. They recommend that children use rear-facing harnessed CRS until they outgrow the size guidelines of the product, with the AAP additionally recommending rear-facing restraint at least through age 2 (AAP 2011; NHTSA 2011). These recommendations were based on analysis of U.S. crash data indicating that children up to age 2 in forward-facing child restraints are 1.76 times more likely to experience serious injury than children in rear-facing child restraints, with the analysis showing a more distinct benefit for rear-facing children in side impact crashes (Henery et al. 2007). The main advantage of rear-facing restraints is that the head, neck, and chest are kept generally aligned and protected from large movements relative to the child. This is particularly important for the smallest occupants, whose heads make up a greater proportion of their body mass. Previous recommendations had suggested rear-facing use through age 1 and/or 20 pounds. However, because many U.S. rear-facing CRS can accommodate children up to 30 to 40 pounds rear-facing, there should be products available so that most children up to age 2 can travel rear-facing.

After outgrowing a rear-facing restraint, the next step is to use a harnessed forward-facing child restraint, again until the child outgrows the size limits of the product. Forward-facing child restraints reduce odds of an injury by 78–82% compared to lap-and-shoulder belts (Arbogast et al. 2004; Zaloshnja et al. 2007), providing a greater reduction in injury risk compared to using belt-positioning boosters (described further in the next paragraph). For forward-facing child restraints, restraint is provided by a snug-fitting 5-point harness that keeps the child properly positioned within the structure of the child restraint and reduces the likelihood of occupant contact, in particular head contact, with the vehicle interior. Most forward-facing CRS have a minimum weight of 20 pounds for use in forward-facing mode. Maximum weights for forward-facing harnessed mode range from 40 to 80 pounds.

After children outgrow their harnessed CRS, they should use belt-positioning booster seats. Children aged 4–8 using booster seats have a 55% lower risk of serious injury compared with those using seat belts alone (Arbogast et al. 2009). Effective belt-positioning booster seats raise the child upward and may reroute the vehicle seat belt to achieve good belt fit. An early study of booster seat fit (Klinich et al. 1994) suggested that, on average, children would not have adequate belt fit using only the vehicle seat belt until they reached a stature of 145 cm. More recent studies have demonstrated that even children beyond this stature would also probably have better belt fit when using a belt-positioning booster (Reed et al. 2009). But many state laws use this height as a limit for using belt-positioning boosters below a certain age. Another strategy for assessing readiness to use a

vehicle belt system is the 5-step test (SafetyBeltSafe 2009). To effectively use a seat belt alone, the child should be able to sit so that the buttocks touches the vehicle seatback with the legs hanging comfortably over the seat front, the belt crossing the shoulder between the neck and arm with the lap belt as low as possible touching the thighs; the child should be able to maintain this seated position for the entire trip. The advantage of this method is that it accounts for both the size of the child and the vehicle geometry but is more challenging to include in legislation.

### **Gaps between legislation and best practice**

Some states have chosen to require use of a CRS as directed through a certain age or size (such as a height of 145 cm). This strategy relies on the child restraint manufacturer's instructions to enforce best practice recommendations. Several problems can arise with this approach. For convertible child restraints that can be used rear-facing or forward-facing, manufacturers usually encourage rear-facing use as long as the child fits in the restraint and falls below the rear-facing weight limit. However, they will usually allow use of the forward-facing mode if the child weighs 9 kg (20 lb) and is at least age 1. Thus, in states that specify using a CRS as directed by the manufacturer, a 9-kg (20-lb) 1-year-old child could legally ride forward-facing although this does not follow best practice.

Another potential issue deals with the lower limits of age and weight for belt-positioning booster use. The majority of booster seats allow their use by a child weighing 13.6 kg (30 lb; Stockburger 2013). Some have a lower age limit of 3 years, and some do not specify a lower age limit. In states that specify using a CRS per the instructions, a large 2-year-old could legally use a booster.

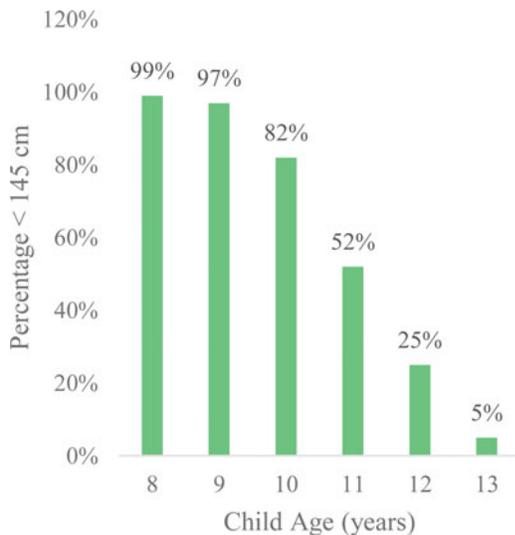
Another issue arises when legislation specifically requires use of a booster seat for a particular age or size of child. Several states specify use of a booster when children reach a weight of 18 kg (40 lb) or are ages 4 to 7 years. However, many of these children would benefit from using a forward-facing harnessed restraint system. If legislation specifies booster use, it could discourage children from using harnessed restraint systems longer, and use of forward-facing harnessed restraints could be considered illegal in some states because of the wording of the legislation.

A similar issue occurs when legislation specifies the age or size when a child can use a seat belt. Best practice recommends that children use a belt-positioning booster seat until they can achieve good fit in only the vehicle seat belt. Although most states allow belt use at age 7 or 8, a substantial number of children older than age 8 would likely have better belt fit in a booster.

## **Methods**

### **Distribution of child sizes**

To examine how age, height, and weight limits specified in different state laws compare to the actual distribution of children by age, height, and weight, the 2001 Centers for Disease Control



**Figure 1.** Percentage of children with stature less than 145 cm at each year of age.

and Prevention growth chart tables were downloaded for analysis (Kuczmarski et al. 2000). Stature by age and weight by age were averaged for girls and boys for each age. For children aged 8 to 13, the percentage of children who are less than 145 cm in height for each age year was calculated. For children 2 to 5, the percentage of children in each age year who weigh less than 13.6, 18, or 23 kg (30, 40, or 50 lb) was calculated.

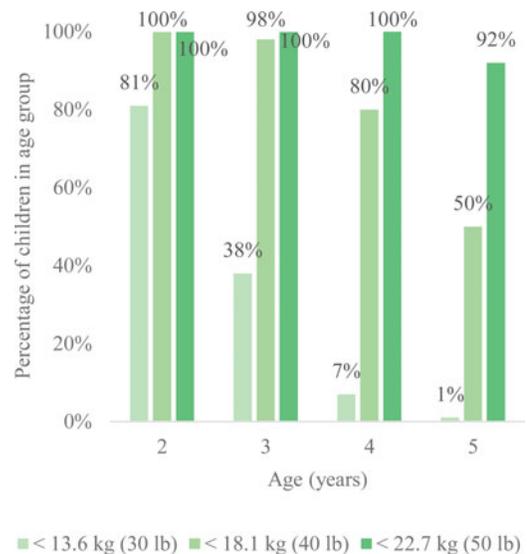
### Child sizes vs. ages vs. best practice

Because best practice depends on children's size as well as age, we present relevant data on height, weight, and age prior to describing details of the scoring scheme. Figure 1 shows the percentage of children aged 8 to 13 who are less than 145 cm (4 ft. 9 in.) in stature. Although most state laws do not require child restraint use beyond age 7, most children aged 8 or 9 and 82% of children aged 10 are likely not tall enough to achieve good belt fit without a belt-positioning booster. When considering only stature distribution, half of 11-year-old children and one quarter of 12-year-old children would also likely benefit from using a booster.

Figure 2 shows the percentage of 2-, 3-, 4-, and 5-year-olds who weigh less than 13.6, 18, or 23 kg (30, 40, or 50 lb). If legislation required use of rear-facing restraints until 13.6 kg (30 lb), this would cover 81% of 2-year-olds, 38% of 3-year-olds, and 7% of 4-year-olds. If legislation did not allow booster use until a weight of 18 kg (40 lb) was reached, half of 5-year-olds, 20% of 4-year-olds, and 2% of 3-year-olds would be able to use a belt-positioning booster.

### Review of laws

Text of state laws governing child passenger safety use was reviewed using the LexisNexis state law database available through the University of Michigan. In some cases, restraint specifications for children fell under the state seat belt law rather than the child restraint law, so these were also reviewed when necessary. The text of each current law was reviewed; earlier versions were reviewed to document changes since 2002. The current child passenger safety requirements for each age of



**Figure 2.** Percentage of children aged 2, 3, 4, or 5 years who weigh less than 13.6, 18, or 23 kg (30, 40, or 50 lb).

child were recorded, as well as the changes in requirements that occurred with each revision of the law. In addition to the type of restraint required, the enforcement level (primary or secondary) was noted. Requirements for sitting in the rear seat were also recorded.

A scoring scheme with ratings from 0 to 4 was developed to rate child restraint laws relative to current best practice recommendations for a particular age. A rating of 3 corresponds to a law that requires a restraint that is sufficient to meet best practice, and a rating of 4 is given to a law that specifies several options that would meet best practice. Scores of 0, 1, or 2 are given to laws requiring less than best practice to different degrees. A score of 0 is given when children could legally ride unrestrained or if children under 2 could legally use a seat belt.

When developing the scoring system, the enforcement level of the law (primary or secondary) and the requirements for seat belt use by row (front only or all) were considered as a way of differentiating among the strength of different seat belt laws. Enforcement level was not considered for children who should be using child restraint systems, because child restraint use is subject to primary enforcement in nearly every state. Several studies show higher rates of belt use in states with primary enforcement (Bhat et al. 2015; Costich and Slavova 2015; Goetzke and Islam 2015; Lee et al. 2015), so we used this approach as a means of describing the strength of the seat belt law as it applies to older child occupants.

### Coding of best practice

Appendix A (see online supplement) summarizes specific wordings from state laws that were the basis for the law score for each age of child. Rationale for the scoring system is presented below.

For 11-, 12-, and 13-year-olds, language that indicates "CRS or seat belt" was aligned with best practice recommendation (score = 3) because some children in this age range would benefit from using a belt-positioning booster as indicated in Figure 1. Laws that require use of a CRS for the smallest children in this age range (such as those under 145 cm in stature or those failing

Table 1. Distribution of law scores by state for 2015.

State	Total score	Child Age (years)													
		1	<1	2	3	4	5	6	7	8	9	10	11	12	13
Alabama	28	3	2	3	3	3	3	1	1	1	1	1	2	2	2
Alaska	38	3	2	2	2	2	4	4	4	2	2	2	3	3	3
Arizona	23	1	1	2	2	2	4	4	4	0	0	0	1	1	1
Arkansas	31	1	1	2	2	2	4	2	2	2	2	2	3	3	3
California	35	1	1	2	2	2	4	4	4	2	2	2	3	3	3
Colorado	45	3	3	4	4	4	4	4	4	2	2	2	3	3	3
Connecticut	31	3	1	2	2	2	2	2	2	2	2	2	3	3	3
DC	37	2	2	2	2	2	4	4	4	2	2	2	3	3	3
Delaware	23	1	1	2	2	2	2	2	2	1	1	1	2	2	2
Florida	15	1	1	2	2	2	4	0	0	0	0	0	1	1	1
Georgia	29	1	1	2	2	2	4	4	4	1	1	1	2	2	2
Hawaii	29	1	1	2	2	2	4	4	4	1	1	1	2	2	2
Idaho	15	1	1	2	2	2	4	0	0	0	0	0	1	1	1
Illinois	29	1	1	2	2	2	4	4	4	1	1	1	2	2	2
Indiana	35	1	1	2	2	2	4	4	4	2	2	2	3	3	3
Iowa	34	3	2	2	2	2	4	2	2	2	2	2	3	3	3
Kansas	29	1	1	2	2	2	4	4	4	1	1	1	2	2	2
Kentucky	25	1	1	2	2	1	3	3	3	1	1	1	2	2	2
Louisiana	32	3	2	3	3	1	2	2	2	2	2	2	3	3	2
Maine	34	2	2	3	3	3	4	4	4	1	1	1	2	2	2
Maryland	35	1	1	2	2	2	4	4	4	2	2	2	3	3	3
Massachusetts	23	1	1	2	2	2	4	4	4	0	0	0	1	1	1
Michigan	29	1	1	2	2	2	4	4	4	1	1	1	2	2	2
Minnesota	29	1	1	2	2	2	4	4	4	1	1	1	2	2	2
Mississippi	21	1	1	2	2	1	2	2	1	1	1	1	2	2	2
Missouri	36	1	1	2	2	3	4	4	4	2	2	2	3	3	3
Montana	15	1	1	2	2	2	4	0	0	0	0	0	1	1	1
Nebraska	23	1	1	2	2	2	4	1	1	1	1	1	2	2	2
Nevada	13	1	1	2	2	2	2	0	0	0	0	0	1	1	1
New Hampshire	26	1	1	2	2	2	4	4	1	1	1	1	2	2	2
New Jersey	23	1	1	2	2	2	4	4	4	0	0	0	1	1	1
New Mexico	35	4	1	2	2	2	4	4	2	2	2	2	3	3	2
New York	19	2	2	2	2	2	3	3	3	0	0	0	0	0	0
North Carolina	35	1	1	2	2	2	4	4	4	2	2	2	3	3	3
North Dakota	33	1	1	2	2	2	4	4	2	2	2	2	3	3	3
Ohio	31	1	1	2	2	1	3	3	3	2	2	2	3	3	3
Oklahoma	37	4	4	2	2	4	4	4	4	1	1	1	2	2	2
Oregon	43	4	3	3	3	3	4	4	4	2	2	2	3	3	3
Pennsylvania	25	1	1	2	2	1	3	3	3	1	1	1	2	2	2
Rhode Island	29	1	1	2	2	2	4	4	4	1	1	1	2	2	2
South Carolina	28	3	2	3	3	3	3	1	1	1	1	1	2	2	2
South Dakota	11	1	1	2	2	2	0	0	0	0	0	0	1	1	1
Tennessee	35	3	3	3	3	1	3	3	3	3	2	2	2	2	2
Texas	29	1	1	2	2	2	4	4	4	1	1	1	2	2	2
Utah	29	1	1	2	2	2	4	4	4	1	1	1	2	2	2
Vermont	39	4	2	2	2	2	4	4	4	2	2	2	3	3	3
Virginia	29	1	1	2	2	2	4	4	4	1	1	1	2	2	2
Washington	35	1	1	2	2	2	4	4	4	2	2	2	3	3	3
West Virginia	29	1	1	2	2	2	4	4	4	1	1	1	2	2	2
Wisconsin	39	3	3	4	4	4	4	4	4	1	1	1	2	2	2
Wyoming	27	1	1	2	2	2	4	4	4	4	0	0	1	1	1

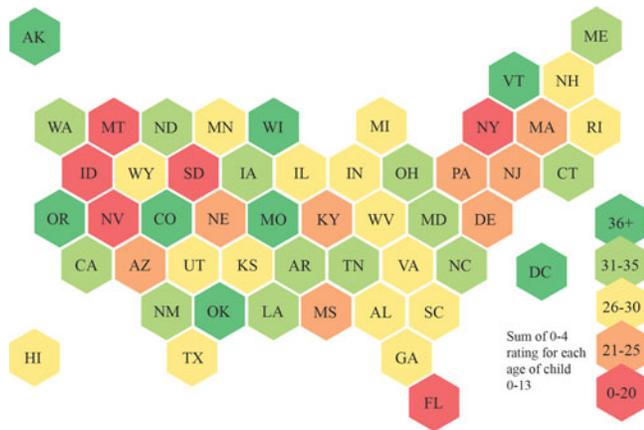
Note. Lowest to highest scores shaded from red, orange, yellow, light green, green.

the 5-step test) would receive a score of 4. Legislation that specifies seat belt use as the only option for this age group received a score of 2, because use of a booster might be interpreted as being illegal. If seat belt enforcement is secondary but required in all positions, it received a score of 1; if seat belt enforcement is required only in the front seat (with primary or secondary enforcement) it received a score of 0.

For 8-, 9-, and 10-year-olds, use of only a seat belt was considered best practice if children were tall enough to achieve good belt fit. However, given the stature distribution shown in Figure 1, legislation that specifies CRS or booster use for children in this age group unless they achieve good belt fit was considered sufficient to meet best practice and receive a score of 3; a height threshold of 145 cm would be a reasonable simplified

criterion. Language allowing “seat belt or booster” or “seat belt or CRS” received a score of 2. Specifying only seat belt use received a score of 1 (because it does not suggest a booster or CRS as a possible option). Laws with secondary enforcement or front-seat-only use of seat belt received a score of 0. A score of 4 was given if a state requires harnessed restraint use for this age group.

For 5-, 6-, and 7-year-old children, laws that require booster use (to 145 cm or 36 kg [80 lb]) were considered to be sufficient to reflect best practice and receive score of 3. Laws that specify CRS use, or CRS or booster use, received a score of 4, because they also suggest that harness child restraints may be beneficial. Legislation specifying seat belt use or CRS/booster use received a score of 2, as did laws that only require booster use or CRS use to a weight of 27 or 29 kg (60 or 65 lb). If only seat belt use is



**Figure 3.** Total score of state ratings of child passenger safety laws relative to best practice recommendations for each age of child in 2015.

specified for this age range it received a 1; if enforcement is secondary or restraint is only required in the front seat it received a 0.

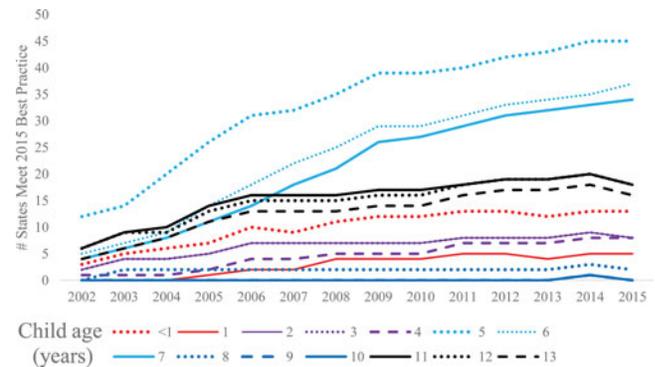
Because best practice recommendations call for delaying booster use at least until 18 kg (40 lb; because all forward-facing harnesses can accommodate children to this weight or higher), when referring to Figure 2, all children aged 2 or 3 years should be in harnesses. In addition, most 4-year-old children weigh less than 23 kg (50 lb) and many forward-facing harnesses can accommodate children to this weight. Thus, legislation requiring use of a forward-facing harnesses child restraint system for children aged 2 to 4 years would receive a score of 3. Because 80% of 2-year-olds and 38% of 3-year-olds weigh less than 13.6 kg (30 lb), many could continue to remain rear-facing beyond age 2 with greater safety benefits. Legislation indicating rear-facing or forward-facing CRS would receive a score of 4 to reflect this. Laws that allow CRS or booster use for children ages 2–4 received a score of 2. Laws that allow CRS or seat belt for these ages received a score of 1. If enforcement is secondary or restraint is only required in the front seat it received a score of 0.

For children under age 2, laws that use the term rear-facing received a score of 3. If a child must remain rear-facing to age 1 regardless of weight, the score would be 4 for a child less than 1 year. If a child must remain rear-facing to age 2, the score would be 4 for a child aged 13 to 23 months. Legislation requiring a harnesses child restraint received a score of 2, and laws specifying use of a CRS received a 1. Laws requiring child restraint use in only the front seat or allowing use of a seat belt received a 0.

## Results

### Distribution of law scores

Table 1 shows the scores by age for each state in 2015. In addition to the score for each age, the first column totals the scores for all ages. The distribution of total scores is plotted geographically in Figure 3. Figure 4 shows trends in legislation since 2002 for each age of child by indicating the number of states each year where child passenger safety laws meet or exceed current best



**Figure 4.** Number of states meeting/exceeding current best practice recommendations by child age for years 2002–2015. Best practice by age group = Rear-facing (red), forward-facing (purple), child restraint system (light blue), child restraint system (blue), seat belt or child restraint system (black).

practice recommendations for restraint use. Future updates to law scores will be posted at [CPSBestPractice.org](http://CPSBestPractice.org) (Klinich and Manary 2016).

## Discussion

This study has developed a quantitative rating system of the strength of child restraint laws relative to current best practice recommendations. A benefit of the rating system is that it uses the same scale for each age of child even though recommendations for best practice vary with age. The process examined the language used among laws and awarded higher scores for phrasing that was more specifically associated with best practice recommendations. The results allow use of the law strength as a predictor in numerical models to examine factors affecting child restraint use and injury risk.

Some legislatures have tried to simplify the wording of the child passenger safety laws by specifying that children should use child restraint systems as directed until the child reaches a particular age. Though instructions on child restraints always include recommendations for best practice, they still allow use of products under conditions that do not meet best practice in an effort to make their product appeal to a wider range of consumers. For example, most convertible child restraints allow use rear-facing to a weight of 18 kg (40 lb) but allow forward-facing use at 9 kg (20 lb) if the child is at least age 1. Another example is allowing booster use by children who weigh 13.6 kg (30 lb) without specifying a lower age limit. Until there are greater restrictions on how child restraint manufacturers can label their products, legislation may be a more effective way of encouraging best practices in restraining child occupants.

Currently, no states require use of a booster seat beyond the age of 8, even though over 90% of children aged 8 to 10 likely need a belt-positioning booster to achieve acceptable belt fit. However, there are currently 18 states where the law indicates that children older than age 11 should use a seat belt or child restraint system. This wording suggests the possibility that older children might benefit from using a child restraint and was rated higher than states indicating that only seat belt use is allowed for these children.

When developing the scoring system for children under 2, we focused on differentiating between laws that use the word *rear-facing*, those that required harnessed restraint use, and those that specified using child restraint systems as directed. At the start of this project, the best laws required rear-facing CRS use to age 1 and 9 kg (20 lb), which includes some children over age 1, so we chose to award these laws a score of 3 because they include best practice language about rear-facing, even if they did not cover all of the children who are recommended to be rear-facing. In May 2015, Oklahoma became the first state to legislate rear-facing child restraint use up to age 2.

The review of recent state laws regarding child passenger safety showed that wording differs among all states. Including best practice recommendations in state child restraint laws provides an opportunity to educate drivers, while resolving issues with manufacturers' instructions that do not specify lower age limits or sizes consistent with best practice recommendations. An issue frequently seen is that wording in some legislation may encourage the driver to allow child passengers to prematurely move on to the next step in child restraint products. Recommendations to avoid this are listed below.

- Avoid wording that lets children under 5 use a booster seat.
- Avoid wording that says that children over 4 must use a booster seat; some may still benefit from using a harnessed seat.
- Avoid wording that says that children over 7 must use a seat belt; many may still benefit from using a booster.
- Avoid wording that says that children 2–4 must be forward-facing; some may benefit from being rear-facing.

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## References

- American Academy of Pediatrics, Committee on Injury, Violence, and Poison Prevention. Policy statement: child passenger safety. *Pediatrics*. 2011;127:788–793.
- Arbogast KB, Durbin DR, Cornejo RA, Kallan MJ, Winston FK. An evaluation of the effectiveness of forward facing child restraint systems. *Accid Anal Prev*. 2004;36:585–589.
- Arbogast KB, Jermakian JS, Kallan MF, Durbin DR. Effectiveness of belt positioning booster seats: an updated assessment. *Pediatrics*. 2009;124:1281–1286.
- Bae JY, Anderson E, Silver D, et al. Child passenger safety laws in the United States, 1978–2010: policy diffusion in the absence of strong federal intervention. *Soc Sci Med*. 2014;100:30–37.
- Bhat G, Beck L, Bergen G, Kresnow MJ. Predictors of rear seat belt use among US adults, 2012. *J Safety Res*. 2015;53:103–106.
- Brixey SN, Corden TE, Guse CE, Layde PM. Booster seat legislation: does it work for all children? *Inj Prev*. 2011;17:233–237.
- Costich JF, Slavova SS. Using enforcement and adjudication data to assess the impact of a primary safety belt law. *Traffic Inj Prev*. 2015;16:664–668.
- Eichelberger AH, Chounard AO, Jermakian JS. Effects of booster seat laws on injury risk among children in crashes. *Traffic Inj Prev*. 2012;13:631–639.
- Farmer P, Howard A, Rothman L, et al. Booster seat laws and child fatalities: a case-control study. *Inj Prev*. 2009;15:348–350.
- Goetzke F, Islam S. Determinants of seat belt use: a regression analysis with FARS data corrected for self-selection. *J Safety Res*. 2015;55:7–12.
- Gunn VL, Phillippi RM, Cooper WO. Improvement in booster seat use in Tennessee. *Pediatrics*. 2007;119:e131–e136.
- Henry B, Sherwood CP, Crandall JR, et al. Car safety seats for children: rear facing for best protection. *Inj Prev*. 2007;13:398–402.
- Klinich KD, Manary MA. 2016. Child Passenger Safety: Rationale for Best Practice. CPSBestPractice.org. Accessed June 1, 2016.
- Klinich KD, Pritz HB, Beebe MS, et al. *Study Of Older Child Restraint/Booster Seat Fit And NASS Injury Analysis*. East Liberty, OH: NHTSA, Vehicle Research and Test Center; 1994. DOT/HS 808 248.
- Kuczumarski RJ, Ogden CL, Grummer-Strawn LM, et al. *CDC growth charts: United States. Advance data from vital and health statistics*; no. 314. Hyattsville, MD: National Center for Health Statistics; 2000.
- Lee LK, Monuteaux MC, Burghardt LC, et al. Motor vehicle crash fatalities in states with primary versus secondary seat belt laws: a time-series analysis. *Ann Intern Med*. 2015;163(3):184–190.
- Mannix R, Fleegler E, Meehan WP III, et al. Booster seat law and fatalities in children 4 to 7 years of age. *Pediatrics*. 2012;130:996–1002.
- NHTSA. Car seat recommendations for children. 2011. Available at: <http://www.safercar.gov/parents/Car-Seat-Safety.htm>. Accessed June 1, 2016.
- Pressley JC, Trieu L, Barlow B, et al. Motor vehicle occupant injury and related hospital expenditures in children aged 3 years to 8 years covered versus uncovered by booster seat legislation. *J Trauma*. 2009;67(Suppl):S20–S29.
- Reed MP, Ebert SM, Sherwood CP, et al. Evaluation of the static belt fit provided by belt-positioning booster seats. *Accid Anal Prev*. 2009;41:598–607.
- SafetyBeltSafe. *Boosters Are for Big Kids*. 2009. Technical Bulletin #630. Torrance, CA: SafetyBeltSafe USA.
- Sauber-Schatz EK, West BA, Bergen GB. Vital Signs: restraint use and motor vehicle occupant death rates among children aged 0–12 years—United States, 2002–2011 *MMWR Morb Mortal Wkly Rep*. 2014;63:113–118.
- Staunton C, Davidson S, Kegler S, et al. Critical gaps in child passenger safety practices, surveillance, and legislation: Georgia, 2001. *Pediatrics*. 2005;115:372–379.
- Stockburger J. Minimum weight limits on some booster seats may put a child at risk. *Consumer Reports*. April 10, 2013. Accessed June 1, 2016.
- Sun K, Bauer MJ, Hardman S. Effects of upgraded child restraint law designed to increase booster seat use in New York. *Pediatrics*. 2010;126:484–489.
- Winston FK, Kallan MJ, Elliott MR, et al. Effect of booster seat laws on appropriate restraint use by children 4 to 7 years old involved in crashes. *Arch Pediatr Adolesc Med*. 2007;161:270–275.
- Zaloshnja E, Miller TR, Hendrie D. Effectiveness of child safety seats vs. safety belts for children aged 2 to 3 years. *Arch Pediatr Adolesc Med*. 2007;161:65–68.