

ENHANCED CHILD RESTRAINT DATA COLLECTION IN NASS CDS

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Paper Number 05-0216

ABSTRACT

The National Highway Traffic Safety Administration's (NHTSA), National Automotive Sampling System (NASS), has conducted detailed field crash investigations through its Crashworthiness Data System (CDS) since 1988. Each year CDS collects detailed information on a nationally representative, random sample of minor, serious and fatal, police-reported, tow-away traffic crashes involving passenger cars, light trucks and vans. CDS data supports research into the crashworthiness of passenger vehicles and the biomechanics of trauma, development of test equipment procedures and criteria, and the development and support of motor vehicle safety standards for occupant protection and consumer information programs.

Data collection into these real-world crashes involving child occupants provides a unique data set useful to the agency as well as the whole child occupant protection community.

In 2002, new and updated data collection methodologies related to child occupant restraints were incorporated into the NASS, CDS, Electronic Data Collection System. This paper presents a summary of these improved data collection methodologies.

BACKGROUND

The primary impetus behind the CDS was a need for more detailed information on how a vehicle and occupant respond in a crash, and how the interior components of the vehicle injure and/or protect occupants. In 1988, the CDS was initiated with 36 trained field research teams across the country which studied about 7,000 crashes each year. In 2004, the CDS had 27 field research teams and 76 field researchers collecting data from about 5,500 crashes. The CDS currently collects and codes crash information involving over 600 data elements obtained during on-site crash scene inspection and exterior and interior vehicle inspections, interviews with crash victims, along with pertinent medical information. Interviews with crash victims may be

done in person or over the telephone entailing questions dealing with pre and post-crash events involving all occupants of the vehicle. Details regarding the occupant, e.g., seating position, restraint type available, restraint use, along with any available medical/injury information, are collected and coded into each case.

Dating back to 1999, NHTSA has collected about 200 occupied child restraint cases per year involving approximately 250 child restraints each year, (allowing for more than one child restraint per crash). Overall cases involving child restraints make up about 5% of the total number of cases coded in CDS since 1999. The yearly totals dating back to 1999 are listed in Table 1 and shown graphically in Figure 1.

YEAR	TOTAL # OF CDS CASES	CHILD SEAT CASES	# OF CHILD SEATS CODED
1999	4,274	182	230
2000	4,307	210	248
2001	4,090	188	220
2002	4,589	225	279
2003	4,754	219	276

Source: NASS CDS, 1999-2003

Motor vehicle crashes remain a leading cause of death for children of all ages, and according to the Agency's Fatality Analysis Reporting System (FARS), there have been 2,519 passenger vehicle occupant fatalities among children under 5 years of age between 1999 and 2003. Of these 2,519 fatalities, an estimated 1,636 (65 percent) were restrained by either a child seat or a vehicle safety belt system. The FARS data file contains limited information, police accident report (PAR) only, and other official State records, documenting details from all fatal traffic crashes within the 50 states, DC and Puerto Rico. It is in part, due to this lack of detailed information, that the Agency is using its resources within other program areas to acquire and document restraint use data by children in all types of crashes.

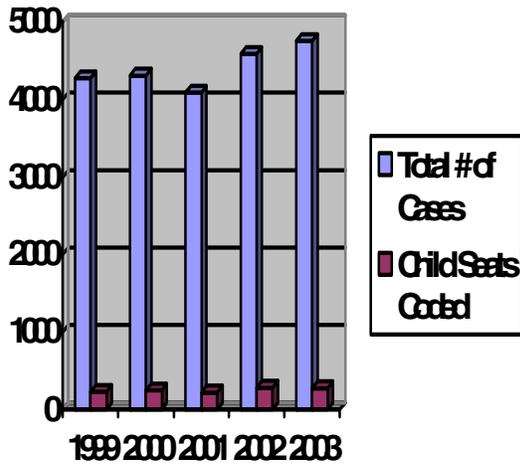


Figure 1. Child Seats Coded within CDS by Year

NHTSA is committed to understanding how child restraint systems perform in real-world crashes. This, coupled with the requirements initiated in the implementation of the Transportation Recall Enhancement, Accountability, and Documentation (TREAD) Act, Section 14, created the need for improved and updated real-world crash data and collection methods related to child occupants. As a result of TREAD, in 2002 the Agency developed enhanced child restraint data collection variables and attributes in an effort to improve data collection regarding the specific types of restraints used by child occupants. Therefore, this paper highlights the efforts to enhance data collection in NASS CDS on child restraints.

INTRODUCTION

Prior to 2002

The Agency's collection of child restraint information prior to 2002 lacked certain detail/specificity necessary to identify the various types of child restraints involved in crashes. The majority of the child restraint "Types" were being coded as "Unknown/Other" due in part to lack of information in the field (e.g., the child restraint had been destroyed and was no longer available for inspection coupled with the fact that the parent/care giver was unfamiliar with the restraint and unable to provide many identifying details).

Only a limited number of variables regarding child seat characteristics and usage were coded prior to 2002, some of which were outdated and no longer reflective of current child restraint types and designs. For example, the attributes for Seat Type were Infant, Toddler, Convertible, Booster, Integral, Other and Unknown.

The predominant means of obtaining child safety seat information was through an interview consisting of seven questions, which could be conducted by telephone or in person. The interview form is shown in Figure 2.

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CHILD SAFETY SEAT INFORMATION			
WAS THERE A PERSON IN A CHILD SAFETY SEAT IN THIS VEHICLE?			
<input type="checkbox"/> YES (IF "YES" COMPLETE THIS SECTION AND OBTAIN IMAGES OF THE SEAT)			
<input type="checkbox"/> NO <input type="checkbox"/> UNKNOWN (IF "NO" OR "UNKNOWN" SKIP THIS SECTION)			
	DRIVER	OCCUPANT # _____	OCCUPANT # _____
MAKE AND MODEL OF THE SAFETY SEAT?			
TYPE OF SEAT?	<input type="checkbox"/> Infant <input type="checkbox"/> Toddler <input type="checkbox"/> Convertible <input type="checkbox"/> Booster <input type="checkbox"/> Integral <input type="checkbox"/> Other Specify: _____ <input type="checkbox"/> Unknown	<input type="checkbox"/> Infant <input type="checkbox"/> Toddler <input type="checkbox"/> Convertible <input type="checkbox"/> Booster <input type="checkbox"/> Integral <input type="checkbox"/> Other Specify: _____ <input type="checkbox"/> Unknown	<input type="checkbox"/> Infant <input type="checkbox"/> Toddler <input type="checkbox"/> Convertible <input type="checkbox"/> Booster <input type="checkbox"/> Integral <input type="checkbox"/> Other Specify: _____ <input type="checkbox"/> Unknown
DIRECTION SEAT WAS FACING PRIOR TO THE CRASH?	<input type="checkbox"/> Front <input type="checkbox"/> Rearward <input type="checkbox"/> Unknown	<input type="checkbox"/> Front <input type="checkbox"/> Rearward <input type="checkbox"/> Unknown	<input type="checkbox"/> Front <input type="checkbox"/> Rearward <input type="checkbox"/> Unknown
VEHICLE'S SEAT BELT USED TO HOLD THE SEAT IN PLACE?	<input type="checkbox"/> No <input type="checkbox"/> Yes * <input type="checkbox"/> Unknown	<input type="checkbox"/> No <input type="checkbox"/> Yes * <input type="checkbox"/> Unknown	<input type="checkbox"/> No <input type="checkbox"/> Yes * <input type="checkbox"/> Unknown
	<input type="checkbox"/> *IF YES: <input type="checkbox"/> WAS LOCKING CLIP USED? <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> Unknown	<input type="checkbox"/> *IF YES: <input type="checkbox"/> WAS LOCKING CLIP USED? <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> Unknown	<input type="checkbox"/> *IF YES: <input type="checkbox"/> WAS LOCKING CLIP USED? <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> Unknown
HOW WAS THE VEHICLE'S SEAT BELT SECURED TO THE CHILD SEAT?	<input type="checkbox"/> Looped through designated rear framing studs <input type="checkbox"/> Looped through arm rest slots <input type="checkbox"/> Belt across safety shield <input type="checkbox"/> Looped through rear frame outside the designated framing studs <input type="checkbox"/> Other (specify): _____ <input type="checkbox"/> Unknown	<input type="checkbox"/> Looped through designated rear framing studs <input type="checkbox"/> Looped through arm rest slots <input type="checkbox"/> Belt across safety shield <input type="checkbox"/> Looped through rear frame outside the designated framing studs <input type="checkbox"/> Other (specify): _____ <input type="checkbox"/> Unknown	<input type="checkbox"/> Looped through designated rear framing studs <input type="checkbox"/> Looped through arm rest slots <input type="checkbox"/> Belt across safety shield <input type="checkbox"/> Looped through rear frame outside the designated framing studs <input type="checkbox"/> Other (specify): _____ <input type="checkbox"/> Unknown
WHAT WAS THE CHILD SEAT EQUIPPED WITH AT TIME OF PURCHASE?	<input type="checkbox"/> Harness <input type="checkbox"/> Shield <input type="checkbox"/> Tether <input type="checkbox"/> Unknown	<input type="checkbox"/> Harness <input type="checkbox"/> Shield <input type="checkbox"/> Tether <input type="checkbox"/> Unknown	<input type="checkbox"/> Harness <input type="checkbox"/> Shield <input type="checkbox"/> Tether <input type="checkbox"/> Unknown
ANY OF THESE ADDED AFTER THEY OWNED THE SAFETY SEAT?	<input type="checkbox"/> Harness <input type="checkbox"/> Shield <input type="checkbox"/> Tether <input type="checkbox"/> None <input type="checkbox"/> Unknown	<input type="checkbox"/> Harness <input type="checkbox"/> Shield <input type="checkbox"/> Tether <input type="checkbox"/> None <input type="checkbox"/> Unknown	<input type="checkbox"/> Harness <input type="checkbox"/> Shield <input type="checkbox"/> Tether <input type="checkbox"/> None <input type="checkbox"/> Unknown
Describe any additional information here:			

Figure 2. Pre-2002 Child Restraint Interview Form

Information regarding the child restraint could be obtained by conducting interviews, both over the phone and in person, as well as from inspecting the child restraint, when available, during vehicle inspections. From these two sources the following information could be coded: Make, Model, Type, Orientation, Harness, Shield and Tether availability. Prior to 2002, a sample of this information is shown in Figure 3 of the "Child Seat Tab" from the NASS data entry program, NASSMain.

Child restraint Proper Use/Misuse information was coded using seat belt variables. There has never been a single variable or attribute, which gave the overall proper/improper use of the child restraint.

Figure 3. Occupant Form, Child Seat Tab Detail

The Proper Use/Misuse variables were defined as: Proper Use of Manual Belt (used properly with child safety seat – indicated when the manual belt was installed so as to comply with the manufacturers directions); and Proper Use of Automatic Belt (used properly with child safety seats – indicated when the automatic belt was installed so as to comply with the manufacturers directions). Proper/improper child seat installation is difficult to ascertain even when the child seat is available for inspection in the crash vehicle, while still installed with the vehicle safety belt system. It proves even more difficult to determine proper/improper use through information obtained by an in-person or over-the-telephone interview only. In addition proper/improper use information was not coded regarding the child seat’s use, design type for child occupant, etc. So often times the proper/improper use information was misinterpreted. It was in part because of these “misinterpretations” that the proper use/misuse attribute was removed from the 2003 CDS file.

METHODOLOGY

Improved Data Collection Methodologies Incorporated in 2002

Improvements in the data collection and coding began with revamping methodologies, one of the first of which entailed developing a new, comprehensive Child Seat Interview Form. The new interview form consists of numerous questions pertaining to various child restraint types, (e.g., infant only, convertible, forward facing only, and belt-positioning booster seat) the parent/caregiver’s knowledge of and familiarity with the child restraint, and its use and

installation. There are also questions regarding information sources the parent/caregiver has used, (e.g., child seat checkpoints/clinics attended, vehicle and child restraint owner’s manuals,) which aided them in the child restraint’s use and installation. A reference sheet with various child restraint graphics is also part of the interview. It provides a visual of various seat types, which serves to help identify the type of child seat involved in the crash when the seat is no longer available and in-person interviews are conducted. Field researchers have always been encouraged to conduct in-person interviews rather than telephone interviews.

For those cases where the child seat is no longer available for inspection and/or an in-person interview is not possible, questions can be asked over the phone. Answers to several of these over-the-telephone interview only questions may still be able to help data analysts ascertain child seat type, harness system, orientation, proper/improper use, etc. Sample questions from the 2002 Child Restraint Interview Form are shown in Figures 4 and 5.

Another enhancement made in the CDS entailed updating the child seat make/model and type selection/pick list which now includes child restraints dating back to about 1985. Prior to 2002 this child seat “pick-list” was comprised of about 30 different makes of child seats covering about 120 different models, and five child seat types. Field researchers reference this list for selection of the respective child seat involved in a crash. The pick-list was expanded to include several older and newer models, and has been updated every year since 2002. This listing also includes the harness design for each model seat type along with the appropriate height and weight use recommendations according to each respective manufacturer.

The current list (up through 2004) identifies about 80 different makes, covering approximately 470 models, with 10 child seat types from which to choose. The current child restraint types are classified as: Infant Seat (ISS), Convertible Seat (CSS), Forward Facing Only (FSS), Booster Seat (BSS), Booster/Forward Facing Seat (BSS/FSS), Booster/Convertible Safety Seat (BSS/CSS), Integrated Seat (INT), Harness (HSS), Vest (VSS), and Special Needs (SNSS).

This listing also provides information regarding a restraint’s harness system type and placement according to the occupant’s weight and height in addition to providing a restraint’s attachment/hardware system, e.g., Lower Anchorages and Tethers for Children (LATCH) features.

PSU Number: _____ Case Number Stratum: _____ Vehicle Number: _____ Interviewer Role: _____			
Occupant Information:	Occupant # _____ Height _____ Weight _____ Age _____	Occupant # _____ Height _____ Weight _____ Age _____	Occupant # _____ Height _____ Weight _____ Age _____
Seating Position of child restraint?	<input type="checkbox"/> Front Mid <input type="checkbox"/> Front Right <input type="checkbox"/> 2nd Left <input type="checkbox"/> 2nd Mid <input type="checkbox"/> 2nd Right <input type="checkbox"/> 3rd Left <input type="checkbox"/> 3rd Mid <input type="checkbox"/> 3rd Right <input type="checkbox"/> Cargo area/trunk <input type="checkbox"/> Other (specify) _____	<input type="checkbox"/> Front Mid <input type="checkbox"/> Front Right <input type="checkbox"/> 2nd Left <input type="checkbox"/> 2nd Mid <input type="checkbox"/> 2nd Right <input type="checkbox"/> 3rd Left <input type="checkbox"/> 3rd Mid <input type="checkbox"/> 3rd Right <input type="checkbox"/> Cargo area/trunk <input type="checkbox"/> Other (specify) _____	<input type="checkbox"/> Front Mid <input type="checkbox"/> Front Right <input type="checkbox"/> 2nd Left <input type="checkbox"/> 2nd Mid <input type="checkbox"/> 2nd Right <input type="checkbox"/> 3rd Left <input type="checkbox"/> 3rd Mid <input type="checkbox"/> 3rd Right <input type="checkbox"/> Cargo area/trunk <input type="checkbox"/> Other (specify) _____
At the time of the crash how was the child restrained?	<input type="checkbox"/> Child restraint with a harness/shield system <input type="checkbox"/> Booster seat w/shield <input type="checkbox"/> Booster seat w/seatbelt <input type="checkbox"/> Veh Seatbelt w/Other (specify) _____ <input type="checkbox"/> Vehicle seatbelt only (IF VEHICLE SEATBELT ONLY STOP, DO NOT CONTINUE)	<input type="checkbox"/> Child restraint with a harness/shield system <input type="checkbox"/> Booster seat w/shield <input type="checkbox"/> Booster seat w/seatbelt <input type="checkbox"/> Veh seatbelt w/Other (specify) _____ <input type="checkbox"/> Vehicle seatbelt only (IF VEHICLE SEATBELT ONLY STOP, DO NOT CONTINUE)	<input type="checkbox"/> Child restraint with a harness/shield system <input type="checkbox"/> Booster seat w/shield <input type="checkbox"/> Booster seat w/seatbelt <input type="checkbox"/> Veh seatbelt w/Other (specify) _____ <input type="checkbox"/> Vehicle seatbelt only (IF VEHICLE SEATBELT ONLY STOP, DO NOT CONTINUE)
Was anything in the child's hand or lap at the time of the crash?	<input type="checkbox"/> No <input type="checkbox"/> Yes* *If Yes, What <input type="checkbox"/> Bottle <input type="checkbox"/> plastic or <input type="checkbox"/> glass <input type="checkbox"/> Toy <input type="checkbox"/> Cup <input type="checkbox"/> plastic or <input type="checkbox"/> glass <input type="checkbox"/> Other, specify _____ <input type="checkbox"/> Unknown	<input type="checkbox"/> No <input type="checkbox"/> Yes* *If Yes, What <input type="checkbox"/> Bottle <input type="checkbox"/> plastic or <input type="checkbox"/> glass <input type="checkbox"/> Toy <input type="checkbox"/> Cup <input type="checkbox"/> plastic or <input type="checkbox"/> glass <input type="checkbox"/> Other, specify _____ <input type="checkbox"/> Unknown	<input type="checkbox"/> No <input type="checkbox"/> Yes* *If Yes, What <input type="checkbox"/> Bottle <input type="checkbox"/> plastic or <input type="checkbox"/> glass <input type="checkbox"/> Toy <input type="checkbox"/> Cup <input type="checkbox"/> plastic or <input type="checkbox"/> glass <input type="checkbox"/> Other, specify _____ <input type="checkbox"/> Unknown
Type of Restraint?	<input type="checkbox"/> Infant <input type="checkbox"/> Convertible <input type="checkbox"/> Forward Facing Only <input type="checkbox"/> Booster w/shield <input type="checkbox"/> Belt-Positioning Booster w/seatbelt <input type="checkbox"/> Integral <input type="checkbox"/> Other (specify) _____ <input type="checkbox"/> Unknown	<input type="checkbox"/> Infant <input type="checkbox"/> Convertible <input type="checkbox"/> Forward Facing Only <input type="checkbox"/> Booster w/shield <input type="checkbox"/> Belt-Positioning Booster w/seatbelt <input type="checkbox"/> Integral <input type="checkbox"/> Other (specify) _____ <input type="checkbox"/> Unknown	<input type="checkbox"/> Infant <input type="checkbox"/> Convertible <input type="checkbox"/> Forward Facing Only <input type="checkbox"/> Booster w/shield <input type="checkbox"/> Belt-Positioning Booster w/seatbelt <input type="checkbox"/> Integral <input type="checkbox"/> Other (specify) _____ <input type="checkbox"/> Unknown
What weight child is the restraint recommended for?	<input type="checkbox"/> 0-20 lbs. <input type="checkbox"/> 0-22 lbs. <input type="checkbox"/> 0-40 lbs. <input type="checkbox"/> 5-40 lbs. <input type="checkbox"/> 20-40lbs. <input type="checkbox"/> 30-60 lbs. <input type="checkbox"/> 30-80 lbs. <input type="checkbox"/> 40-100lbs <input type="checkbox"/> Other, specify _____ <input type="checkbox"/> Unknown	<input type="checkbox"/> 0-20 lbs. <input type="checkbox"/> 0-22 lbs. <input type="checkbox"/> 0-40 lbs. <input type="checkbox"/> 5-40 lbs. <input type="checkbox"/> 20-40lbs. <input type="checkbox"/> 30-60 lbs. <input type="checkbox"/> 30-80 lbs. <input type="checkbox"/> 40-100lbs <input type="checkbox"/> Other, specify _____ <input type="checkbox"/> Unknown	<input type="checkbox"/> 0-20 lbs. <input type="checkbox"/> 0-22 lbs. <input type="checkbox"/> 0-40 lbs. <input type="checkbox"/> 5-40 lbs. <input type="checkbox"/> 20-40lbs. <input type="checkbox"/> 30-60 lbs. <input type="checkbox"/> 30-80 lbs. <input type="checkbox"/> 40-100lbs <input type="checkbox"/> Other, specify _____ <input type="checkbox"/> Unknown
Do you still have the restraint involved in the crash?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown

Figure 4. Sample of 2002 Child Restraint Interview

PSU Number: _____ Case Number Stratum: _____ Vehicle Number: _____ Interviewer Role: _____			
Does the seat have a high back (similar to a bucket seat)?	<input type="checkbox"/> Yes <input type="checkbox"/> No* <input type="checkbox"/> Unknown *If No, was the booster a sitting base only <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown	<input type="checkbox"/> Yes <input type="checkbox"/> No* <input type="checkbox"/> Unknown *If No, was the booster a sitting base only <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown	<input type="checkbox"/> Yes <input type="checkbox"/> No* <input type="checkbox"/> Unknown *If No, was the booster a sitting base only <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown
What restrained the child?	<input type="checkbox"/> Lap/shoulder belt used <input type="checkbox"/> Lap belt only <input type="checkbox"/> No belt system <input type="checkbox"/> Other, specify _____ <input type="checkbox"/> Unknown	<input type="checkbox"/> Lap/shoulder belt used <input type="checkbox"/> Lap belt only <input type="checkbox"/> No belt system <input type="checkbox"/> Other, specify _____ <input type="checkbox"/> Unknown	<input type="checkbox"/> Lap/shoulder belt used <input type="checkbox"/> Lap belt only <input type="checkbox"/> No belt system <input type="checkbox"/> Other, specify _____ <input type="checkbox"/> Unknown
Continue if the seat was used as a belt-positioning booster with both the lap and shoulder belt			
At the time of the crash what was the child's posture?	<input type="checkbox"/> Upright <input type="checkbox"/> Leaning <input type="checkbox"/> forward <input type="checkbox"/> left side <input type="checkbox"/> right side <input type="checkbox"/> forward and left <input type="checkbox"/> forward and right <input type="checkbox"/> Unknown	<input type="checkbox"/> Upright <input type="checkbox"/> Leaning <input type="checkbox"/> forward <input type="checkbox"/> left side <input type="checkbox"/> right side <input type="checkbox"/> forward and left <input type="checkbox"/> forward and right <input type="checkbox"/> Unknown	<input type="checkbox"/> Upright <input type="checkbox"/> Leaning <input type="checkbox"/> forward <input type="checkbox"/> left side <input type="checkbox"/> right side <input type="checkbox"/> forward and left <input type="checkbox"/> forward and right <input type="checkbox"/> Unknown
Where was the shoulder belt positioned on the child?	<input type="checkbox"/> Over shoulder crossing chest <input type="checkbox"/> Across the neck <input type="checkbox"/> Across the face <input type="checkbox"/> Under the Arm <input type="checkbox"/> Across the child's arm (off shoulder) <input type="checkbox"/> Behind the back <input type="checkbox"/> Unknown <input type="checkbox"/> Other specify _____	<input type="checkbox"/> Over shoulder crossing chest <input type="checkbox"/> Across the neck <input type="checkbox"/> Across the face <input type="checkbox"/> Under the Arm <input type="checkbox"/> Across the child's arm (off shoulder) <input type="checkbox"/> Behind the back <input type="checkbox"/> Unknown <input type="checkbox"/> Other specify _____	<input type="checkbox"/> Over shoulder crossing chest <input type="checkbox"/> Across the neck <input type="checkbox"/> Across the face <input type="checkbox"/> Under the Arm <input type="checkbox"/> Across the child's arm (off shoulder) <input type="checkbox"/> Behind the back <input type="checkbox"/> Unknown <input type="checkbox"/> Other specify _____
How was the fit of the shoulder belt?	<input type="checkbox"/> Snug <input type="checkbox"/> Loose <input type="checkbox"/> Unknown	<input type="checkbox"/> Snug <input type="checkbox"/> Loose <input type="checkbox"/> Unknown	<input type="checkbox"/> Snug <input type="checkbox"/> Loose <input type="checkbox"/> Unknown
Notes:			

Figure 5. Sample of 2002 Child Seat Interview Questions

Additional updating and restructuring was also made to the child seat and safety belt data collection variables and attributes. The attributes capture design features of the seat, e.g., harness/shield design, not designed with harness/shield, 3-pt harness, 5-pt harness, T-shield, Tray-shield, Shield and unknown. In addition, the improved attributes reflect how the features are used, e.g., harness used, harness in top, highest, middle or bottom slot, harness used, slots used unknown, shield used, etc. This has allowed for new information to be coded regarding a seat's harness/shield design and use, the LATCH features availability and use, and installation of the child seat in the vehicle by indicating the vehicle's belt routing and use.

Information regarding the child's position within the restraint is also collected. Through the interview process, the child's posture is noted as sitting upright, reclined, supine, slumped forward to the side, etc.

Specific information on the child restraint's design, installation features, (e.g., LATCH equipped, vehicle safety belt lock-offs, etc.), restraint use, harness strap(s) location, and LATCH features, are collected and documented for each child occupant. There are also questions, which may help determine the type of vehicle safety belt system used to install the child restraint and/or the child in instances where a vehicle inspection may have not been completed. For example safety belt types like lap/shoulder combination, lap belt only; locking features, latch plates, retractor types, (e.g., sliding, lightweight locking/cinching, locking, emergency and automatic locking, switchable retractor, etc.) and how the vehicle safety belt was used/locked to secure the child restraint.

Information is also collected pertaining to the use/installation of vehicle safety belt adaptations/add-ons, as well as use of aftermarket belt-positioning devices. All pertinent information regarding the child occupant, (e.g., interview, photos of crash scene, vehicles and child restraint) are collected and coded into the automated CDS file enabling researchers to reconstruct the pre and post crash environment of the child occupant. A sample of the Occupant Form, Child Seat Tab used for coding child seat information beginning in 2002 is shown in Figure 6.

Figure 6. Sample of Child Seat Tab beginning with 2002

Once a child restraint make and model have been entered into the Child Seat Tab, the type of restraint along with certain other design features automatically pre-fill certain of the blanks extrapolating from previously entered data regarding each respective child restraint from the pick-list. The left-hand side of the Child Seat Tab, which specifies Design Feature Used defines how the child restraint is designed/equipped beginning with the type of harness system. A drop down list of harness options available for the particular seat allows selections such as 3-pt, 5-pt, T-shield, Tray-shield, and Shield. It can also be noted, via the drop down list, whether the child restraint was equipped with a harness retainer clip, top tether or lower anchorages. The How Feature Used side of the tab describes how the restraints features were used beginning with the orientation of the seat, orientation, e.g., rear, forward, supine; if harness was used which slots were used, e.g., harness straps in top/highest slot, harness straps in middle/bottom slot, slots used unknown; tether used or not used, LATCH used or not used, belt routing indicating which slots/channels on the child restraint were used for vehicle belt installation, and whether or not a locking clip was used on the vehicle belt system.

Updated photography requirements for child restraints were also incorporated into the 2002 CDS data collection year. In particular, field researchers were required to take photos of both the front and back of the child restraint, which could help clearly identify the type of seat, it's harness system and the harness system's position/location as it was likely

used with the child. The new guidelines also request that all labels identifying the seat be photographed, especially the label which indicates the manufacturer make/model number and date of manufacture, which can help identify the seat's specific manufacturer and model.

Another very important data collection enhancement incorporated into the CDS has been providing additional child restraint and vehicle safety belt training for field researchers. An 8-hour child seat and vehicle safety belt update training was provided to all field researchers during NASS year-end training in November 2001, and field researchers have been provided with child occupant restraint update information at every year-end training since implementation of the new variables. Several of the field researchers have become certified Child Passenger Safety (CPS) Technicians through the Standardized Child Passenger Safety course, and it is planned to have at least 1 field researcher certified as a Technician at each of the 27 field research teams.

PROCEDURES

In-depth information relating to the case child occupant's environment, both pre- and post- crash, is gathered (e.g., restraint type used, how used, its installation, harness strap location, seating location, vehicle safety belt type utilized to anchor the child restraint, top tether and lower anchorage systems/LATCH, etc.). This information is collected from many sources, including a hands-on examination of the vehicle, and the child restraint, when available. When applicable, medical information regarding the child occupant is also sought. Once the information is obtained it is entered into the CDS using the Abbreviated Injury Scale, AIS-90 coding protocols.

Details regarding the child restraint crashes selected for CDS are collected and subsequently coded into each case by field researchers. The information coded is then reviewed and checked for accuracy by quality control staff, built-in edit check software, as well as receiving a second review by NHTSA headquarters staff prior to final data file release for child restraint cases coded since 2002.

DATA SUMMARIZATION

Data Parameters

Pursuant to the changes enjoyed by the Oracle NASS CDS files, the SAS data sets will be updated to an

approximately 30-file data set, known internally as the oracle look-a-like file. This will occur retroactively to 2002, the year for which the child passenger safety modifications were made to the NASS CDS. Currently, the SAS data set available on the World Wide Web contains the traditional 11-file data set.

Years

NASS CDS was consulted for tow away crashes occurring in 2002 through 2003. These are the two most recent years available for the NASS System. These also mark the first two years of enhanced child seat collection.

Age Selection

Based upon a query reviewing all child seat cases in the NASS CDS for the years 1999 through 2003, it was determined that children through 9 years old were observed to be restrained by some child restraint system. This was not to say that some form of child safety seat and/or vehicle-equipped safety belt restrained all children from ages 0 through 9 years. Instead, there was incidence of some child safety seat usage among children up to 9 years of age.

Restraint Usage Aggregations

The restraint usage was categorized as: vehicle installed restraint, child restraint system secured with a vehicle installed restraint, none, or other. If the child was restrained with a lap, shoulder, lap and/shoulder belt, or an unknown type of manual restraint, the child was considered secured by a vehicle-installed restraint. If the manual restraint usage indicated that it secured a child safety seat and that a child safety seat was present in the seating position, then the child restraint system was secured with a vehicle installed restraint. Using the old definitions owing to their current availability in SAS, child seat was considered: infant seat, toddler seat, convertible, booster seat with shield, booster seat without shield, other seat, or unknown seat. In the case of an absent or inoperative manual restraint in a seating position, then a child was considered unrestrained. If the restraint usage did not fit the previous definitions, it was classified as other. These would include any child safety seat that was secured with one of the manual restraint usage options or the presence of an integrated seat. Until the advent of the new child safety seat variables, integrated seats were denoted through the child seat make variable as an aggregate of any make or model.

Seating Position

The seating positions were disaggregated in two ways. The first method of analysis contemplated any

seating positions. The second method of analysis only considered child safety seat compatible seating positions.

First, any front seat, left, middle, right, on/in lap, or other, were aggregated. The second seat was comprised of any other seating position rear of the front seat but excluding other seats or unenclosed areas.

The second method only considered seating position in which a child seat could be installed. The front seat only considered the right front seating positions. Although, many vehicles are equipped with center seating positions, these generally avail themselves of a lap belt. It is not a comparable attribute amongst all vehicles. Further, the lap belt is not appropriate for use with belt positioning boosters. Since the present examination reports on an aggregate of child seat types, ages, and vehicle types, the front middle seating position was eliminated from consideration within the front row. The rear seats were any left, middle, or right seating position behind the front seat.

Child Seat Type

The child seat types were better defined, as of 2002. Using the SAS data set, the analyst was limited to the older formats. Upon the introduction of the Oracle look-a-like data set, SAS data users will have the enhanced child seat data. It should be noted that many of the child seat terms have been outdated and will be more completely defined with regard to orientation. The current formatting may have required the analyst to consult child seat orientation in concert with the child seat type.

Restraint Usage in Conjunction with Child Seat Type

When examining children transported in child safety seats, the manual restraint usage must also be considered. The safety of a child can be optimized only with the child secured in the child safety seat and the child safety seat secured to the vehicle/vehicle seat. Although misuse of manual restraints and/or child safety seats was not directly contemplated, it may be considered a gross misuse to omit securing the child safety seat to the vehicle/vehicle seat.

As shown in Table 1, the frequency of child safety seats in a seating position occupied by a child was reported. Over the two-year period, 2002 through 2003, 555 children were reported. These 555 children need not have been secured to the child safety seat by virtue of harness or adult safety belt, nor would they have necessarily had the child seat

secured to the vehicle. A more refined search considered whether the child seat was secured to the vehicle. The presence of the child seat, secured to the vehicle, did not indicate whether the harness, for pre-boosted seat child, was fastened. It could, however, be surmised owing to the prevalence of low severity injuries among children transported in child safety seats that the children were fastened in the seat. The 30-file data was designed to reflect the child safety seat enhancement and provide complete information with regard to the child seat placement and the harness and/or safety belt usage of the child.

When studying those cases for which manual restraint usage indicated the presence of a child safety seat and that seat was present in an occupied seating position, the value from Table 1, 279 child seats for 2002 and 276 child seats for 2003, exceeded the number of child seats secured to the vehicle, 236 child seats for 2002 and 245 child seats for 2003. A difference of 74 cases was attributable to a combination of adult omissions in securing children in the safety seat or securing the harness, child behaviors, and early child safety data collection methods employed by CDS, as reflected in the 11-file SAS formats. For these two years, however, the new data set has been designed to allow the users to map from the older to the newer versions of the data set. With regard to this study, 19 cases were examined more carefully owing to a seemingly elevated number of child safety seats that were not secured to the vehicle.

The number of children transported in child safety seats differed when compared to children transported in a child safety seat that was secured to the vehicle, per Table 2. Nineteen cases were studied individually where the manual restraint usage was omitted and a child safety seat was reported. These cases were reviewed in their entirety using the CDS Electronic Case Access available on the NHTSA website. Five cases were found to be legitimately unrestrained occupants. Eight cases involved integrated seats; understandably, these were coded as unrestrained owing to a lack of evidence that must have accompanied the use of the vehicle belt system. Integrated seats do not require the manual restraint system for installation in the vehicle. One case indicated that the belt was routed unconventionally, as verified on the Electronic Case Access and to be resolved when using the forthcoming 30-file format. One LATCH installed child safety seat was identified, which would not have availed itself of the vehicle installed restraint system. A convertible seat was identified as secured by an automatic belt in the front passenger seat. This could not have been

detected using the SAS data set owing to the formatting present for the automatic belt usage. Only the manual restraint use provided indication of the child seat presence. In practice, the automatic restraint was an uncommon way of securing the child safety seat. The unrestrained classification was made based upon the manual restraint use. Two other cases were determined to be restrained owing to more ample information contained in the forthcoming 30-file data set.

Table 2: Discrepancies to be Resolved with the Introduction of the Oracle look-a-like, 30-file Data Set	
Restraint Use Status	Frequency
Unrestrained	5
Automatic Belt Use	1
Integrated Belt-positioning booster seat	8
Integrated Convertible Seat	1
Restrained, belt routed unconventionally	1
<i>LATCH</i>	1
Restrained	2
SAS-reported Unrestrained Occupants	19
Source: NASS CDS, 2002-2003 and NASS CDS Electronic Case Access	

A more complicated query would have been needed when using the 11-file format to capture additional restraint use cases. Further, the integrated seat has been subsumed into the child safety seat types. In the previous query, the child safety seat, child safety orientation, and child safety seat make would have been queried to assess the child safety seat.

Injury Severity

Injury severity was determined using The Abbreviated Injury Scale (AIS) as devised by the Association for the Advancement of Automotive Medicine. Injuries are ranked with regard to risk of mortality from 0 through 7, as defined in Table 3. The highest injury severity, AIS score, sustained by an occupant became the Maximum AIS (MAIS) reported in CDS.

Data Composition

NASS CDS is a weighted sample estimating the yearly incidence of police-reported tow away crashes in the United States occurring on public roadways. Weighted estimates were based upon a sample of 21,020 occupants transported in vehicles that were towed. Of these occupants, 1,333 were children less

than ten years old. Fifty-three percent of these children were involved in crashes in 2002 and 47 percent in 2003. The weights must be incorporated into any meaningful analysis. Without these weights, the cases become an interesting series of anecdotal accounts.

Table 3: Abbreviated Injury Scale Values

MAIS Value	Description
7	Unknown
0	Uninjured
1	Minor
2	Moderate
3	Serious
4	Severe
5	Critical
6	Maximum

Source: Injury Coding Manual, 2000

Nearly ten million occupants were involved in tow away crashes during 2002 through 2003. Of these occupants, approximately 620,000 occupants were children under the age of ten years, with 55 percent occurring in 2002 and 45 percent occurring in 2003. This decrease is not statistically significant since CDS should not be used for yearly changes, instead it must be over several years to establish trends useful for analysis.

Since two years may not be used for a meaningful data analysis, owing to the small sample size, both weighted and raw numbers have been prepared. The raw numbers are illustrative and should not be used to interpret the data set.

Data Interpretation

Based upon the data parameters set forth, several questions were addressed. This section cannot be deemed an analysis owing to the small data set. Instead, it was meant to introduce the data set and describe its population while looking toward the 30-file data set. Issues considered included: the manner in which children were restrained, occupant seating location within the vehicle, types of child seats used, and injury severity.

How are children restrained?

Approximately 620,000 children were involved in tow away passenger vehicle crashes over the years 2002 through 2003, per Table 4a. Of these, 34 percent were transported in child restraint systems secured by a vehicle-installed restraint. Half the children were restrained by the vehicle installed

restraint system. Less than 10 percent of these children were unrestrained.

Table 4a: Restraint Usage for Children from Birth through Nine Years Old, by Age, Weighted Data

Age	Vehicle Installed Restraint	CRS Secured with a Vehicle Installed Restraint	None	Other
0	475	29,160	4,001	2,646
1	2,781	67,141	3,044	6,157
2	4,626	39,852	4,739	6,747
3	6,536	32,619	1,668	1,032
4	15,135	20,575	10,699	2,299
5	28,720	12,551	9,899	6,022
6	67,293	6,546	3,082	1,427
7	41,071	3,647	8,753	8,253
8	92,272	14	3,825	2,756
9	48,253	1,552	6,388	5,323

Source: NASS CDS, 2002 - 2003

Table 4b: Restraint Usage for Children from Birth through Nine Years Old, by Age, Raw Data

Age	Vehicle Installed Restraint	CRS Secured with a Vehicle Installed Restraint	None	Other
0	2	96	15	10
1	6	106	12	24
2	15	99	19	19
3	24	80	16	16
4	45	47	21	11
5	53	32	25	14
6	93	13	18	13
7	81	6	27	18
8	95	1	19	17
9	89	1	22	13

Source: NASS CDS, 2002 - 2003

Where were these children seated?

Eighty-five percent of the children less than 10 years old were transported in the rear seating positions, per Table 5a. When limiting the seating positions to only those compatible with child restraint systems, a nearly identical percentage were transported in the rear seat, per Table 6a. This was understandable owing to child restraint system usage being predicated upon a seating position with vehicle-installed manual restraints. Those children using a child restraint system in conjunction with a vehicle-installed restraint in the front seat comprised 36 percent and an equivalent percentage in the rear seating equipped positions. These differences in restraint usage and seating position may be attributable to safety messages, dating to the mid-1990's, advocating rear seating positions for children 12 years old and under.

Table 5a: Restraint Usage for Children from Birth through Nine Years Old, by Seating Position, Weighted Data

Seating Position	Vehicle Installed Restraint	CRS Secured with a Vehicle Installed Restraint	None	Other
Front Row	29,205	26,647	24,559	9,415
Rear Rows	277,653	187,012	31,313	31,909
Other	303	0	226	1,336

Source: NASS CDS, 2002 - 2003

Table 5b: Restraint Usage for Children from Birth through Nine Years Old, by Seating Position, Raw Data

Seating Position	Vehicle Installed Restraint	CRS Secured with a Vehicle Installed Restraint	None	Other
Front Row	92	20	47	25
Rear Rows	410	461	146	118
Other	1	0	1	12

Source: NASS CDS, 2002 - 2003

What were the various types of child safety seats used?

Although 61 percent of children 0 through 9 years old used no child restraint system, the value was partially comprised of graduates to the vehicle-installed restraints, as well as unrestrained occupants,

Table 6a: Restraint Usage for Children from Birth through Nine Years Old, by CRS Compatible Seating Position, Weighted Data

CRS Compatible Seating Position	Vehicle Installed Restraint	CRS Secured with a Vehicle Installed Restraint	None	Other
Right Front Passenger Seat	28,546	26,647	12,878	5,478
Left, Right, and Middle Rear Rows	276,153	187,012	23,305	31,450
Other	2,462	0	19,916	5,733

Source: NASS CDS, 2002 – 2003

Table 6b: Restraint Usage for Children from Birth through Nine Years Old, by CRS Compatible Seating Position, Raw Data

CRS Compatible Seating Position	Vehicle Installed Restraint	CRS Secured with a Vehicle Installed Restraint	None	Other
Right Front Passenger Seat	82	20	27	23
Left, Right, and Middle Rear Rows	403	461	115	114
Other	18	0	52	18

Source: NASS CDS, 2002 – 2003

per Table 7a. From Table 8a, it should be recognized that children 0 through four years old comprise only 8 percent of the child safety seat omissions; 53 percent are 5 through 9 years old. As noted above, the majority of children were restrained, whether in age-appropriate child safety seats or, early graduations, by the vehicle installed restraint system. Of special concern were the five percent of children classified as booster-seat-with-shield users. As defined previously, these were formatting errors inherent to the SAS data set and will be corrected in the Oracle look-a-like file. When using the data, it should be noted that the reporting standards are appropriate and quality control has been performed to verify that these seats have been correctly classified. Each data user should label the SAS format booster seat with shield as aggregate booster seat. Table 7a was created using the format file provided with NASS CDS SAS data set for 2002 through 2003,

which aggregated booster seats with and without shields under the booster-seat-with-shield attribute.

Table 7a: Restraint Usage for Children from Birth through Nine Years Old, by Child Safety Seat Type, Weighted Data

Child Safety Seat	Vehicle Installed Restraint	CRS Secured with a Vehicle Installed Restraint	None	Other
None	307,161	0	48,527	25,244
Infant Seat	0	14,153	1,449	130
Toddler Seat	0	51,218	476	130
Convertible	0	83,033	3,862	0
Booster Seat with Shield*	0	29,465	429	0
Other Seat	0	218	0	0
Unknown Type	0	35,570	1,357	17,156

Source: NASS CDS, 2002 - 2003
 *NOTE: Mislabeled Aggregation of booster seats.

Table 7b: Restraint Usage for Children from Birth through Nine Years Old, by Child Safety Seat Type, Raw Data

Child Safety Seat	Vehicle Installed Restraint	CRS Secured with a Vehicle Installed Restraint	None	Other
None	503	0	175	108
Infant Seat	0	55	5	1
Toddler Seat	0	81	1	1
Convertible	0	155	3	0
Booster Seat with Shield*	0	56	8	0
Other Seat	0	3	0	0
Unknown Type	0	131	2	45

Source: NASS CDS, 2002 - 2003
 *NOTE: Mislabeled Aggregation of booster seats.

As mentioned previously, the child seat type variable accounted for only those children transported in child safety seats, per Table 8a. The “none” category, comprising 61 percent of all occupants less than ten years of age, was not meant to be synonymous with unrestrained. Instead, it was the aggregate of not using a child safety seat. This group subsumed all

vehicle installed safety belt users, as well as unrestrained occupants. Of the children using some form of child safety seat, the majority, 36 percent, were transported in a convertible seat and ranged in age from birth through 6 years of age. Without exposure numbers, with regard to vehicle, child age, and child seat type used for transporting children less than 10 years old, it was only possible to assess the restraint usage behavior of children involved in tow away crashes, not the generalized child restraint usage for children in this age group.

Table 8a: Child Safety Seat Usage for Children from Birth through Nine Years Old, by Age, Weighted Data

Age	None	IS	TS	CS	BSS	Oth Unk
0	1,873	15,711	672	9,318	0	8,709
1	6,496	22	20,666	31,934	1,450	18,555
2	10,740	0	3,821	24,201	1,465	15,738
3	8,246	0	7,699	15,375	7,112	3,422
4	23,901	0	7,294	4,918	10,857	1,739
5	41,109	0	8,687	1,122	2,287	3,987
6	71,688	0	148	28	4,487	1,997
7	58,077	0	2,837	0	684	126
8	98,839	0	0	0	0	27
9	59,965	0	0	0	1,552	0

Source: NASS CDS, 2002 - 2003
 Key: None = no child safety seat present, IS = infant seat, toddler seat, TS = toddler seat, CS = convertible seat, BSS = booster seat with shield, and Oth Unk = other or unknown child restraint system present.

Table 8b: Child Safety Seat Usage for Children from Birth through Nine Years Old, by Age, Raw Data

Age	None	IS	TS	CS	BSS	Oth Unk
0	15	58	1	15	0	34
1	22	3	15	61	3	44
2	42	0	19	40	3	48
3	47	0	25	24	14	26
4	70	0	11	12	16	15
5	89	0	8	5	16	6
6	121	0	2	1	9	4
7	126	0	2	0	2	2
8	130	0	0	0	0	2
9	124	0	0	0	1	0

Source: NASS CDS, 2002 - 2003
 Key: None = no child safety seat present, IS = infant seat, toddler seat, TS = toddler seat, CS = convertible seat, BSS = booster seat with shield, and Oth Unk = other or unknown child restraint system present.

How severe are the injuries sustained by children 0 through 9 years old?

Of the uninjured children, MAIS 0, 41 percent were transported in a child restraint system secured by a vehicle-installed manual restraint, per Table 9a. Another 50 percent were secured by the vehicle-installed manual restraint. As the injury severity

declined, an increase in the restraint usage was noted. It must be noted that this cannot be asserted with any statistical confidence owing to the small sample size, however, an indication exists that must be tested over the coming years.

Table 9a: Restraint Usage for Children from Birth through Nine Years Old, by Maximum Abbreviated Injury Score, Weighted Data

MAIS	Vehicle Installed Restraint	CRS Secured to a Vehicle Installed Restraint	None	Other
0	210,987	173,301	22,422	17,180
1	92,031	35,788	23,501	9,852
2	1,806	1,587	4,694	459
3	578	266	3,882	5
4	260	549	526	10
5	94	260	169	52
6	71	133	28	15
7	848	385	665	6,982

Source: NASS CDS, 2000 – 2003

Table 9b: Restraint Usage for Children from Birth through Nine Years Old, by Maximum Abbreviated Injury Score, Raw Data

MAIS	Vehicle Installed Restraint	CRS Secured to a Vehicle Installed Restraint	None	Other
0	236	293	54	69
1	208	143	69	41
2	17	14	20	7
3	15	6	12	1
4	4	3	7	1
5	3	6	6	2
6	2	2	1	1
7	16	9	22	29

Source: NASS CDS, 2000 - 2003

Summary

Data shown in this section were meant to highlight changes to the NASS CDS data collection. Data analysis cannot be performed on two years of data, the period since the modifications were instituted. Approximately, five years of data must be compiled to perform meaningful analyses. In the case of child seat cases, more years may be needed owing to the low frequency of children reported in crashes each year.

CASE AVAILABILITY

Electronic case files may be accessed via the NHTSA website, Electronic Case Access Screen. The hyperlink is as follows:
<http://www-nrd.nhtsa.dot.gov/departments/nrd-30/ncsa>

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