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Child passenger safety: protecting your patients on every trip

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Motor vehicle crashes continue to be the leading cause of death and acquired disability for children < 19 years old in the United States,[1] and road traffic injuries account for more than 260,000 pediatric deaths worldwide each year.[2] Fortunately, for children who are too small for adult seat belts, child safety seats (CSS), in the form of either a harness-based restraint or belt-positioning booster seat, can significantly reduce the risk of injury and death[3-5] in a crash by helping to distribute forces over hard, bony surfaces and preventing ejection from the vehicle. Substantial increases in child restraint use in the United States over the past 10 years[6,7] have led to a reduction in pediatric crash-related deaths by almost 50%.[8] To achieve this, U.S.-based pediatricians, educators, governments and others have coordinated efforts and developed consistent messaging to meet the traffic safety needs of families.

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The following evidence-based prioritized list has served as the common child passenger safety message for families: 1) use a restraint on every trip, 2) keep children under 13 years old in the rear of the vehicle, 3) use the appropriate restraint for the child's age and size, and 4) use the restraint correctly.[9] While promoting restraint use on every trip is the highest priority, rear seating with appropriate and correct restraint use is also necessary for optimal protection: the right seat used at the right time in the right way. This is important since CSS misuse in any form can lead to increased risk of serious injury or death.[4,5] The term "misuse" covers the broad range of improper use of CSS including: 1) incorrect restraint selection for the child, 2) loose or incorrect CSS-to-vehicle attachment, and 3) loose or incorrect restraint of the child in the CSS. CSS misuse in the United States is very common, and most frequently occurs in the form of incorrect seat selection, loose attachment of the seat to the vehicle, either by the vehicle belt or Lower Anchors and Tethers for Children (LATCH) straps, tether non-use, and improper harness use.[10,11]

It is with the U.S. experience in mind that Oliveira et al.[12] present "Child safety seat usage errors in under-4s," to highlight the need to focus the attention of the Brazilian community on consistent, appropriate and correct use of child restraint systems. In their observational study of child restraint use among 324 children 0-4 years old attending 32 Brazilian daycares, they found high rates of misuse: nearly 43% of the children were in incorrectly used child seats (either the wrong restraint for the child, or grossly observable restraint misuse/non-use). Although these observations were made in 2007 when Brazilian child passenger safety laws were in their infancy, it is likely that without specific interventions, CSS use may increase but misuse will remain prevalent. Understanding risk factors for child seat misuse and barriers for proper use is important for developing interventions to maximize the safety of children in vehicles. In their study, Oliveira et al. found that usage errors were influenced by the presence of multiple children in the vehicle, parental educational level, and parental income, similar to the factors found in the United States.[13] Given the similarities between

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the state of child passenger safety in these two countries, the U.S. experience may be helpful for informing safety planning in Brazil.

Research in the United States has revealed barriers to CSS use including inadequate parent knowledge (about the current child passenger safety recommendations and the potential for crash-related injury), limited access to CSS (due to low availability and/or cost) and low self-efficacy in the use of child restraint systems for their children (not able to correctly use the seat).[14] Similar issues were discovered in Beijing, China[15] and will likely be relevant in the Brazilian population where they will need to be addressed in educational campaigns and community interventions. Additionally, surveillance of child restraint patterns, correlating patterns of child seat misuse, and subsequent effects on injury risk will be important, particularly given the continuous evolution in legislation, policy, car seat design and availability, vehicle design, pediatric anthropometry, and trends in parental behaviors over time.

Child passenger safety legislation will likely have a significant impact, as it did for U.S.-based pediatric safety practices[16] and injury rates, because caregivers view laws as a positive factor for increasing car seat use.[17] In 1978, the first U.S. CSS law was implemented for children less than 4 years following advocacy by a Tennessee pediatrician, Dr. Robert Sanders.[18] Since 1985, all 50 U.S. states and the District of Columbia have passed legislation mandating the use of CSS.[19] In addition to new laws, there have been changes in recommendations for best practices in child. Most recently, the American Academy of Pediatrics (AAP) released a policy statement[9] with an accompanying technical report[20] which summarized new algorithm-based recommendation and provided evidence to support these best practices. One of the notable changes from prior recommendations was that all infants and toddlers should ride in a rear-facing CSS until they are 2 years of age *or* until they reach the highest weight or height allowed by their car safety seat's manufacturer. This was based on U.S. data[21] and extensive experience in Sweden where crash-related fatalities for young children are nearly non-existent.[22] A second updated recommendation was that 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 57 inches (145 cm) in height and are between 8 and 12 years of age. This can help prevent serious injuries from improper lap and/or shoulder belt placement.[5] Laws and guidelines in the United States helped to create common messaging delivered by pediatricians and the various groups interacting with the families about child safety.

These changes in legislation and policy were accompanied by a dramatic rise in number and breadth of available CSS, reducing the barrier of access to CSS noted by parents. As an example, the number of child restraints suitable for children 1 to 4 years in the U.S. market increased by nearly 50% between 2000 to 2010.[23,24] Changes in CSS design and vehicle restraint systems have also evolved over time. Most notable is the LATCH system, designed to standardize the manner in which CSS are attached to vehicles without the use of the vehicle belt. Since September 2002, hardware components for the LATCH system have become mandatory for all CSS and new vehicles in the United States. Even though the LATCH system has superior sled test performance,[25] it has had faced challenges from both a design and real-world implementation experience. A recent analysis by the U.S.-based Insurance Institute for Highway Safety evaluated the rear seat designs in 98 vehicles, and found that only 21 had child restraint attachment hardware that met the authors' easy-installation criteria for depth, clearance and force.[26] Overall, the addition of LATCH has increased options for CSS use and, therefore, opportunities for misuse. As in the United States, Brazilian child safety experts will need to remain current on the latest technologies and their associated benefits and challenges to child protection.

Another significant influence on child passenger safety has been the emerging obesity epidemic. While there is some evidence that overweight children may be at increased risk for crash-related injury in certain body regions,[27] those in an appropriate restraint for their weight are well-protected in crashes.[28] The main concern is that parents of overweight children may inappropriately graduate them early to an incorrect restraint for their size, thereby increasing their crash-injury risk. This concern is relevant in Brazil and other developing countries where pediatric obesity is increasingly prevalent.[29]

Finally, parental behaviors have changed over time. The first parents (or societies) to restrain their children following a new law or recommendation (i.e., "early adopters") likely have different safety-relevant characteristics than later adopters of child restraints. Therefore, later adopters may have a higher baseline crash risk or be involved in more serious crashes when they occur.[30] Early adopters may have more favorable socioeconomic characteristics and more positive attitudes toward innovations, whereas later adopters may be unaware/skeptical of child restraint effectiveness or may not like the authoritarian nature of laws. Preventive innovations, such as child restraint systems, have a slower rate of adoption than incremental innovations (i.e., those with more immediate rewards) because the relative advantages of preventive innovations may seem abstract or may still be unknown. This is particularly true for relatively rare events, such as crash-related injury, as parents may have difficulty understanding their probability of injury risk in the absence of a crash. As a result, it will be important to continue to monitor and evolve messaging to ensure that safety messaging remains relevant to the population.

While there continue to be significant advances in child passenger safety, it is constantly evolving through

legislation, policy, technology, and human factors. Improved crashworthiness and innovations in restraint systems are countered by threats to safety such as distracted driving and fleets of smaller vehicles. Additionally, rapidly developing countries such as Brazil are experiencing a mismatch between increasing vehicle use and a relative lack of an accompanying passenger safety initiative. To this end, the World Health Organization along with the United Nations General Assembly has proclaimed 2011-2020 the Decade of Action for Road Safety, with a corresponding framework for countries and communities to increase action to save lives on the world's roads. One of their pillars of activities specifically addresses the establishment of data systems for on-going monitoring and evaluation.[31] It is important that such data systems recognize the unique needs of children and collect child-specific crash data in order to monitor the epidemiology of car seat use and misuse, crashes involving children, and their subsequent injuries. It is critical that the child passenger safety community understands barriers to proper restraint of children and targets influential stakeholders. Maximizing the use of proper restraints is fundamental and essential in order to protect every child on every trip.

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