SAFE KIDS WORLDWIDE™

Child Passenger Safety

Impact of Safe Kids Buckle Up Inspections on Caregiver Knowledge, Confidence and Skill

August 2017

Executive Summary

Advancements in technology, legislation and public education have increased child passenger over the last few decades. Despite this, every day one child dies, and another ten suffer injuries severe enough to require hospitalization following a motor vehicle crash (MVC).

The Safe Kids Buckle Up (SKBU) program, sponsored by General Motors for the past 20 years, has been using certified child passenger safety technicians (CPSTs) to teach caregivers how to correctly install child restraint systems (CRSs) and has documented more than 2 million CRS inspections. In 2016, we replicated a 2005 study examining the impact of SKBU child passenger safety inspections on caregiver knowledge, skill and confidence with installing their child's CRS in their own vehicle.

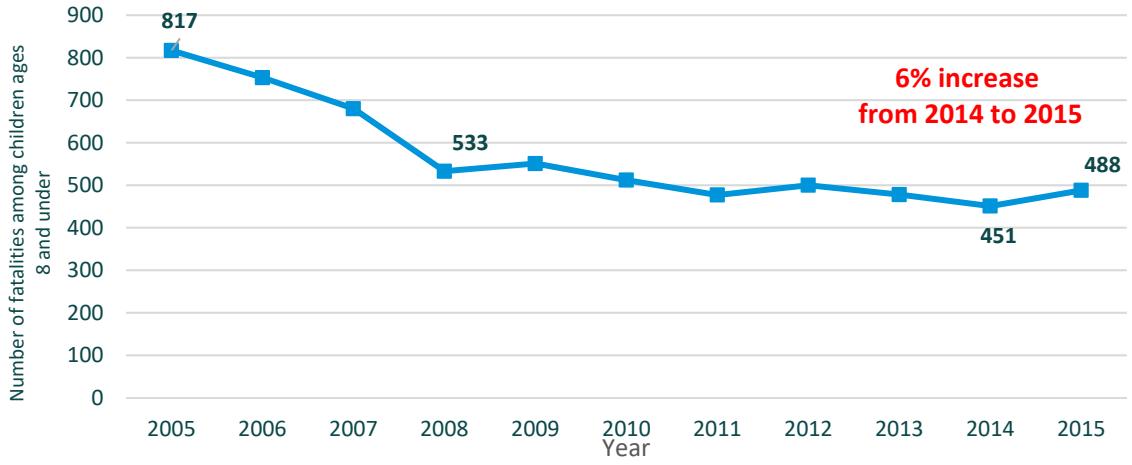
The 2016 results confirmed that hands-on education by CPSTs at SKBU inspections increases caregiver knowledge, skill and confidence therefore leading to safer transport of their children. Our findings also suggested that SKBU inspections are effective in increasing caregiver skills regardless of their educational level. However, the study also highlighted several areas where little progress has been made between 2005 and 2016, including tether use, correct use of seat belts and harnesses and knowledge regarding the risks of second hand CRS use. These are all areas where technological advances and/or educational enhancements could lead to further improvements. Thus our recommendations include further research to better understand reasons for non-use and misuse, enhancing CPST training, engaging vehicle and CRS manufacturers on ways to enhance technology and educational resources and collaborating with advocacy groups in multiple sectors to ensure caregivers get consistent accurate on CRS and the importance of having their CRS checked by a certified CPST.

Introduction

Since the first safety belt was introduced in the 1950s and the first child restraint system[i] (CRS) was designed for crash protection in 1968, CRSs have become more effective at securing and stabilizing children in vehicles, as well as more user-friendly for caregivers.[1-7] Between 1994 and 2014, the MVC fatality rate among children 8 years and under decreased by more than half, from 23.5 to 10.5 per 100,000 children[8], and the National Highway Traffic Safety Administration (NHTSA) estimates that CRSs have saved 10,940 lives in this age group since they began tracking lives saved in 1975.[9]

In 2015, MVCs claimed the lives of 488 children 8 years and under and led to 3,722 hospitalizations and more than 72,000 Emergency Department visits in that same age group.[8,10] Among the fatalities in this age group in 2015, a quarter of children were unrestrained. Further, the number of deaths in 2015 represented a 6 percent increase over 2014 (Figure 1).[8]

Figure 1. After a 10-year decrease of 53 percent, motor vehicle fatalities among children age 8 and under increased 6 percent from 2014 to 2015[8]



Child restraint systems, when used correctly, have been shown to decrease the risk of a fatal injury by 71 percent among infants, 54 percent among toddlers and 45 percent among children ages 4 to 8 years.[1-2] However, studies examining installation of CRSs have reported misuse rates of between 46 to 95 percent.[4,11-12] Previous research looking to understand these high rates of misuse suggests that installation is a physically demanding, complex process possibly made more complicated by manufacturer's installation instructions that require a reading level that exceeds that of most American consumers.[13-14] In addition, physical incompatibilities are often found between CRSs and vehicles.[15]

One example of a technology designed to make CRS use easier was the introduction of the Lower Anchor and Tether for Children (LATCH) system in 1999. LATCH, which bypasses use of the available seat belt completely, was meant to simplify CRS installation, decrease misuse and

[i] Child Restraint Systems (CRS) refers to both car seats with a harness and belt positioning booster seats

provide increased stability in the event of a crash.[5-7] As of September 2002, all new vehicles and CRSs are required to provide a standardized system to anchor CRSs to the vehicle.[6] Two LATCH anchors are available in most passenger vehicles, but vary by seating position location and by vehicle model. This requires caregivers to use their vehicle owner's manual to identify the LATCH positions for a CRS. CRSs are also equipped with LATCH attachments to connect the CRS to the factory installed vehicle lower anchors and top tether (typically for forward-facing children over age 2 years). Rear-facing children under age 2 years use a CRS with lower attachments only or the seat belt. This variability and complexity of choosing and using LATCH over seat belt often confuses caregivers.

Today, with more than 30 manufacturers producing many variations and styles of CRS, understanding which one is best for a child and how to appropriately and safely install it is a daunting task for any parent.[16] Hands-on individualized training on CRS installation by an expert has been found to significantly reduce installation errors compared to use of the manufacturer's manual alone.[12,17-18] In fact, installation and training with a Child Passenger Safety Technician (CPST) certified by an accredited body such as Safe Kids Worldwide is considered the "gold standard" for correct installation of CRSs.[19]

The Safe Kids Buckle Up (SKBU) program, sponsored by General Motors for the past 20 years, has been using certified CPS technicians to teach caregivers how to correctly install CRSs and has documented more than 2 million CRS inspections. An evaluation of SKBU check-up events in 2005[ii] found an increase in caregiver knowledge, confidence and skill when installing a CRS at six weeks following a check-up event.[20] In light of significant technological advances in CRS design, updated guidance on installation and CRS use from the American Academy of Pediatrics[21] (AAP) and NHTSA and increased efforts to raise awareness and educate families on that guidance since 2005, Safe Kids Worldwide undertook to replicate the study in 2016. In partnership with the National Safety Council and with sponsorship from NHTSA, we examined the impact of SKBU child passenger safety inspections on caregiver knowledge, skill and confidence with installing their child's CRS in their own vehicle and compared findings to the 2005 study results.

Study Findings

Study Sample

The majority of the 236 caregivers who participated in the 2016 study were non-Hispanic/Latino Caucasian mothers under age 40. The racial and ethnic profile of the 2016 participants more closely represents the U.S. population than the 2005 study sample did, however a higher proportion had a bachelor's degree or higher (54 versus 45 percent, respectively). Participants in 2016 represented 22 states compared to 29 in the 2005 study, however the 2016 sample did cover all four U.S. Census geographic regions, with the largest proportion from the South and urban settings.

Almost 7 out of 10 caregivers indicated they were attending the check-up event to ensure that everything was okay with their child's CRS. About 20 percent said they came because they recently purchased a new CRS and wanted to verify they were using it correctly.

[ii] While the study report was released in 2007, the data collected reflect the situation in 2005.

Participants' children ranged in age from 1 week to 7 years (average 25 months) and upon arrival at the baseline inspection, 51 percent were in a rear-facing seat, 41 percent in a forward-facing seat with harness, 4 percent were in a belt-positioning booster and 1 percent were restrained with only a lap/shoulder belt. A full description of study methods and the study sample from 2016 are included in Appendix A.

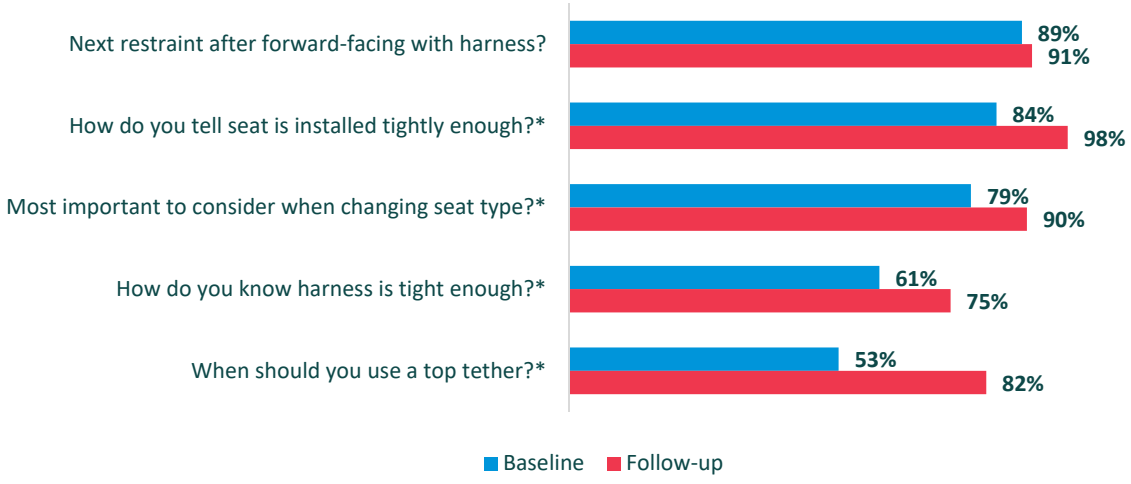
Caregiver Knowledge

In 2016, five questions related to CRS use and safety were used to assess caregiver knowledge. Given changes in practice since the 2005 study, only one question overlapped between the two studies.

We found that caregiver knowledge varied by question in 2016, and that there was a statistically significant gain in knowledge from baseline to follow-up for four of the questions. The questions with the highest proportion of incorrect answers at both baseline and follow-up occurred for items addressing the harness and top tethers (Figure 2). While there were significant increases in the number of correct responses for both questions at follow-up, 1 out of 4 caregivers still did not correctly identify the criteria for a tight harness and nearly 2 out 10 caregivers did not know when to use a top tether.

We found no significant difference in the proportion of parents who correctly answered the question asking how you can tell if a child's seat is installed tightly enough between the 2005 and 2016 samples at either baseline or follow-up.

Figure 2. The proportion of caregivers correctly answering knowledge questions increased for four of the five questions in 2016



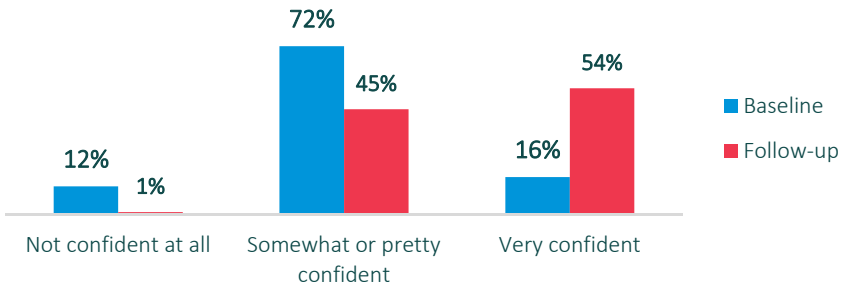
* Indicates statistically significant change in proportion from baseline to follow-up.

Caregiver Confidence

To measure caregiver confidence, we asked participants how confident they felt about their ability to correctly install their own child's CRS on their own, without the help of another person. At baseline about 7 in 10 caregivers reported they were "somewhat" or "pretty" confident and only 16 percent indicated they were "very" confident (Figure 3). Higher levels of confidence were reported by those with lower levels of education and those who identified themselves as the primary person responsible for installing the CRS. Lack of confidence, on the other hand, was associated with having recently purchased a new car, needing to change the direction of the CRS from rear-facing to forward-facing, use of lower anchors for installation and being a grandparent.

At follow-up, the proportion of caregivers who felt "very" confident more than tripled from 16 to 54 percent. In addition, the proportion who said they were "not at all" confident decreased from 13 to one percent. The increase in confidence experienced by caregivers in 2016 was significantly greater than the increase reported in 2005.

Figure 3. Caregiver confidence increased following participation in a SKBU inspection in 2016



Caregiver Skill

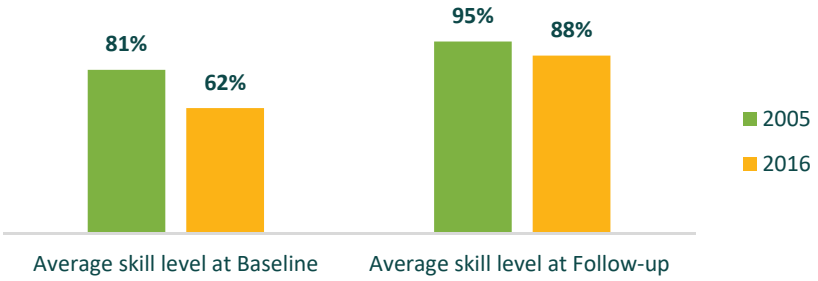
Caregiver skill in CRS installation was scored out of a possible 100 points for each method of attachment (e.g., lower anchors or seat belt) and CRS type (e.g., rear facing only, convertible, etc.). At baseline, caregivers scored an average of 62/100 for installing their child's CRS into their own vehicle, and we found a significant increase in average skill level to 88/100 at follow-up. Average skill level increased for almost all methods of attachment and CRS types. The exception was forward-facing seats attached to lower anchors without a tether.

Our data showed that caregivers with lower levels of education had lower skill levels at baseline, and this was statistically significant. However, at follow-up we no longer found a significant relationship between education and skill, suggesting that SKBU inspections are effective in increasing skill regardless of caregiver education level. While the average skill levels at baseline and follow-up in 2016 were

At follow-up we no longer found a significant relationship between education and skill, suggesting that SKBU inspections are effective in increasing skill regardless of caregiver education level.

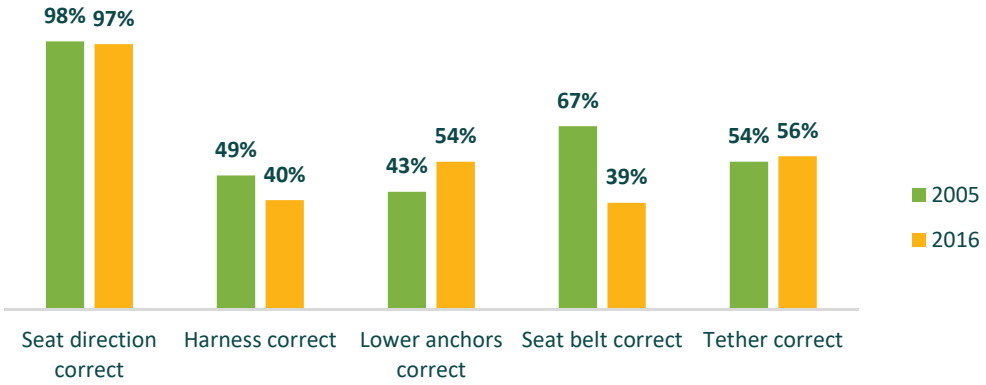
lower than in 2005 (Figure 4), the average improvement was significantly greater in 2016 – 26 percent versus 14 percent.

Figure 4. Average caregiver skill level was lower in 2016 at both baseline and follow-up inspections



In addition to overall skill levels, we also looked at specific CRS installation skills. The greatest number of caregiver errors at baseline in 2016 were related to the CRS harness, lower anchors, seat belt and tether (both rear- and forward-facing seats) (Figure 5). As anticipated, with a higher percentage of vehicles on the road with LATCH in 2016 compared to 2005, more caregivers were using lower anchors with or without a tether in 2016. While the proportion correctly using lower anchors was slightly higher in 2016 than in 2005, this difference was not statistically significant (Figure 5).

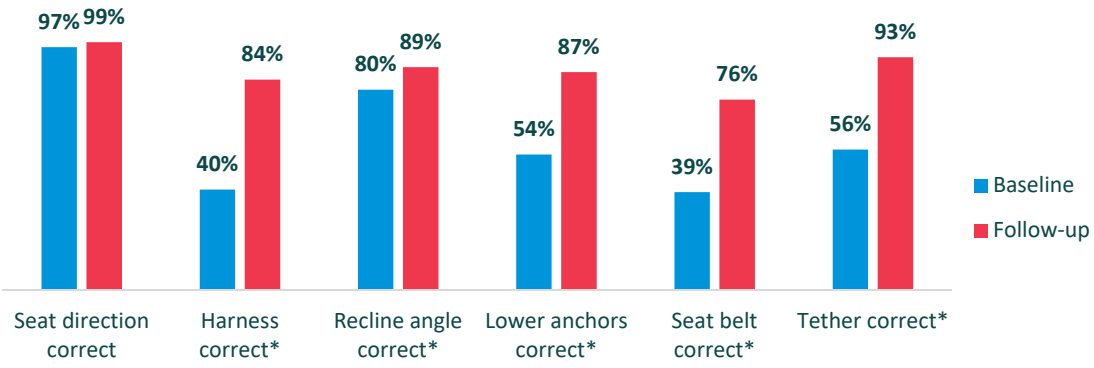
Figure 5. Proportion of caregivers who correctly installed specific aspects of CRS at baseline in 2005 and 2016



* Indicates statistically significant change in proportion from 2005 to 2016.

At follow-up in 2016, the proportion of caregivers who correctly performed each of these individual tasks had increased significantly from baseline (Figure 6). Using the seat belt correctly remained the most difficult skill, with almost 1 in 4 caregivers using it incorrectly at follow-up.

Figure 6. Proportion of caregivers who correctly installed specific aspects of CRS at baseline and follow-up in 2016



* Indicates statistically significant change in proportion from baseline to follow-up.

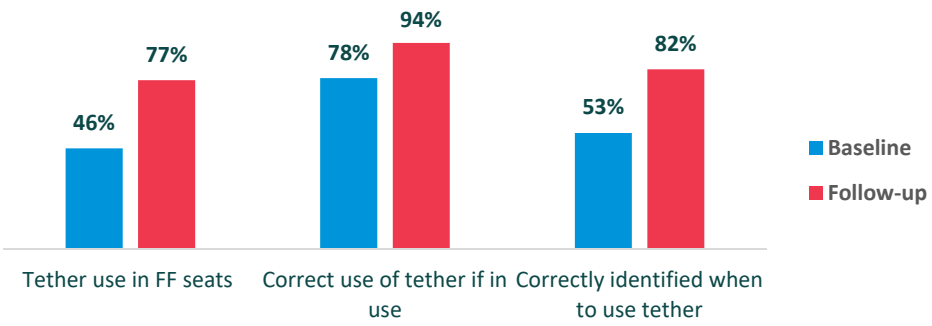
While we did not find a relationship between caregiver levels of skill and confidence at baseline in 2016, at follow-up, caregivers with higher levels of skill also had higher levels of confidence. Although the direction of this relationship is not clear, it is evident from our study that caregivers experience gains in both confidence and skill following participation in SKBU inspections.

Top tethers

Upon arrival at the baseline inspection, less than half of caregivers arriving with a forward-facing seat in 2016 were using top tethers. In addition, of those who were using top tethers with a forward-facing seat, just under 8 out of 10 were using them correctly (Figure 7). Given that just over half answered the knowledge question on tethers correctly, this is not surprising. In fact, caregivers who arrived at baseline using only a seat belt to secure a forward-facing seat were 3.5 times more likely to have answered the tether knowledge question incorrectly. While there was improvement in use, correct use and knowledge of tethers at follow-up, the levels at baseline are concerning.

Top tethers are designed to reduce forward movement of the CRS during a crash or sudden stop, when attached and tightened to the vehicle's tether anchor, thereby providing extra protection to the forward-facing child.[3] The fact that the proportion of caregivers using tethers correctly at baseline in 2016 is similar to the proportion in 2005 suggests little progress has been made in the last decade. This, despite the presence of a tether on every forward-facing CRS model with a harness, at least three top tether anchor points in every vehicle since 2002 and increased focus on labelling, instructions and websites to assist caregivers with CRS installation.

Figure 7. Caregiver use, correct use and knowledge of tethers with forward-facing seats at baseline in 2016



Second-hand CRS

Another important issue is the use of second-hand CRSs. We found that at baseline inspection in 2016, most caregivers were following current guidelines for deciding if their children's CRSs are safe to use with respect to expiration date, labels, recalls and knowing the history of the CRS. However, only 6 out of 10 caregivers knew that it is not safe to use a CRS purchased at a garage sale and there was only a slight increase to 7 out of 10 caregivers at follow-up. The level of knowledge on this issue in 2016 was significantly lower at both baseline and follow-up compared to 2005, suggesting that knowledge of the risks involved in using a second-hand CRS may be less well known today, and that they may not be included or as clearly conveyed during inspections today compared to 2005.

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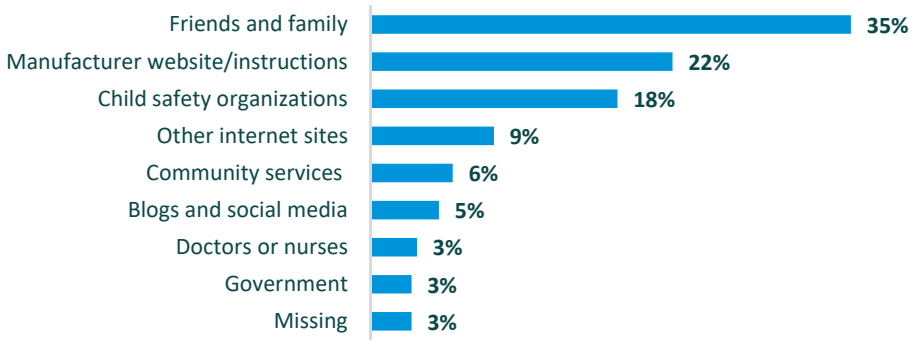
Caregiver Sources of Information on CPS

One area we explored in 2016, not included in the 2005 study, is where caregivers are going for CPS information. We found more than 3 in 10 participating caregivers turn to friends or family, while only 2 in 10 rely on manufacturers' websites or materials when looking for information on CPS (Figure 8). Caregivers ages 20 years or younger were significantly more likely to list friends or family as their source for information compared to older caregivers. This is consistent with research suggesting that younger generations are more likely to rely on their social networks for advice than previous generations.[22-23]

In addition, certain caregiver information sources were significantly correlated with knowledge. For example, caregivers who reported getting CPS information from their friends were more likely to know when a harness was tight enough, but less likely to know when it was appropriate to switch a child from one CRS type to the next. While exploratory, these findings are valuable in that they highlight that some information sources may be helpful or harmful, depending on the specific question and underline the importance of verifying information with manufacturers.

Figure 8. Where caregivers look for CPS information in 2016



Conclusions

Although we found that participation in a SKBU inspection event increased caregiver knowledge, skill and confidence with respect to CRS installation, the results of this study should be generalized with caution for a number of reasons. First, we examined the impact of SKBU inspection events, which may not be representative of all CRS inspections. Second, our sample was a convenience sample of caregivers coming to SKBU inspection events and may not be representative of either all caregivers attending SKBU events or all caregivers with children riding in CRS. Finally, while race and ethnicity have been reported as predictors of CRS misuse in previous studies, they were not significant in our study, which may reflect the small sample size, or the makeup of our sample.

That children in the current study were more often appropriately restrained at follow-up compared to baseline inspections, confirms the findings of the 2005 study that hands-on education by CPS technicians at SKBU inspections does increase caregiver knowledge, skill and confidence and lead to safer transport of their children. Further, the fact that no significant relationship between education and skill levels was found at follow-up inspection, suggests that SKBU inspections are effective in increasing skills regardless of caregiver educational level.

However, the 2016 results do highlight several areas where further attention is needed. Tether use, correct use of seat belts and harnesses and knowledge regarding the risks of second hand CRS use were all at undesirable levels at baseline inspection in 2016, and were not much improved from 2005. All of these are areas where technological advances and/or educational enhancements could lead to further improvements. The CPS community needs to look further into these issues and our recommendations are as follows:

- Conduct focused research that explores caregivers' knowledge and understanding of top tethers, seat belt and harnesses as part of CRS installation, including reasons for non-use and misuse.
- Ensure that educational programs, technical updates and other resources, including NHTSA's Child Passenger Safety Technician (CPST) Training, specifically address how to

effectively communicate the value of top tethers, correct use of seat belts and harnesses to all caregivers who attend inspections.

- Engage both vehicle and CRS manufacturers in discussions on possible technological advances and enhancements to instruction manuals and guidance provided through customer service, instructional videos, websites and other educational avenues to increase visibility and accessibility, use and correct use of top tethers, and, correct use of seat belts and harnesses.
- Collaborate with advocacy groups in the safety, medical, regulatory and education sectors to create, standardize and disseminate clear guidance on these issues and work to ensure that the information that both formal and informal sources are providing to caregivers is accurate and consistent.
- Identify and utilize effective approaches to engaging and utilizing social networks to increase caregiver access to timely, accurate information on CRS and the importance of having their CRS checked by a certified CPST.

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Appendix I

Study Methodology

The study used single group pre-test post-test design with a convenience sample of 236 caregivers recruited through SKBU child safety seat inspections led by 30 Safe Kids coalitions over a nine-month period from April to December 2016. Data on knowledge and confidence were collected using caregiver surveys and data on skill was abstracted from standard checklists completed by certified technicians at SKBU events. Participants completed the pre-survey, then participated in a normal car seat inspection process including teach-back with a certified technician. Six weeks later they returned with the same vehicle, car seat and child and completed a follow-up survey after which the car seat was removed and they were asked to reinstall it. Installation was then checked and documented by a certified technician. This methodology replicated the 2005 evaluation.[20] Non-parametric chi-square tests were performed on matching pairs of data to determine statistically significant changes in knowledge, skills and confidence among participants and multivariate linear and logistic regression models were used to determine significant relationships and predictors. The study was reviewed and approved by the Institutional Review Board at Children's National Health System in Washington, D.C.

Detailed Description of Study Sample

Table 1. Select demographic characteristics of caregivers

	Proportion of caregivers (%)	
	2016 Study Sample	2015 U.S. Population
Gender		
Male	16	49
Female	84	51
Race		
White/ Caucasian	65	81
Black/ African-American	16	13
Asian	6	4
American-Indian/ Alaska Native	1	1
Ethnicity		
Hispanic-Latino	14	13
Not Hispanic-Latino	86	87
Education		
Less than high school graduate	7	13
High school graduate or higher	93	87
Bachelor's degree or higher	54	30

Table 2. Restraint Type

	Baseline, n (%)	**Follow-up, n (%)**
Restraint type on arrival		
Belt-positioning booster	10 (4)	9 (4)
Forward-facing with harness	99 (41)	106 (44)
Rear-facing	121 (51)	122 (51)
Lap/shoulder	3 (1)	0 (0)
Unknown/missing	6 (3)	2 (1)
Total	239	239
Restraint type on departure		
Belt-positioning booster	9 (4)	10 (4)
Forward-facing with harness	105 (44)	104 (44)
Rear-facing	122 (51)	124 (52)
Lap/shoulder	1 (<1)	0 (0)
Unknown/missing	2 (1)	1 (<1)
Total	239	239

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