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Working Group Best-Practice Recommendations for the Safe Transportation of Children in Emergency Ground Ambulances

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PLEASE NOTE: These recommendations, which were developed by an Expert Working Group convened in a contract overseen by the National Highway Traffic Safety Administration do not necessarily reflect the policies, recommendations or opinions of NHTSA or its employees, vendors, or contractors. The membership of the working group is provided on page 5 of this report.

Glossary of Terms

Term	Definition
bench seat	Also known as the squad bench, this is the multi-person side facing seat alongside the cot mounting area in the rear of a ground ambulance.
call-taker	The person responsible for answering a 911 call for response to an emergency situation and request for an immediate response, which may include a medical emergency and the need for emergency medical services.
captain's chair	Also known as the EMS provider's seat, this is the passenger location that (typically an EMS professional) faces the rear exit of the emergency ground ambulance that is typically located immediately behind the driver's seat. From this location, the person is physically able to see the patients being transported.
child restraint system (CRS)	A CRS is any device (except a passenger system lap seat belt or lap/shoulder seat belt), designed for use in a motor vehicle to restrain, seat, or position a child.
cot	A temporary bed used in emergency ground ambulances for the purposes of transporting patients via ambulance to a medical facility for treatment. Also commonly referred to as a stretcher or gurney. A wheeled cot (elevating) or wheeled cot-bench (non-elevating) may be referred to as a litter.
cot restraints	A restraining device that is designed for use on a cot in an ambulance to restrain or position a child in a sitting position. Cot restraints may be devices that are permanently mounted (integrated) or can be secured to a cot in an ambulance.
emergency ambulance or emergency ground ambulance or ground ambulance	An emergency ambulance, emergency ground ambulance, or ground ambulance is a vehicle designed for the transportation of sick or injured people to, from, or between places of medical treatment.
emergency medical services (EMS)	Emergency medical services are the responses and activities dedicated to providing out-of-hospital medical care and/or transportation to definitive medical care, to patients with illnesses and injuries that the patient, or the medical practitioner, believes constitutes a medical emergency. At the community level, EMS may also be referred to as but not limited to: first aid squad, emergency squad, rescue squad, ambulance squad, ambulance service, ambulance corps, or life squad.
EMS provider seat	Also known as the captain's chair (see definition above).
EVOC	The Emergency Vehicle Operators Curriculum (EVOC) is the national standard curriculum developed by NHTSA and the U.S. Office of Personnel Management for training personnel in the safe operation of emergency ground ambulances.

Term	Definition
FARS	The Fatality Analysis Reporting System is NHTSA’s annual census of data collected on all fatal motor vehicle traffic crashes occurring in the United States and the injuries, people, and vehicles involved in these crashes.
five-point cot restraint system	A system for restraining a patient to the cot of a ground ambulance, consisting of three horizontal restraints across the patient’s torso (chest, waist, and knees) and two vertical shoulder restraints across each of the patient’s shoulders.
FMVSS No. 208	Federal Motor Vehicle Safety Standard No.208 is the standard for occupant crash protection. FMVSS No. 208 specifies the performance requirements for active and passive restraints (seat belts) using anthropomorphic test dummies seated in the front outboard seats of passenger cars and of certain multi-purpose passenger vehicles, trucks, and buses. The purpose of FMVSS No. 208 is to reduce the number of fatalities and the severity of injuries to occupants involved in crashes.
FMVSS No. 213	Federal Motor Vehicle Safety Standard No. 213 is the standard for child restraint. FMVSS No. 213 specifies requirements for child restraint systems used in motor vehicles and aircraft. The purpose of FMVSS No. 213 is to reduce the number of children killed or injured in motor vehicle crashes and in aircraft.
HRSA	The U. S. Department of Health and Human Services’ Health Resources and Services Administration is the primary Federal agency for improving access to health care services for people who are uninsured, isolated, or medically vulnerable.
NEMESIS	Established in 2001, the National Emergency Medical Services Information System is a project to create a national EMS database that contains standardized data elements from local and State EMS agencies from the entire United States
securement	The act or process of fastening a child restraint system or other safety device or piece of equipment to ensure the safety of the child being transported in the system or device or equipment so as not to allow movement or subject the child to unsafe or inappropriate conditions while being transported.
stretcher	Also referred to as a cot (see definition above).
squad bench	Also known as the bench seat (see definition above).

1.0 Background

The National Highway Traffic Safety Administration of the U.S. Department of Transportation initiated a project in September 2008 titled “Solutions to Safely Transport Children in Emergency Vehicles.” The major objectives of this project were to:

1. Build consensus in the development of a uniform set of recommendations to safely and appropriately transport children (injured, ill, or uninjured) from the scene of a crash or other incident in an ambulance;
2. To foster the creation of best practice recommendations after reviewing the practices currently being used to transport children in ambulances; and
3. To provide consistent national recommendations that will be embraced by local, State and national emergency medical services organizations, enabling them to reduce the frequency of emergency transport of ill, injured or uninjured children who may be transported in an unsafe or inappropriate manner.

To achieve these major objectives, a working group was formed; the working group was comprised of members with experience, background, and extensive knowledge in the current practices of the emergency transportation of children in ground ambulances. The expert members of the working group were drawn from those organizations and entities involved in the health care of children and the emergency transportation of children and others in ground ambulances. It should be noted that throughout the remainder of this document, references to ambulances are limited to ground ambulances, unless otherwise stated. Also, based upon the deliberations of the working group, it was decided to use the terms “child” or “children” versus “youth” to the extent practical throughout the remainder of this document, to represent all children, starting at birth.

The panel of experts comprising the working group and the organizations represented are shown in the following table.

Working Group Members from Children’s Health, Medical, and Emergency Organizations

Michael Aries	International Association of Firefighters
Katrina Altenhofen, MPH, PS, EMSC Program Manager	National Association of State EMS Officials
Marilyn J. Bull, M.D., FAAP	American Academy of Pediatrics
James M. Callahan, M.D., FAAP, FACEP	American College of Emergency Physicians (ACEP)
Andrew L. Garrett, M.D., MPH	National Association of Emergency Medical Service Physicians (NAEMSP)
Ken Knipper	National Volunteer Fire Council
Tommy Loyacono, MPA, NREMT-P	National Association of Emergency Medical Technicians
John Russell, M.D., FAAP	American Ambulance Association
Joseph L. Wright, M.D., MPH, FAAP	National Emergency Medical Services for Children’s Resource Center (EMSC NRC)
Cynthia Wright-Johnson, R.N., MSN	Emergency Nurses Association (ENA)

General support for the project was also provided by the International Association of Fire Chiefs.

Members from NHTSA, the sponsors for the project, along with partners from other Federal agencies, also participated in the activities and deliberations of the working group. The working group members from Federal agencies are shown in the following table:

Working Group Members from Federal Agencies

Alexander (Sandy) Sinclair	NHTSA Headquarters, Traffic Injury Control, Research and Program Development, Office of Occupant Protection
David Bryson	NHTSA HQ, TIC, Research and Program Development, Emergency Medical Services
Thelma Kuska, R.N., BSN, CEN, FAEN	NHTSA Region 5
Eileen Holloran	Health Resources and Services Administration, U. S. Department of Health and Human Services
Dan Kavanaugh	Health Resources and Services Administration, U. S. Department of Health and Human Services

Operational support for the project was provided under NHTSA contract DTNH22-08-C00085 by Maryn Consulting, Inc.

A first step to achieving the project’s major objectives was to complete a review of the literature of current practices for the emergency transportation of child passengers in ground ambulances. The emphasis of the literature review included research in professional journals and elsewhere that described an ideal or model uniform approach to transport children safely in ambulances, as well as articles and

publications that documented unsafe or incorrect practices. The expectation was that the findings from the literature review would serve as a point of reference for consensus building efforts towards the development of the recommendations for the safe transportation of children.

Maryn Consulting, Inc. conducted the literature review, reviewing several hundred pages of information related to ambulance safety issues and the emergency transportation of children in ground ambulances. Relevant sources addressing various aspects of the transportation of children in ground ambulances (statistical information, existing guidelines, current practices and outcomes, safety research, etc.) were examined in depth and analyzed. The expert members of the working group were asked to review and provide comment on the literature review before it was finalized. Key findings from the literature review served as the foundation for the deliberations and activities of the working group. The literature review addressed the following major topics:

- Background: An overview of statistical findings and data sources specific to ambulance transportation issues and child transportation in ground ambulances and media coverage of the issue of child transportation in ground ambulances.
- Ambulance Safety Issues: An overview of ambulance safety issues in general, with references to research and publications regarding this topic.
- Child Transport in Ambulances: Existing Guidelines: An overview of the current published guidelines regarding the safe transportation of children in ground ambulances at the national and State levels, as well as those promulgated by relevant practitioner associations.
- Child Transport in Ambulances: Current Practices and Outcomes: A description of current trends in the transportation of children in ambulances and questions identified by practitioners regarding this topic.
- Child Transport in Ambulances: Safety Research: An overview of engineering and safety research findings regarding safe and unsafe methods of transporting children in ground ambulances.

The literature review, completed in May 2009, is included in its entirety as Appendix A.

The second step to achieving the major objectives of the project was the convening of the working group of experts. A series of teleconferences and a meeting were held, aimed at discussing issues of critical importance related to the major goals of the project, leading to the development of the recommendations contained in this report. Maryn Consulting, Inc. convened monthly teleconferences of the working group members in 2009 and 2010; deliberations were recorded. In addition to holding the monthly teleconferences, the working group was brought together for a one day meeting in Washington, DC, on July 22, 2009. The agenda for the July 22, 2009 meeting and a list of the participants are listed in Appendix B.

2.0 A Description of the Problem

Describing and defining the problem of the unsafe and inappropriate methods of transporting children (injured, ill, or uninjured) from the scene of a crash or other incident in a ground ambulance is somewhat challenging, due to limited data involving such crashes. Also, existing protocols do not currently provide detailed guidance to EMS and child passenger safety professionals in the United States on how

best to safely transport children in ground ambulances from the scene of a traffic crash or medical emergency to a hospital or other facility.

In describing the problem, it should be noted that this project focused on developing recommendations for safely transporting children in ground ambulances by defining the project scope to address those situations for which the most evidenced-based information is available. As such, the issues of neonatal intensive care transportation and the unique circumstances that may present when transporting children with special health care needs in ground ambulances, while critically important, were considered outside of the purview of this effort and are not specifically addressed in the recommendations presented in this report. For the same reasons, while the inter-facility transportation of children in ground ambulances is not specifically addressed in the recommendations provided in this report, it is recognized that many of these recommendations would also apply to those patients.

Data sources regarding ambulance crashes involving child ambulance occupants in the United States, as well as abroad, are limited. There is no single national EMS dataset in the United States that can be analyzed to better understand the annual number of ambulance trips, the number that involve children, the frequency of ambulance crashes, the victims or types of injuries associated with such crashes, or the possible causes of such crashes and the injuries involved. While efforts are underway to enhance the National EMS Information System (NEMIS) to better inform EMS related policy, protocols, and practices, detailed data on crashes and other incidents involving ambulances are not easily extracted from existing EMS data collection systems.¹ While a number of States, local communities, and private sector EMS providers capture some of this information, this data is often not readily available or easily accessible on a national level.

Estimates suggest that ground EMS responds to approximately 30 million emergency calls each year.¹ Approximately 6.2 million patient transport ambulance trips occur annually,² of which approximately 10 percent of those patients are children.³ Insurance companies report that approximately 10,000 ambulance crashes result in injury or death each year.⁴ Estimates suggest that up to 1,000 ambulance crashes involve pediatric patients each year.⁵

Some information regarding ambulance crashes can be gleaned from analyses of data available from NHTSA's Fatality Analysis Reporting System (FARS). However, it should be noted that the FARS data do not capture crash information unless that crash results in a fatality. A research article published in 2006 examining the specific issue of ambulance crashes using FARS data from 1987 to 1997 reported that 339 ambulance crashes were recorded and that resulted in 405 fatalities and 838 injuries. These fatalities and injuries include those involving ambulance drivers and passengers, as well as other vehicle drivers and passengers, in addition to pedestrians and bicyclists.⁶

¹ Levick, N. R. (2007). Emergency Medical Services: A Transportation Safety Emergency. Paper presented at American Society of Safety Engineers' Professional Development Conference, June 24-27, 2007; Orlando, FL. Available at www.objectivesafety.net/2007ASSE628Levick.pdf.

² Levick, N. R. (2002). New Frontiers in optimizing ambulance transport safety and crashworthiness. *The Paramedic*; 4:36-39.

³ Winters, G., & Brazelton, T. (2003). Safe Transport of Children. *EMS Professionals*. July-August 2003:13-21.

⁴ American Ambulance Association. Position Paper: Safe Driving Statement, May 6, 2002. McLean, VA: Author. Available at www.the-aaa.org/about/positionpapers/afaedriving.html.

⁵ Winters & Brazelton.

⁶ Kahn, C. A. (2006). EMS, First Responders and Crash Injury. *Topics in Emergency Medicine*; 28(1)68-74.

An examination of 2010 FARS data indicates that two fatal crashes involving ambulances involved children (under age 18) who were riding in ambulances. However, in both cases the fatalities occurred in vehicles other than the ambulances. A 3-year-old female riding in the rear compartment of one of the ambulances involved in a fatal crash was uninjured and a 16-year-old male riding in the rear compartment of an ambulance involved in another fatal crash had only minor injuries.

Although recent crash data in the United States does not indicate that children are being killed or injured in ambulance crashes as patients or passengers, a review of local and national media coverage of ambulance crashes suggests that children of all ages may not be properly restrained while riding in ambulances and can potentially be injured if involved in a crash. Children riding in ambulances may be patients or passengers accompanying a parent or caregiver; they may be receiving transportation from the scene of a crash, a medical emergency, or involved in an inter-facility transport.⁷

Meanwhile, accepted national protocols for EMS and child passenger safety professionals in the United States for how best to safely transport children in ground ambulances from the scenes of traffic crashes or medical emergencies to hospitals or other facilities is very limited. There are unanswered questions regarding the placement and restraint of injured, ill, or uninjured children among EMS and child passenger safety professionals. The limited amount of national standards and protocols regarding the transportation of children in ground ambulances complicates the work of EMS professionals and may result in the improper and unsafe restraint of highly vulnerable child passengers. As a result, EMS agencies, advocates, and academicians have turned to NHTSA for leadership, which led to this effort.

3.0 Previous Guidance Regarding the Safe Transportation of Children in Emergency Ground Ambulances

The issue of variation in emergency child transport guidelines was first identified in a 1998 study that reported the results of a survey examining State requirements regarding the use of child restraint systems for children in ground ambulances.⁸ The study revealed that 35 States did not require patients of any age to be restrained in ground ambulances. Of those States that require the use of child restraint systems, requirements varied between those that require the child to be restrained on a cot, or restrained in a child restraint system, or restrained using both.

Following the publication of the 1998 study, NHTSA and the HRSA Emergency Medical Services for Children program (EMS-C) convened a national consensus committee to review EMS child transportation safety practices. This group of representatives from EMS national organizations, Federal agencies, and transportation safety engineers developed a document titled *The Dos and Don'ts of Transporting Children in an Ambulance* (December 1999). *The Dos and Don'ts* document provides general guidance for EMS practitioners in the field regarding how to most safely transport children in a ground ambulance. With respect to the safe transportation of children, *The Dos and Don'ts* document included the following recommendations:

⁷ NHTSA: Solutions to Safely Transport Children in Emergency Ground Ambulances; Literature Review Findings; May 28, 2009; Completed under NHTSA Contract: DTNH22-08-C00085 with Maryn Consulting, Inc. Sources for the articles obtained from LexisNexis search conducted in October 2008 include the Associated Press (1999, 2003, and 2008); Financial Times (2008), Press Association (1992 and 1995).

⁸ Seidel, J. S., & Greenlaw, J. (1998). Use of restraints in ambulances: a state survey. *Pediatric Emergency Care*; 14(3):221-3.

- *Do tightly secure all monitoring devices and other equipment.*
- *Do ensure available restraint systems are used by EMTs and other occupants, including the patient.*
- *Do transport children who are not patients, properly restrained, in an alternate passenger vehicle whenever possible.*
- *Do not leave monitoring devices and other equipment unsecured in moving EMS vehicles.*
- *Do not allow parents, caregivers, EMTs or other passengers to be unrestrained during transport.*
- *Do not have the child/infant held in the parent, caregiver, or EMT's arms or lap during transport.*
- *Do not allow emergency vehicles to be operated by persons who have not completed the DOT NHTSA Emergency Vehicle Operating Course (EVOC), National Standard Curriculum, or its equivalent.*

Since the publication of the *Dos and Don'ts* document, States, localities, and private EMS providers across the country have developed their own guidelines, some of which are more detailed than the *Dos and Don'ts* document. There remains, however, limited uniformity; EMS practitioners continue to struggle with unanswered questions. For example, a State EMS requirement to restrain all child passengers may result in the placement of a child in a child restraint system strapped to a side-facing bench in the rear compartment of an ambulance, rather than in the captain's chair of the ambulance. The use of a child restraint system in such a fashion is prohibited by all child restraint system manufacturers. In addition, safety researchers conclude it "is not recommended, because this usage applies the severity of a frontal impact to the less protected side-facing child."⁹ In this example, more specific guidance regarding the safest placement of the child is required.

Use of child restraints involved in a crash:

Please note that NHTSA recommends that child restraints should be replaced following a moderate or severe crash in order to ensure a continued high level of crash protection for child passengers.

In addition, NHTSA recommends the re-use of a child safety seat that has been involved in a "minor" crash. A "minor" crash should meet ALL the following criteria:

- a. The vehicle was able to be driven away from the crash site;
- b. The vehicle door nearest the safety seat was undamaged;
- c. There were no injuries to any of the vehicle occupants;
- d. The air bags (if present) did not deploy; AND
- e. There is no visible damage to the safety seat.

Source: www.nhtsa.gov/people/injury/childps/childrestraints/reuse/restraintreuse.htm

⁹ Bull, M. J., Weber, K. B., Talty, J., & Manary, M. A. (2001). Crash Protection for Children in Ambulances. In: *45th Annual Proceedings of the Association of the Advancement of Automotive Medicine (AAAM)*. Des Plaines, IL: AAA:353-367.

4.0 A “Non-Technical” Definition of a “Child”

Defining a “child,” in order to address the safe transportation of children in emergency ground ambulances and to provide an accurate framework for developing recommendations is also a challenge. In the course of reviewing existing data, professional articles, and official protocols, as well as media coverage, it was learned that the definition of a “child” is not always consistent or consistently addressed. In many cases, a focus on very young children can be inferred from the context of the article or protocol, but a uniform definition of child has not been developed for the purposes of emergency ground ambulance transport.

At its July 2009 meeting in Washington, DC, the expert members of the working group discussed options for defining a child for the purposes of this project by considering the following questions:

- Should age and/or stature be considered in developing our recommendations?
- Should we use previously established age categories?

The working group decided to use the terms child or children to represent all children, starting at birth. Next, the working group considered several possible options for defining a child, including: by age; by child restraint system requirements; or by height/weight. The working group considered the pros and cons of each option, what might be most useful to EMS professionals in the field, and what definition would be needed to ensure that all children would be safely transported. Among the options considered were NHTSA’s current car seat recommendations for children¹⁰ for the appropriate child restraint system to be used, based upon the child’s age. The prevailing view of the expert panel members of the working group was that the realities of delivering EMS in the field necessitates having an algorithm for safely transporting all occupants of a ground ambulance, regardless of age and by injury severity.

The working group members continued their deliberations by considering the following question:

- How is a "child" or a "pediatric patient" in the EMS setting defined with regard to operations? Examples include: choosing the appropriate type of therapy or determining if a specialized child restraint system must be used to transport a child safely by EMS.

There is a range of options here, and little consensus. The various definitions of a child or pediatric patient are inconsistent. The term "child" may be used to denote all non-adult patients, OR it may be used to represent all non-adult, non-adolescent patients, OR it may be used to represent all non-adult, non-adolescent, non-neonatal, and non-infants.

- Even the "non-adult" descriptor lacks consensus and is variable depending on the setting; it could be those under 17, 18, or 21 years old.
- Weight or length are commonly used to "proxy" for age in the field by EMS professionals to determine (e.g., using a measurement tape) if a patient is pediatric versus adult.
- EMS and medical personnel are not always accurate at estimating age, height, and weight.
- Parents and caregivers are also not always accurate at estimating age, height, and weight.

¹⁰ For details on NHTSA’s guidance for parents and caregivers on selecting and installing the proper child restraint for children, visit www.nhtsa.dot.gov and click on Child Safety.

To provide appropriate care, some EMS professionals prefer to use a very simple standard in the field: *if you think your patient is a child/pediatric patient, then treat and restrain the patient accordingly*. This approach eliminates one additional factor or issue of concern for EMS personnel and allows them to focus on the real perils of the child patient in EMS, including safe transportation, safe use of medications and provision of therapy. While this is a “non-technical” definition, the consensus of the working group was to adopt this definition. This definition is practical and could be easily adopted and implemented by EMS professionals and the working group recommends using it in the implementation of the recommendations contained in this report. EMS professionals, their agencies and others involved in the transportation of children in ambulances are urged to consider the use of a method or technique to more accurately define the weight and height of a child, if available, in order to determine the safest method of transportation. In this regard, EMS professionals, their agencies and others may consider using a length/weight-based measurement tool or other appropriate measurement device for pediatric equipment sizing to estimate height and weight.

5.0 Operational Safety Issues Related to the Safe Transportation of Children in Emergency Ground Ambulances

As stated in the Background of this report, the major goal of the working group was to develop a uniform set of recommendations to safely and appropriately transport children (injured, ill, or uninjured) from the scene of a crash or other emergency incident in a ground ambulance. As such, the working group was committed to developing recommendations that cover every aspect of an EMS ground ambulance response and the full coordination of response elements from the call-taker to the receiving medical facility.

With the foregoing in mind, the first principle to be followed to ensure the safe transportation of children in emergency ground ambulances is *to make everything as safe as possible*. It is important to note that safety for transporting a child in an ambulance starts with general operational policy and procedures that enhance ambulance safety for all occupants, regardless of age. These include:

- seat belt and restraint use for ALL ambulance occupants all of the time;
- securement of movable equipment;
- maintaining and cleaning neonatal and child restraint seats and equipment per manufacturer’s instructions;
- following current pediatric standards of care for injured children;
- driver screening and selection (including background checks as provided for by the State’s EMS personnel policy);
- training that includes hands-on emergency ground ambulance operation instruction;
- monitoring of driving practices through use of technology and other means;
- use of principles of emergency medical dispatching to determine resource and response modalities; and
- methods to reduce the unnecessary use of emergency lights and sirens (when transporting patients) when appropriate.

While the recommendations that follow may not mention these operational policy and procedures specifically, it is anticipated that EMS professionals and their organizations will implement operational policies and procedures that address these factors to the maximum extent possible.

To support the recommendations that follow, and within the limitations as stated, guidelines for the gathering of statistics and design engineering standards for the chassis, patient module, treatment equipment, and the testing and maintenance of those ideals will be required. It is important to note, however, that the project effort leading to the development of the recommendations contained in this report did not include a determination on these issues or others that may be related, e.g., evaluating the efficacy of one child restraint system compared to another; conducting field tests of transport solutions or equipment; evaluating the crashworthiness of EMS ground ambulances; and assessing ambulance design.

6.0 The Goal of the Recommendations

The ultimate goals of the recommendations contained in this report are to:

Prevent forward motion/ejection, secure the torso, and protect the head, neck, and spine of all children transported in emergency ground ambulances.

By ensuring that this goal is met in all scenarios involving the transportation of children in emergency ground ambulances from the scene of a traffic crash or medical emergency, the working group panel of experts believes that the safety of such transportation will be improved.

7.0 The Recommendations

The recommendations for the safe transportation of children via emergency ground ambulances from the scene of a traffic crash or medical emergency are presented as follows to address five situations:

Situation 1	For a child who is uninjured/not ill
Situation 2	For a child who is ill and/or injured and whose condition <i>does not require</i> continuous and/or intensive medical monitoring and/or interventions
Situation 3	For a child whose condition <i>requires</i> continuous and/or intensive medical monitoring and/or interventions
Situation 4	For a child whose condition <i>requires</i> spinal immobilization and/or lying flat
Situation 5	For a child or children who <i>require</i> transport as part of a multiple patient transport (newborn with mother, multiple children, etc.)

On occasion, one of the above situations may present the circumstance where an uninjured child or children may need to be transported from the scene of an emergency in order to ensure appropriate adult supervision to the uninjured child or children, and/or to provide for family continuity. The working group recommends that all EMS systems use this document and its recommendations and “pre-plan,” i.e., plan in advance for those situations events where infants and children may be on the scene - as primary patients or not - so such events can be successfully mitigated. Pre-planning for such events must also involve other public health, public safety and other partners to be most successful.

Some situations EMS systems and their partners need to pre-plan for are:

1. Injured or ill parents, guardians or caregivers who need to be transported to definitive care, with uninjured and well infants and/or children on the scene.
2. Events involving multiple patients who need to be transported. This may include a mother in labor or a parent/guardian and one or more newborns.

Addressing and planning for these situations in advance will better prepare EMS personnel and their agencies and other public safety personnel, patients, family members and the general public. Regardless of what type of vehicle is used in these situations, an age/size-appropriate child restraint system that complies with FMVSS No. 213 must always be used. **Generally speaking, when the number of patients exceeds the ability to provide adequate care with existing EMS personnel and emergency ground ambulances, or to secure child patients as described in the following recommendations, EMS personnel need to request additional transportation resources that can respond in a timely manner.**

“The Ideal” is the ultimate goal for safely and appropriately transporting children in emergency ground ambulances, and is presented in **bold** as the first recommendation for transporting a child in each of the five situations. “If the Ideal is not Practical or Achievable” is also provided in each of the five situations—this recommendation provides guidance to EMS professionals for the safe transportation of children if the Ideal cannot be achieved. For the situation involving the transportation of a child who is uninjured and/or not ill, a third recommendation for safely transporting the child, “If Resources are Limited,” is also presented.

Further, in addition to the guidance provided in the following recommendations, it is the consensus of the working group that **it is *not* appropriate to transport children, even in a child restraint system, on the multi-occupant squad bench located in the rear of ground ambulances.**

Appendix C, General Considerations and Selecting Child Restraint Systems for Ground Ambulance Transport, provides guidance to EMS providers for identifying equipment that may be used to meet the requirements of each of the recommendations. EMS providers are encouraged to check with equipment manufacturers for detailed information on the proper use and installation, results of crash testing, and possible limitations of any equipment that is obtained for the purposes of fulfilling the recommendations for the safe transportation of children in emergency ground ambulances.

Transportation of children in convertible child restraint systems or on car beds on an ambulance cot may be appropriate in some circumstances. Instructions for selection of equipment for this purpose and the installation are provided in Appendix D.

Situation 1 For a child who is uninjured/not ill ¹¹ (accompanying an injured or ill patient) Consult manufacturers' guidelines to determine optimal orientation for the child restraint (i.e., rear-facing or forward-facing) depending on the age and size of the child.	
The Ideal	<p>Transport the child in a vehicle other than an emergency ground ambulance using a size-appropriate child restraint system ¹² that complies with FMVSS No. 213.</p> <p>Consult child restraint manufacturers' guidelines to determine optimal orientation for the child restraint (i.e., rear-facing or forward-facing) depending on the age and size of the child.</p>
If the Ideal Is Not Practical or Achievable	<ol style="list-style-type: none"> 1. Transport the child in a size-appropriate child restraint system that complies with FMVSS No. 213 appropriately installed in the front passenger seat (with air bags in the "off" position, if an on/off switch is available) of the emergency ground ambulance (If EMS providers have turned off the air bag while transporting a child in the front seat of a vehicle with an on/off switch, they should reactivate the air bag after the child has been transported to the medical facility and the child restraint system has been removed from the front passenger seat); or 2. Transport the child in the forward-facing EMS provider's seat /captain's chair, which is currently rare in the industry) in a size-appropriate child restraint system that complies with FMVSS No. 213; or 3. Transport the child in the rear-facing EMS provider's seat/captain's chair in a size-appropriate child restraint system that complies with FMVSS No. 213. This system can be a convertible or combination seat using a forward-facing belt path). Do not use a rear-facing only seat in the rear-facing EMS provider's seat. ¹³ You may also use an integrated child restraint system certified by the manufacturer to meet the injury criteria of FMVSS No. 213; or 4. If necessary, transport the ill or injured patient in the original emergency ground ambulance and leave the non-ill, non-injured child under appropriate adult supervision on scene. Transport the non-ill, non-injured child in a size-appropriate child restraint system that complies with FMVSS No. 213 to a hospital, residence or other location, in another appropriate vehicle.

¹¹ Please consult Appendix C, General Considerations and Selecting Child Restraint Systems for Ground Ambulance Transport, for guidance on how to select equipment that may be used to meet the requirements of each of the recommendations. EMS providers are encouraged to check with equipment manufacturers for detailed information on the proper use and installation, results of crash testing, and possible limitations of any equipment that may be considered for use to fulfill the recommendations for the safe transportation of children in emergency ground ambulances.

¹² NHTSA's Ease of Use Ratings for child restraint systems is a five-star ratings system that allows parents and caregivers to evaluate how easy certain CRS features are to use before purchasing a seat for their personal use in transporting a child. While the testing requirements and regulations do not include emergency ground ambulances, EMS agencies and providers may wish to review the Ease of Use Ratings materials available at www.nhtsa.gov when selecting CRS systems for use in emergency ground ambulances.

¹³ Please note that a rear-facing-only child restraint system cannot be installed on a rear-facing EMS provider's seat as it does not have a forward-facing belt path and is engineered to face rearward on a forward-facing seat. As such, a rear-facing-only seat will not safely secure a child in a rear-facing EMS provider's seat.

Situation 2 For a child who is ill and/or injured and whose condition <i>does not</i> require continuous and/or intensive medical monitoring and/or interventions¹⁴	
The Ideal	Transport the child in a size-appropriate child restraint system that complies with the injury criteria of FMVSS No. 213—secured appropriately on cot.
If the Ideal Is Not Practical or Achievable	<ol style="list-style-type: none"> 1. Transport in the forward-facing EMS provider’s seat/captain’s chair, which is currently rare in the industry, in a size-appropriate child restraint system that complies with FMVSS No. 213. Consult child restraint manufacturers’ guidelines to determine optimal orientation for the child restraint (i.e., rear-facing or forward-facing), depending on the age and size of the child. 2. Transport the child in the rear-facing EMS provider’s seat/captain’s chair in a size-appropriate child restraint system that complies with FMVSS No. 213. This system can be a convertible or combination seat using a forward-facing belt path. Do not use a rear-facing-only seat in the rear-facing EMS provider’s seat.¹⁵ You may also use an integrated child restraint system certified by the manufacturer to meet the injury criteria of FMVSS No. 213; or 3. Secure the child to the cot,¹⁶ head first, using three horizontal restraints across the child’s torso (chest, waist, and knees) and one vertical restraint across each of the child’s shoulders. The cot should be positioned (subject to the manufacturer’s specifications) to provide for the child’s comfort based upon the child’s injuries and/or illness and to allow for appropriate medical care.

¹⁴ Please consult Appendix C, General Considerations and Selecting Child Restraint Systems for Ground Ambulance Transport, for guidance on how to select equipment that may be used to meet the requirements of each of the recommendations. EMS providers are encouraged to check with equipment manufacturers for detailed information on the proper use and installation, results of crash testing, and possible limitations of any equipment that may be considered for use to fulfill the recommendations for the safe transportation of children in emergency ground ambulances.

¹⁵ Please note that a rear-facing-only child restraint system cannot be installed on a rear-facing EMS provider’s seat as it does not have a forward-facing belt path and is engineered to face rearward on a forward-facing seat. As such, a rear-facing-only seat will not safely secure a child in a rear-facing EMS provider’s seat.

¹⁶ All children transported on a cot shall be restrained to the cot with the 5-point cot restraint system that includes three horizontal restraints across the torso (chest, waist, and knees) and one vertical restraint across each shoulder.

Situation 3 For a child whose condition requires continuous and/or intensive medical monitoring and/or interventions¹⁷	
The Ideal	Transport child in a size-appropriate child restraint system that complies with the injury criteria of FMVSS No. 213—secured appropriately on cot.
If the Ideal Is Not Practical or Achievable	Secure the child to the cot; ¹⁸ head first, with three horizontal restraints across the torso (chest, waist, and knees) and one vertical restraint across each shoulder. If the child’s condition requires medical interventions, which requires the removal of some restraints, the restraints should be re-secured as quickly as possible as soon as the interventions are completed and it is medically feasible to do so. In the best interest of the child and the EMS personnel, the emergency ground ambulance operator is urged to consider stopping the ambulance during the interventions. If spinal immobilization of the child is required, please follow the recommendation for Situation 4.

¹⁷ Please consult Appendix C, General Considerations and Selecting Child Restraint Systems for Ground Ambulance Transport, for guidance on how to select equipment that may be used to meet the requirements of each of the recommendations. EMS providers are encouraged to check with equipment manufacturers for detailed information on the proper use and installation, results of crash testing, and possible limitations of any equipment that may be considered for use to fulfill the recommendations for the safe transportation of children in emergency ground ambulances.

¹⁸ All children transported on a cot shall be restrained to the cot with the 5-point cot restraint system that includes three horizontal restraints across the torso (chest, waist, and knees) and one vertical restraint across each shoulder.

Situation 4 For a child whose condition requires spinal immobilization and/or lying flat¹⁹	
The Ideal	Secure the child to a size-appropriate spineboard and secure the spineboard to the cot,²⁰ head first, with a tether at the foot (if possible) to prevent forward movement. Secure the spineboard to the cot with three horizontal restraints across the torso (chest, waist, and knees) and a vertical restraint across each shoulder.
If the Ideal Is Not Practical or Achievable	Secure the child to a standard spineboard with padding added, as needed, (to make the device fit the child) and secure the spineboard to the cot, head first, with a tether at the foot (if possible) to prevent forward movement. Secure the spineboard to the cot with three horizontal restraints across the torso (chest, waist, and knees) and a vertical restraint across each shoulder.

¹⁹ Please consult Appendix C, General Considerations and Selecting Child Restraint Systems for Ground Ambulance Transport, for guidance on how to select equipment that may be used to meet the requirements of each of the recommendations. EMS providers are encouraged to check with equipment manufacturers for detailed information on the proper use and installation, results of crash testing, and possible limitations of any equipment that may be considered for use to fulfill the recommendations for the safe transportation of children in emergency ground ambulances.

²⁰ All children transported on a cot shall be restrained to the cot with the 5-point cot restraint system that includes three horizontal restraints across the torso (chest, waist, and knees) and one vertical restraint across each shoulder.

Situation 5

For a child or children requiring transport as part of a multiple patient transport (newborn with mother, multiple children, etc.).²¹ Consult child restraint manufacturers' guidelines to determine optimal orientation for the child restraint (i.e., rear-facing or forward-facing) depending on the age and size of the child.

<p>The Ideal</p>	<ol style="list-style-type: none"> 1. If possible, for multiple patients, transport each as a single patient according to the guidance shown for Situations 1 through 4. 2. Transport in the forward-facing EMS provider's seat /captain's chair, which is currently rare in the industry) in a size-appropriate child restraint system that complies with FMVSS No. 213. 3. For mother and newborn, transport the newborn in an approved size-appropriate child restraint system that complies with the injury criteria of FMVSS No. 213 in the rear-facing EMS provider seat /captain's chair) that prevents both lateral and forward movement, leaving the cot for the mother. Use a convertible seat with a forward-facing belt path). Do not use a rear-facing only seat in the rear-facing EMS provider's seat.²² You may also use an integrated child restraint system certified by the manufacturer to meet the injury criteria of FMVSS No. 213. <p>PLEASE NOTE: A child passenger, especially a newborn, must never be transported on an adult's lap. Newborns must always be transported in an appropriate child restraint system. Never allow anyone to hold a newborn during transport.</p>
<p>If the Ideal Is Not Practical or Achievable</p>	<p>When available resources prevent meeting the criteria shown for the previous Situations 1 through 4 for all child patients, including mother and newborn, transport using space available in a non-emergency mode, exercising extreme caution and driving at reduced (i.e., below legal maximum) speeds.</p>

²¹ The working group recommends that all EMS systems pre-plan for those situations where multiple infants and children may be on the scene - as primary patients or not - so such events can be successfully mitigated. Pre-planning for such events must also involve other public health, public safety and other partners to be most successful. An example of such an event is one that involves multiple patients, i.e., infants and/or children who need to be transported (to include a mother in labor or with one or more newborns).

²² Please note that a rear-facing-only child restraint system cannot be installed on a rear-facing EMS provider's seat as it does not have a forward-facing belt path and is engineered to face rearward on a forward-facing seat. As such, a rear-facing-only seat will not safely secure a child in a rear-facing EMS provider's seat.

	If additional ground ambulances may be needed based upon preliminary information, request additional ground ambulances to help with transport as soon as possible.
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8.0 LIMITATIONS OF THE RECOMMENDATIONS

As stated previously, the major goal of this project is “to provide consistent national recommendations that will be embraced by local, State, and national emergency medical services organizations, enabling them to reduce the frequency of emergency transport of ill, injured or uninjured children in an unsafe or inappropriate manner.” The most critical aspects of this goal are consistency, practicality and ultimately safety. As reported in the literature review, an examination of existing guidelines, protocols or standards reveals that while over the years States, localities, associations and EMS providers have developed legislation, guidelines or protocols regarding this issue, standards vary across jurisdictions and often provide limited, or in some cases inappropriate, guidance. It is hoped that the recommendations provided in this report will address the lack of consistent standards or protocols among EMS and child passenger safety professionals in the United States regarding how to most safely transport children in ground ambulances from the scene of a traffic crash or medical emergency to a hospital or other facility. It should be noted that the expectation is that States, localities, associations, and EMS providers will implement these recommendations to improve the safe transportation of children in emergency ground ambulances when responding to calls encountered in the course of day-to-day operations of EMS providers. In addition, it is hoped that EMS providers will be better prepared to safely transport children in emergency ground ambulances when faced with disaster and mass casualty situations.

In developing the recommendations and as was noted elsewhere in this report, various issues related to ambulance safety and equipment safety are important for discerning between safe and unsafe methods of transporting children in emergency ground ambulances. However, it is outside the purview of this project to conduct the vast amount of engineering research, crash testing, and field work that would be required to evaluate and determine the effectiveness of ambulance vehicles and child restraint and medical equipment currently available and in use for the purposes of transporting children in emergency ground ambulances.

As such, it is important to note the limitations of the recommendations presented in this report. The deliberations that led to the development of these recommendations did not include efforts to:

- Evaluate the efficacy of one child restraint system over another;
- Address the unique transportation challenges of children with special health care needs;
- Address the special transportation requirements of neonates and children with complex medical problems;
- Identify specific strategies that may be also be needed at the local, State, and national levels to safely transport children in emergency situations involving disasters and mass casualties;
- Conduct any field tests of solutions or equipment;
- Evaluate the crashworthiness of emergency ground ambulances; or
- Assess ambulance design.

Nevertheless, it is hoped that the detailed protocols provided by the recommendations presented in this report will help enhance the safety of children transported in emergency ground ambulances in the U. S.

9.0 ADDITIONAL CONSIDERATIONS

The intent of the recommendations presented in this report is to improve the safe transport of children in emergency ground ambulances. In the course of the deliberations of the working group that led to the recommendations, a number of important issues outside of the purview of this effort were identified. While these issues do not preclude improving the safe transportation of children in emergency ground ambulances, the working group believes it is important their notation be made for further study by the appropriate governmental, medical, professional, or other entities. These additional considerations are presented below:

9.1 Considerations for Governmental and Other Entities

1. Expedite efforts to enhance the NEMSIS to collect detailed data on crashes involving emergency ground ambulances and their passengers of all ages and make these data available at the State and national level.
2. Encourage State EMS agencies to share data with the State Highway Safety Offices and NEMSIS by collaborating on modifications to or an exemption from the Health Insurance Portability and Accountability Act of 1996 (HIPAA) to facilitate the development of NEMSIS.
3. Conduct further study to identify strategies for use at the local, State, and national level that may be needed to safely transport children when faced with disaster and mass casualty incidents.
4. Conduct further study to develop recommendations for the safe transportation of children in situations involving inter-facility transport.
5. Examine real world data to evaluate crash protection of restrained occupants in emergency ground ambulances.
6. Examine real world data to evaluate the structural stability and restraint of cots and other transport devices (including incubators) used for transporting children in emergency ground ambulances.
7. Determine the need for developing standards for child restraint systems and cot restraints that meet the unique medical needs during the transportation of term and pre-term neonates (neonatal transports).
8. Determine the need for developing standards for child restraint systems and cot restraints that meet the medical needs of children with special health care and/or complex medical problems.
9. Examine real world data to evaluate crashworthiness of ground ambulances.

9.2 Considerations for Manufacturers

1. Develop child restraint systems that meet or exceed the injury criteria for FMVSS No. 213 to accommodate child patients of various heights and weights (or lengths including newborn/infant patients) for use on cots in ground ambulances.
2. Develop an integrated cot restraint system that, when tested with child dummies in a dynamic sled test environment simulating a 30 mph ambulance frontal crash, results in dummy injury metrics that are equal to or lower than those specified in FMVSS No. 213
3. Develop products and provide instructions that improve correct and easier use of devices designed for ambulance use.
4. Determine the need to develop crash-tested child restraint systems for use in the rear- or forward-facing EMS provider's seat of ground ambulances.
5. Ensure all EMS personnel seats meet or exceed all applicable FMVSS requirements and can accommodate convertible or rear-facing-only child restraint systems (and adult passenger with three-point belt).
6. Develop improved crashworthy methods of seating for all occupants in the rear of the emergency ground ambulance compartment.

Appendix A
Solutions to Safely Transport Children in Emergency Ground Ambulances

Literature Review Findings

May 28, 2009
Contract: DTNH22-08-C00085



Executive Summary

In September 2008 the National Highway Traffic Safety Administration initiated a project titled “Solutions to Safely Transport Children in Emergency Vehicles.” The objectives of this project are:

1. To initiate consensus building in the development of recommendations to safely and appropriately transport children (injured, ill, or uninjured) from the scene of a crash or other incident in a ground ambulance. Draft recommendations will be created after reviewing relevant research and the practices that are currently being used to transport children in ambulances.
2. To provide recommendations that will be embraced by local, State and national EMS organizations, enabling them to reduce the frequency of inappropriate emergency transportation of ill, injured or uninjured children.

A first step to achieving these objectives is the completion of a literature review of current practices for the emergency transportation of child passengers in ground ambulances. Emphasis includes research in professional journals and elsewhere that describes an ideal or model uniform approach to transport children safely in ambulances, as well as articles and publications that document unsafe or incorrect practices. It should be noted that throughout the remainder of this document, references to ambulances are limited to ground ambulances, unless otherwise noted.

The objective of this report is to provide representatives from the NHTSA with a summary of findings from the literature review. This document is designed to provide NHTSA representatives with an overview of the published research conducted to date regarding the safe transportation of children in emergency vehicles, primarily ambulances. This Literature Review Findings report will serve as a point of reference for consensus building efforts going forward.

During the course of the literature review, researchers from Maryn Consulting, Inc. reviewed several hundred pages of information related to ambulance safety issues and the transport of children in ambulances. Relevant sources were then organized by topic (statistical information, existing guidelines, current practices and outcomes, safety research, etc.). Once organized, researchers examined these sources in depth and recorded information relevant to this study. Finally, researchers analyzed this information and extracted key findings for inclusion in this Literature Review Findings document.

To aid in the review of this document Maryn has organized the summary findings by topic. Below is a list of the topics covered in this document:

Background: This section provides an overview of statistical findings and data sources specific to ambulance transport issues and child transport in ambulances. This section also references media coverage of the issue of child transport in ambulances.

Ambulance Safety Issues: This section provides an overview of ambulance safety issues in general, with references to research and publications regarding this topic.

Child Transport in Ambulances: Existing Guidelines: This section provides an overview of the current published guidelines regarding the safe transport of children in ground ambulances at the national and State levels, as well as those promulgated by relevant practitioner associations.

Child Transport in Ambulances: Current Practices and Outcomes: This section describes current trends in the transport of children in ambulances, and describes questions identified by practitioners regarding this topic.

Child Transport in Ambulances: Safety Research: This section provides an overview of engineering and safety research findings regarding safe and unsafe methods of transporting children in ground ambulances.

Background

Data sources regarding ambulance crashes involving child ambulance occupants in the United States, as well as abroad, are limited. In the United States there is no single, national EMS dataset that can be analyzed to better understand the annual number of ambulance trips, those that involve children, the frequency of ambulance crashes, the victims or types of injuries associated with such crashes, or the causes of such crashes. At this time efforts are underway to develop NEMSIS to capture some of this data so as to better inform EMS related policy, protocols and practices.¹ Many States and private sector EMS providers also capture some of this information. However, these data are often not readily available or easily accessible.

Estimates suggest that ground EMS responds to approximately 30 million emergency calls each year.² Approximately 6.2 million patient transport ambulance trips occur annually,³ of which approximately 10 percent of those patients are children.⁴ Insurance companies report that approximately 10,000 ambulance crashes result in injury or death each year.⁵ Estimates suggest that up to 1,000 ambulance crashes involve pediatric patients each year.⁴ Occupational safety data indicate that “the transportation-related mortality rate for EMS personnel (per 100,000 workers) is 9.6, a rate that eclipses the national average (2.0) and exceeds that of police (6.1) and firefighters (5.7).”⁶

Some information regarding ambulance crashes can be learned from analyses of NHTSA’s Fatality Analysis Reporting System data. However, it should be noted that this data does not capture crash information unless that crash results in a fatality. A research article published in 2006 examining the specific issue of ambulance crashes used FARS data reported between 1987 and 1997 to find that 339 ambulance crashes resulted in 405 fatalities and 838 injures. These fatalities and injuries include those involving ambulance drivers and passengers, as well as other vehicle drivers and passengers, in addition to pedestrians and bicyclists.⁶

An examination of 2007 FARS data indicates that three fatal ambulance crashes reported that year involved children present in the ambulances. In one case the child was not injured; in two cases the children suffered minor injuries.⁷ Because FARS data does not include all ambulance crashes, it is estimated that the number of children injured in ambulance crashes that do not result in fatalities is significantly higher than numbers reflected in FARS (see above). Additional analysis of the FARS data indicates that in 2007 there were 29 fatal ambulance crashes that involved 82 people, including ambulance drivers and passengers, as well as other vehicle drivers and passengers, in addition to pedestrians and bicyclists. Data suggest that during that year 34 people in the rear compartments of ambulances were involved in these fatal accidents.⁷

A review of local and national media coverage of ambulance crashes involving injuries to children suggests such crashes are dangerous. Articles in newspapers across the world, as well as televised news coverage at the local level, suggest ambulance crashes involve children of all ages and can result in injuries ranging from minor to fatal. Injured children may be patients or passengers accompanying a caregiver; they may be receiving transport from the scene of a crash, a medical emergency, or involved in an inter-facility transport.

Presently, there are no accepted protocols among EMS and child passenger safety professionals in the United States for how best to safely transport children in ground ambulances from the scene of a traffic crash or medical emergency to a hospital or other facility.

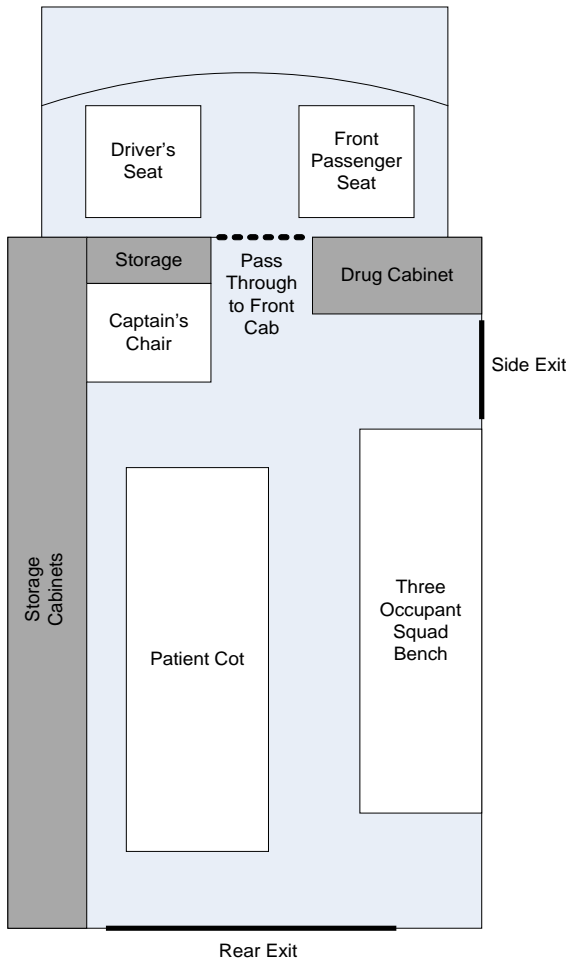


Figure 1: Ambulance Rear Compartment

drivers and medical technicians, as well as other vehicle drivers, passengers and pedestrians. Findings indicated that while “wearing a passenger restraint device was highly significant and protective.”⁸ the use of passenger restraints among patients, technicians and drivers was not common. Additional findings suggested that the risk of an “injury-accident” increased during nighttime and at intersections.⁸

A more comprehensive study examining the characteristics of fatal ambulance crashes across the country between 1987 and 1997 found that ambulance crashes “occurred more often between noon and 6 [p.m.] ... through an intersection ... and striking another vehicle.” Inside the ambulance, the “most serious and fatal injuries occurred in the rear ... and to improperly restrained occupants.”⁹ These findings

There are unanswered questions regarding the placement and restraint of injured, ill, or uninjured children among EMS and CPS professionals. The absence of consistent protocols regarding the transportation of children in ground ambulances complicates the work of EMS professionals and may result in the improper restraint of highly vulnerable child passengers. EMS agencies, advocates and academicians have turned to NHTSA for leadership.

Lastly, it should be noted that when reviewing existing data, professional articles, and protocols, as well as media coverage of this issue, the definition of a “child” is not always consistent, or consistently addressed. In many cases a focus on very young children can be inferred from the context of the article or protocol, but a uniform definition of child has not been developed for the purposes of emergency ambulance transport.

Ambulance Safety Issues

In 1987, a group of researchers reported on an examination of 102 ambulance crashes in Tennessee in one of the first published efforts to better understand the causes and effects of ambulance crashes on patients, passengers, ambulance

regarding injuries to ambulance occupants are supported by similar research examining the characteristics of ambulance crashes.¹⁰

Subsequent research conducted during the early 2000s examined ambulance crashes, and compared ambulance travel to travel in other motor vehicles. Findings suggest that travel in ambulances is less safe than travel in other motor vehicles for all passengers, including patients. A study conducted in Pennsylvania, comparing motor vehicle crashes involving ambulances and similarly sized vehicles, revealed that “ambulance crashes occur more frequently at intersections and traffic signals and involve more people and more injuries than those of similar sized vehicles.”¹¹ Findings from another study using national data suggest that “relative to police cars and fire trucks, ambulances experienced the highest percentage of fatal crashes where occupants are killed and the highest percentage of crashes where occupants are injured.”¹⁰ It should be noted that while ambulance crashes are dangerous for ambulance occupants, data suggest that individuals in other vehicles, pedestrians or bicyclists are significantly more likely to be injured or killed as a result of an ambulance crash than the ambulance occupants themselves.⁹

From an occupational safety perspective, research suggests that ambulance design may inhibit the use of safety restraints by emergency medical technicians. In order to perform certain clinical tasks, such as administering oxygen or performing CPR, paramedics may require different positioning than that permitted by the use of restraints in either the captain’s chair or a side bench.¹² More generally, research suggests that ambulance crashes are the most common cause of work-related fatalities among EMS workers.² Figures 1 and 2 are diagrams of common rear compartment designs of ambulances.¹³

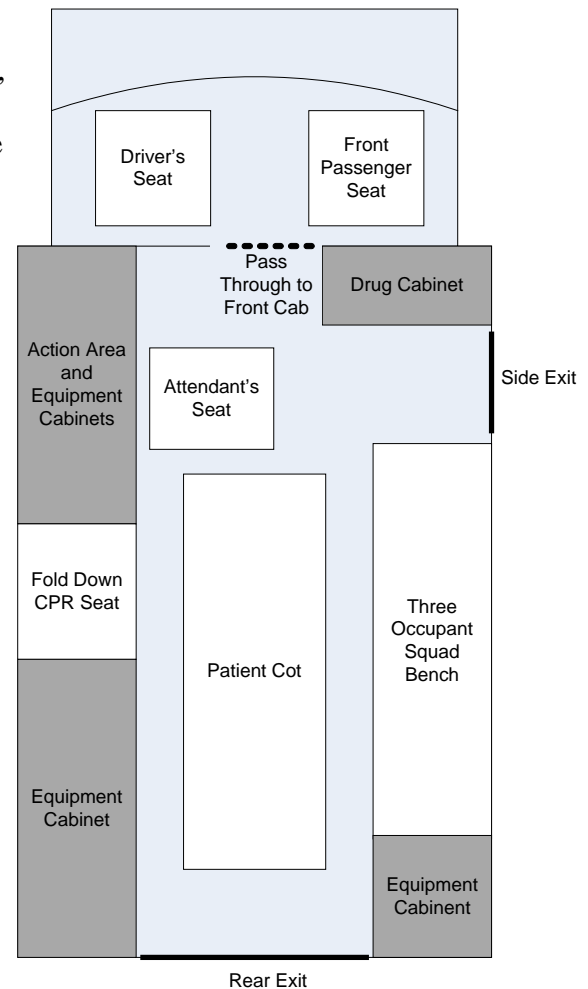


Figure 2: Ambulance Rear Compartment

Safety standards regarding the EMS transport environment are limited, both in the United States and internationally. In the United States, Federal purchase specifications for ambulances are defined in a document published by the U.S. General Services Administration, *Federal Specifications for the Star-of-Life Ambulance*.¹⁴ These specifications require that ambulances purchased by Federal Government agencies meet applicable Federal Motor Vehicle Safety Standards, specifically those addressing braking requirements, fuel systems, lights, reflective devices, door latches and hinges, as well as emergency medical services provider (EMSP) seating and patient compartment seating. All seating positions, in the front and rear ambulance compartments, must be equipped with seat belts. The ANSI/ASSE Z15.1 fleet management standard, published in March 2006, now applies to EMS fleets. This standard applies to a wide variety of fleet and non-fleet vehicles and requires organizations to have a policy in place pertaining to the use of seat belts, and recommends, but does not require, mandatory seat belts be used on behalf of a business or an organization.¹⁵

It should be noted that the designs of rear compartments of ambulances vary widely. Figures 1 and 2 depict typical ambulance designs, but many ambulances may vary in the placement of cots, cabinets, and squad benches as well as the type of pass through to the front cab.

Child Transport in Ambulances: Guidelines

As EMS practitioners encounter a situation requiring the emergency transport of a child in an ambulance, limited guidance is available. In order to identify the best method of restraint, a practitioner must consider the age and stature of the child, if that child is injured or is an accompanying passenger, the medical stability of the patient, and the available locations where the child can be safely restrained inside the ambulance. The wide variation of potential scenarios presents challenges to EMS practitioners.

An examination of existing guidelines, protocols or standards reveals that while over the years States, localities, associations and EMS providers have developed legislation, guidelines or protocols regarding this issue, standards vary across jurisdictions and often provide limited, or in some cases inappropriate, guidance. As discussed earlier, there are no widely accepted protocols among EMS and child passenger safety professionals in the United States for how best to safely transport children in ground ambulances from the scene of a traffic crash or medical emergency to a hospital or other facility.

This issue of variation in emergency child transport guidelines was first identified in a 1998 publication that reported the results of a survey examining State requirements regarding the use of safety restraints for children in ambulances. The study revealed that 35 States did not require patients of any age to be restrained in ambulances. Of those States requiring the use of child safety restraints, requirements varied between requiring restraint on a gurney, in a child seat, or both. Variation across States in the definition of a “child” ranged from individuals under the age of 4 to individuals under 21. At that time the State agencies responsible for the regulation of ambulance services in each State varied as well. Responsible agencies included State EMS, law enforcement, and public safety agencies, as well as Departments of Transportation and Motor Vehicles. Fourteen States did not regulate EMS services. In some States, multiple agencies were involved in the regulation of ambulance safety.¹⁶ This study also noted that at that time “the exact method to safely secure infants and smaller children in ambulances has ... not been well conceived.”¹⁶ Among other recommendations, the authors suggested that a universal age definition of pediatric patient be established, “a method for safely securing infants and children in ambulances...be developed,” and that “biomechanical research on ambulance safety and crashes...be undertaken.”¹⁶

One year after the publication of these State survey findings, the HRSA Emergency Medical Services for Children program and NHTSA convened a national consensus committee to review EMS child transportation safety practices. This group of representatives from EMS national organizations, Federal agencies, and transportation safety engineers developed a document titled *The Dos and Don'ts of Transporting Children in an Ambulance*, which was published in December 1999. This document provides very general guidance for practitioners in the field regarding how to most safely transport children in an ambulance. In addition to recommendations specific to safe emergency driving, guidance also includes the following recommendations:

- *Do tightly secure all monitoring devices and other equipment.*
- *Do ensure available restraint systems are used by EMTs and other occupants, including the patient.*

- *Do not transport children who are not patients, properly restrained, in an alternate passenger vehicle whenever possible.*
- *Do not leave monitoring devices and other equipment unsecured in moving EMS vehicles.*
- *Do not allow parents, caregivers, EMTs or other passengers to be unrestrained during transport.*
- *Do not have the child/infant held in the parent, caregiver, or EMT's arms or lap during transport.*
- *Do not allow emergency vehicles to be operated by persons who have not completed the DOT NHTSA Emergency Vehicle Operating Course (EVOC), National Standard Curriculum, or its equivalent.*

This document does not define “child” with regards to age or stature. The document also states that through grant funds, researchers are “working to fill critical knowledge gaps and developing standards for pediatric EMS transport safety.”¹⁷ However, to date, the federal government has not published more specific guidance.

Since the publication of this *Dos and Don'ts* document, States, localities, and private EMS providers across the country have developed guidelines that include similar information for internal operations. Using safety research published in 2001, some of these guidelines are more detailed than the *Dos and Don'ts* document (see pp. 7-8). However, there is limited uniformity across these publicly and privately promulgated guidelines.

Despite the publication of *Dos and Don'ts* by the Federal Government, and the development of moderately more detailed guidelines across the country, EMS practitioners continue to struggle with unanswered questions. In many cases, the issue of age or size is not addressed. As discussed above, some of the recommended practices are conflicting, others are impractical, and others may be insufficiently detailed to provide useful guidance. For example, a State EMS requirement to restrain all child passengers may result in the placement of a child in a car seat strapped to a side-facing bench in the rear compartment of an ambulance, rather than the captain's seat. In addition, safety researchers conclude it “is not recommended, because this usage applies the severity of a frontal impact to the less protected side-facing child.”¹⁸ In this example, more specific guidance regarding the placement of a child in a side-facing position is required.

It should be noted that more focused research and detailed guidance has been developed for specialized ambulance services providing inter-facility transport of children between hospitals and other care facilities.¹⁹ Due to the specific population focus of these vehicles, these ambulances are typically more appropriately equipped for pediatric transport. Lessons derived from this body of work may inform the efforts to better guide EMS practitioners with regards to emergency child transport. Similarly, standards for the transport of pediatric patients in air ambulances may offer guidance regarding safe protocols for child restraint, particularly injured patients.

Child Transport in Ambulances: Current Practices and Outcomes

Given the limited and sometimes conflicting guidance provided at the Federal, State and local levels, actual emergency child transport practice in ground ambulances varies dramatically. Academic research, as well as anecdotal information published in practitioner publications, suggests that there is

confusion or ambiguity regarding the safe transport of children in ambulances. Actual practices and protocols are often inconsistent. EMS provider training often omits specific discussions of pediatric emergency transport. In many cases, appropriate equipment may be unavailable, leaving the provider to improvise without clear guidance.

In 2000 the results of a study examining the knowledge, opinions, and behaviors of EMS personnel regarding child and provider restraint use in ambulances were published. This study involved surveying EMS providers in a midsized urban area and based its analyses on published safety research that was available at that time, including the *Dos and Don'ts* document. Findings indicated that large percentages of EMS providers did not correctly indicate the safest method of transporting a 2-year-old child (30%) or correctly securing a child seat to an ambulance cot (40%). This study also indicated that although a significant majority (80%) of EMS providers regularly transports children in car seats, approximately 23 percent of providers reported that they occasionally transport children in adult laps. Additionally, 70 percent of EMS providers reported not using seat belts themselves on the squad bench, with 55 percent indicating that using restraints impairs their ability to provide patient care. Not surprisingly, this study also found that specialized emergency pediatric transport services personnel responses more often correctly identified the safest methods of emergency child transport.²⁰

Findings from the 2000 research publication are supported by similar findings from previous examinations of emergency child transport practices, and anecdotal evidence. The observation of approximately 200 ambulance hospital arrivals involving children under 14 in a midsized urban area in 1999 suggested that children were transported without restraints on the side-bench (squad bench seat), in the captain's chair, or in an adult's lap approximately 37 percent of the time. An additional 5 percent were transported without restraints on the ambulance gurney (patient cot).²¹ Publications for EMS practitioners, including journals and newsletters, also refer to the common practices of allowing stable child patients to travel in the laps of adults, and strapping children to cots using the cot belt systems that are designed for adult patients.^{4, 22}

A lack of clear guidelines and consistent training results in these varied practices. In addition, the dynamic nature of emergency medicine requires that solutions take into consideration numerous potential scenarios. The EMS community has identified the following issues related to emergency pediatric transport that remain unresolved:

- *Using a child's own convertible car seat (that has been involved in a crash) properly restrained in the ambulance or transferring the child to a different car seat or car bed for proper restraint in the ambulance;*
- *How to handle child crash victims in car seats that are not convertible models when injuries may be aggravated by transferring them to another method of restraint in the ambulance;*
- *Validation of ambulance-specific test procedures for car seats;*
- *Using a convertible car seat contrary to manufacturer instructions; and*
- *Not all ambulance gurneys have the latest, strongest anchorages to the vehicle floor.*²²

NHTSA has issued a general position statement regarding the reuse of a child restraint that has been involved in a crash. The NHTSA position is that a child restraint may be reused after involvement in a "minor" crash; one of the criteria in the definition of "minor" is that no vehicle occupants are injured.²³ Given that the transport of a child from a crash in an ambulance typically is associated with an injury,

either to the child or his/her caregiver, the NHTSA position does not directly address the first issue noted above by the EMS community.

Despite these identified unresolved emergency child transport questions and the potential for child injury in the rear compartment of an ambulance, a review of legal cases in Westlaw suggests that very few, if any, legal cases involve the improper or lack of restraint of child passengers in the rear compartment of a ground ambulance.

Child Transport in Ambulances: Safety Engineering Research

Very limited safety engineering research has been conducted to identify the safest methods of transporting children in ambulances. However, the principles of child and patient restraint are useful in developing recommended protocols and practices for child restraint in ground ambulances, as well as guiding safety research and crash testing activities. Existing safety engineering research on this issue focuses on younger children, primarily those 6 and younger.

In 2001, Dr. Marilyn Bull, with her colleagues from the Indiana University School of Medicine and the University of Michigan, conducted ambulance crash tests to specifically examine safety outcomes when using convertible car seats, car beds, and harness systems, with 3-year-old, infant and 6-year-old size dummies. The published results are summarized below:

A two-belt attachment with elevated cot backrest was found to be the method with the least performance variability for securing either a convertible child restraint or a car bed. It was concluded that children who weight up to 18 kg, fit in a convertible child restraint, and can tolerate a semi-upright seated position can be restrained in a convertible child restraint secured with two belts to an ambulance cot. Infants who must lie flat can be restrained in a car bed modified for two seat belt paths and secured to a cot. In each case, the cot backrest must be elevated, and the cot and anchor system must be crashworthy. None of the harness configurations tested proved to be satisfactory, but an effective system could be developed by following accepted restraint design principles.¹⁸

In addition to discussing the findings of the specific crash tests conducted by this team of researchers, this study also provides an overview of safety issues involved with the use of restraints for children in other locations within the rear ambulance compartment. The authors suggest it may be possible on some occasions to restrain a child or infant in the rear-facing captain's chair. Some child restraint manufacturers may provide instructions for the installation of a convertible car seat in this seat. Additionally, many of these seats are now equipped with a built-in child restraint that is acceptable for use with an uninjured or less critically injured child (not an infant). However, the authors note, the utilization of the technician seat for a child prohibits the use of that seat for emergency medical personnel. The placement of a child in a car seat strapped onto the side bench in the rear compartment of the ambulance "is not recommended, because this usage applies the severity of a frontal impact to the less protected side-facing child."¹⁸ As discussed above, the use of harnesses on the patient cot for a younger child is not crashworthy. Last, a child held by a properly restrained adult is not an acceptable practice as it leaves the child unrestrained.

The “Conclusions and Recommendations” section of this study has been widely circulated within the EMS community. States, localities, EMS providers, and practitioner associations have incorporated Dr. Bull’s recommendations into protocols and guidelines for EMS practitioners.^{24 25 26} However, as Dr. Bull and her colleagues noted in their findings, these tests were completed using a newer cot and anchor system with a “slide-in track to hold the cot firmly to the ambulance floor.”¹⁸ This system is often not found in older ambulance models. Crash tests conducted in 1998 found that this older type of cot and fastener “did not provide a secure platform for the child restraint.”¹⁸ Therefore, the findings of the 2001 study may not provide the same degree of protection for child transport when older cot and anchor systems are used but may improve safety even in those circumstances in less severe crashes.

Also in 2001, colleagues from the Center for Transportation Injury Research and the U.S. Navy’s Naval Air Warfare Center Aircraft Division at Naval Air Station Patuxent River conducted ambulance crash tests that examined more general dynamics inside the rear compartment of an ambulance during a crash. These tests included a 3-year-old size dummy restrained in a convertible car seat strapped to an ambulance cot in the same manner described in the child restraint crash test. Additionally, three adult dummies of varying sizes, and medical equipment typically found inside the rear ambulance compartment, were involved in the crash tests. Results suggest that the restraint method used for the child was effective. However, unrestrained ambulance occupants in the rear compartment hit the restrained child during the crash, presenting the opportunity for significant injury to the child as well as the adult.²⁷ Findings emphasized that patient safety depends upon the use of safety restraints by all ambulance passengers, and the appropriate securing of all equipment in the rear ambulance compartment.

Conclusion

Although limited research has focused on the specific issue of the emergency transport of children in ambulances, more information has become available since the EMSC and NHTSA’s publication of *The Dos and Don’ts of Transporting Children in an Ambulance*. Given the lack of a universal definition of “child,” as well as the inconsistent protocols and practices currently used by EMS practitioners, additional guidance, developed by topical experts, would improve the safety of all children transported in ambulances in the United States.

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Appendix B

Agenda and List of Participants, Meeting of the Working Group EMS Solutions for Safely Transporting Children in Emergency Vehicles July 22, 2009 Washington, DC

Agenda

- 8:00 – 8:15 Sign In & Refreshments
- 8:15 – 9:00 Welcome Drew Dawson/Sandy Sinclair
Introductions Valerie Boykin
House Keeping/Logistics
Work Group Overview/Activities Update

Topical Discussions

- 9:00 – 9:30 Final Product Hassan Aden
Who is the audience?
What type of product will be most useful?
What should it look like?
- 9:30 – 10:00 Definition of Child Delmas Johnson
Should age and/or stature be considered in developing our recommendations?
Should we use previously established age categories?
- 10:00 – 10:15 Break
- 10:15 – 11:15 Tour/Demo of Ambulance and Equipment
Dr. Joe Wright and Tom Stotz
Cyndy Wright-Johnson
- 11:15 – 11:45 Crash Protection For Children In Ambulances
Dr. Marilyn Bull
- 11:45 – 12:00 NHTSA's 4 Steps For Kids Recommendations
Sandy Sinclair

- 12:00 – 1:00 Working Lunch
 Evaluate/Discuss Standard Ambulance Equipment (Small Group Discussions)
 Identify key issues/considerations/recommendations
- Transport Equipment
 - Securing of Emergency Medical Equipment
- 1:00 – 3:00 Hierarchical Approach/Establishment of Benchmarks
- Car Seats
 - Side Facing Passengers
- 3:00 – 3:30 Wrap Up/Next Steps/Reimbursements
- NHTSA Representatives
 - Valerie Boykin
 - Amy Wilson

Meeting Attendees

Workgroup Members

Name	Organization
Katrina Altenhofen	National Association of State Emergency Medical Services Officials
Dr. Marilyn Bull	The American Academy of Pediatrics
Dr. James Callahan	American College of Emergency Physicians
Dr. Andrew Garrett	National Association of Emergency Medical Service Physicians
Ken Knipper	National Volunteer Fire Council
Tommy Loyacono	National Association of Emergency Medical Technicians
Dr. John Russell	American Ambulance Association
Dr. Joseph Wright	National Emergency Medical Services for Children Resource Center
Cynthia Wright-Johnson	Emergency Nurses Association

NHTSA

Name	Organization
Alexander (Sandy) Sinclair	Occupant Protection/TIC & Contracting Officer's Technical Representative for the Project
Dave Bryson	EMS/Traffic Injury Control (TIC)
Drew Dawson	EMS/TIC
Thelma Kuska	Region 5

Maryn Consulting, Inc.

Name	Organization
Hassan Aden	Alexandria Police Department/Maryn Consultant
Valerie Boykin	Project Manager
Delmas Johnson	Sr. Consultant
Greg Maryn	President
George Perkins	Business Development Manager
Amy Wilson	Operations and Administration Manager

Appendix C

General Considerations and Selecting Child Restraint and Cot Restraint Systems For Ground Ambulance Transport

General Considerations:

- All ground ambulances transporting children should have seats and restraints capable of safely securing children. These can be in the form of either a single system or multiple restraints as long as all sizes are accommodated.²³
- Swiveling seats should be tested in every position in which they are able to be locked when a child restraint is present.
- While there is currently no U.S. dynamic testing standard for ambulance cots, every effort should be made to ensure that the ambulance is equipped with a cot and fastener system that has been statically tested under vehicle crash conditions of at least 2,200 lbs. in accordance with AMD Standard 004. (This meets current GSA and AMD requirements and most of the proposed NFPA 1917 standard.)
- The working group recommends that child restraints should never be attached to a side facing seat or side-facing bench seat. Child restraints should never be attached to a side facing seat or side facing bench.”

Selecting Child Restraints and Cot Restraints for EMS:

There are many child restraint options available to EMS agencies. These may include: integrated seats, conventional child restraint systems for use in motor vehicles, cot mounted devices, board and harness systems, etc. Due to the lack of regulation and testing requirements specific to ground ambulances, many of the available devices may be designed for a different use and either tested to automotive standards or not tested at all. It is not in the purview of this document to recommend any specific product, but it is possible to categorize products based on design and testing characteristics. Ideally, this will provide EMS agencies with some criteria that should correlate to the safety and efficacy of the child restraint system they are considering. They are listed below with “A” being the best option and “D” the worst. It is important to remember that even “D” is much better than transporting a child unrestrained or held in an adult’s arms.

²³ NHTSA’s Ease of Use Ratings for child restraint systems is a five-star ratings system that allows parents and caregivers to evaluate how easy certain CRS features are to use before purchasing a seat for their personal use in transporting a child. While the testing requirements and regulations do not include emergency ground ambulances, EMS agencies and providers may wish to review the Ease of Use Ratings material available at www.nhtsa.gov when selecting CRS systems for use in emergency ground ambulances.

Category A

- Seats and restraints (including integrated restraints) specifically designed to either be permanently mounted or secured on a rear-facing cot or EMS provider's seat in a ground ambulance.
- Restraints will be dynamically tested in the same configuration as they are expected to be used in the ground ambulance; either directly mounted or secured in actual ambulance seats or cots.

Manufacturer can provide documentation of third party testing proving their cot restraints meet or exceed the standards for test pulse and ATD injury criteria specified in FMVSS No. 213.

Documentation must be provided proving compliance in a rear-facing test for both infant and child seat configurations (if applicable) and also in a forward-facing test. Must also be tested forward facing for children over two years old if to be installed in a captain's chair forward-facing or front compartment seat.

Category B

- Devices in this category are proven to be safely secured based on at least one published and peer reviewed study. Must meet all the following criteria to ensure compliance:
 - Convertible child restraints for children up to 40 pounds and infant car beds for infants up to 20 pounds that are designed for passenger cars/trucks and are FMVSS No. 213 tested and certified.
 - Restraint system must be able to be attached to cot using two belt paths to prevent both forward and rearward motion.
 - If a booster type CRS is used, it should only be used on seats with lap/shoulder belts available.
 - Ambulance seat or cot must have a belt and retractor system that allows for a secure, two path attachment of the restraint.
 - Amended instructions and training have been provided for correct mounting in a non-standard direction.

Category C

- Seats and restraints other than those covered in Category B that may either be secured in a rear facing cot or seat and are FMVSS No. 213 tested and certified using a standard, forward facing test sled.
- If a booster type CRS is used, it should only be used on seats with lap/shoulder belt available.

Category D

- All other seats and restraints that are not FMVSS No. 213 tested and certified, or that the manufacturer cannot provide documentation that the seat or restraint meets or exceeds the standards for test pulse and ATD injury criteria specified in FMVSS No. 213.

Appendix D

Recommendations for Using Convertible Child Safety Seat, Car Bed, and Securing Child on Cot in Emergency Ground Ambulances

Convertible Child Safety Seat (CSS)

Child Size: 5 to 40 lbs

Installation Recommendations:

- Install with rear-facing and forward-facing belt paths.
- Choose seat with 5-point internal harness.
- Position seat facing rear of ambulance.
- Elevate cot backrest to fully upright position.
- Adjust restraint recline mechanism to fit snugly against cot seat back.



Appendix D (continued)

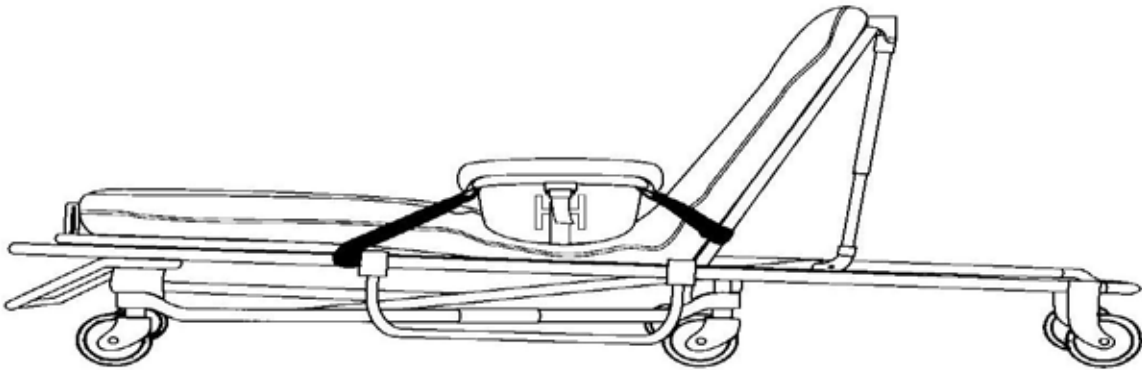
Recommendations for Using Convertible Child Safety Seat, Car Bed, and Securing Child on Cot in Emergency Ground Ambulances

Car Bed

Child Size: 5 to 20 lbs

Installation Recommendations:

- Designed for infants who must lie flat.
- Only use car bed with two belt systems.
Note: Second set of loops must be purchased from the manufacturer.
- Elevate cot backrest to fully upright position.
- Attach belts to cot where sliding is minimized.
- Position head away from side of vehicle.



Appendix D (continued)

Recommendations for Using Convertible Child Safety Seat, Car Bed, and Securing Child on Cot in Emergency Ground Ambulances

Securing Child on Cot Using 4-Point Harness

Installation Recommendations:

- Secure the child to the cot as shown.
- Position cot (subject to the manufacturer's specifications) to provide for the child's comfort based upon the child's injuries and/or illness and to allow for appropriate medical care.
- Attach belts to cot where sliding is minimized.
-



Appendix E

Recommended Best Practices for Child Restraint System Use

Please note: in April 2011, NHTSA and the American Academy of Pediatrics released updated best-practice recommendations for the use of car seats and booster seats. To review these recommendations, please visit:

www.nhtsa.gov/DOT/NHTSA/Traffic%20Injury%20Control/Articles/Associated%20Files/4StepsFlyer.pdf

www.healthychildren.org/English/safety-prevention/on-the-go/Pages/Car-Safety-Seats-Information-for-Families.aspx

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