

National Highway Traffic Safety Administration (NHTSA)
**Recommendations for the Safe Transportation of
Children in Emergency Ground Ambulances**

Public Meeting

Thursday, August 5, 2010

1:30 pm ET



Recommendations for the Safe Transportation of Children in Emergency Ground Ambulances

Welcome and Introduction

Topic Presenters:

Valerie Boykin

Maryn Consulting, Inc.

Mr. Drew Dawson

Director, Office of Emergency Medical Services,
NHTSA



We welcome you to today's public meeting to present the draft Recommendations for the Safe Transportation of Children in Emergency Ground Ambulances.

Technical Instructions:

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- If you are participating via a State government network and are having difficulties connecting to today's webinar, please contact your State Network Administrator to ensure that the transmission is not being blocked due to bandwidth limitations.
- For others with difficulties connecting to today's webinar, please call AT&T Teleconference Services: 1-800-526-2655.

Ground Rules:

- We will follow a set agenda for today's meeting.
- Advance sign up was required for attendance and comment.
- We will adhere to established timeframes.
- Copies of today's agenda and the Draft Recommendations have been sent to registered participants via e-mail.
- We ask that all mobile telephones and similar personal electronic devices be placed on mute or turned off to minimize distractions.
- No additional broadcasting or recording of the meeting by any means is permitted.

Ground Rules (continued):

- Due to the format of the meeting and time constraints, comments and / or questions will be taken in written form only.
- Those joining via webinar may use the ‘Chat’ portion at the bottom right corner of your Meeting Manager screen to type in your comments / questions. Note cards are available for those joining us in person. All comments and questions will be passed on to the Working Group for consideration. A limited number of process questions may be answered during the Q&A period following the Break.

Meeting Agenda

- Welcome Statement - Mr. Drew Dawson, NHTSA
- Purpose of Meeting and Project Overview – Mr. Sandy Sinclair and Mr. Dave Bryson, NHTSA
- Working Group’s Process to Develop the Recommendations – Ms. Valerie Boykin, Maryn Consulting, Inc.
- Overview of Recommendations – Dr. Jim Callahan, Mike Aries, Ken Knipper, and Dr. John Russell , Working Group Members
- Additional Recommendations / General Considerations - Dr. Marilyn Bull and Cynthia Wright-Johnson, Working Group Members
- Break (15 minutes)
- Public Comment Period – Pre-registered speakers
- Summary of Comments & Questions Received - Mr. Sandy Sinclair and Mr. Dave Bryson, NHTSA
- Closing Remarks - Mr. Sandy Sinclair and Mr. Dave Bryson, NHTSA

Mr. Drew Dawson

Director, Office of Emergency Medical Services

Research and Program Development

Office of Traffic Injury Control Programs

The National Highway Traffic Safety Administration (NHTSA)

U. S. Department of Transportation



Recommendations for
the Safe Transportation
of Children in
Emergency Ground
Ambulances

Purpose of Meeting and Project Overview

Topic Presenters:

Sandy Sinclair

NHTSA Occupant Protection Division

Dave Bryson

NHTSA Office of Emergency Medical Services



Some Questions within the Emergency Medical Services Community



How best to transport children in ambulances from the scene of a traffic crash to a hospital or other facility?

How or if to use a child safety seat on a stretcher?

How to properly secure EMS equipment?

What are the protocols for placement and restraint of injured, ill, or uninjured children in emergency response vehicles?

Resulting Issues from these Questions



The absence of consistent standards and protocols complicates the work of EMS professionals.

This may result in the improper restraint of highly vulnerable child passengers.

EMS agencies, advocates, and academicians have turned to NHTSA to resolve this issue.

Purpose of Meeting and Project Overview

Objective 1:

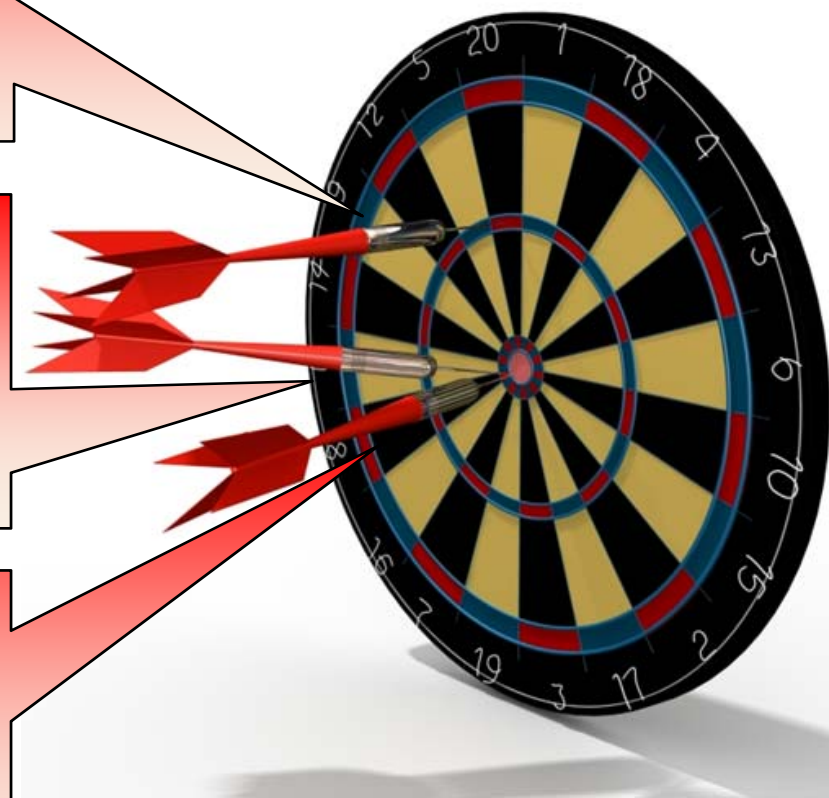
Build consensus in the development of a uniform set of recommendations for the safe and appropriate transportation of children (injured, ill, or uninjured) from the scene of a crash or other incident in an ambulance.

Objective 2:

Foster the creation of best practice recommendations after reviewing the current practices being used to transport children in ambulances.

Objective 3:

Provide a set of consistent recommendations that will be embraced by local, State and national EMS and stakeholder organizations, enabling them to reduce the frequency of inappropriate emergency transport of ill, injured or uninjured children.





This Project Is Not Designed To:

- **Evaluate the efficacy of one restraint over another.**
- **Conduct any field tests of solutions or equipment.**
- **Evaluate the crashworthiness of emergency vehicles.**
- **Assess ambulance design.**

Purpose of Meeting and Project Overview

Organizations Represented on Working Group:



Purpose of Meeting and Project Overview

Federal Agencies on Working Group:



Headquarters



Recommendations for
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Working Group's Process to Develop the Recommendations

Topic Presenter:

Valerie Boykin

Maryn Consulting, Inc.



Project Participants and Partners

- U. S. Department of Transportation National Highway Traffic Safety Administration (NHTSA)
 - Office of Occupant Protection
 - Office of Emergency Medical Services
- U. S. Department of Health and Human Services Health Resources and Services Administration (HRSA)
- Working Group members
- Maryn Consulting, Inc.
- Public meeting participants

Literature Review:

- Addressed the following major areas:
 - Data sources and statistical findings,
 - Ambulance safety issues,
 - Existing guidelines for child transport in ground ambulances,
 - Current practices and outcomes for child transport in ground ambulances, and
 - Safety research regarding safe and unsafe methods of transporting children in ground ambulances.
- Maryn Consulting staff gathered information and drafted document.
- NHTSA, federal partners, Working Group members reviewed, amended and finalized.

Working Group activities: 2009 – present

- NHTSA identified potential Working Group member organizations representing children's health, passenger safety and emergency ground transportation.
- NHTSA and the U.S. Department of Health and Human Services Health Resources and Services Administration (HRSA) also represented on the Working Group.
- Monthly teleconferences were held with Working Group to identify and discuss pediatric emergency transport areas of critical importance, leading to the development of the recommendations.
- Working Group met in Washington, D.C. for a one-day meeting in July 2009 to determine how best to define the problem and frame the recommendations.
- Maryn Consulting scheduled and facilitated Working Group calls and meeting.

Draft Report and Develop Recommendations: 2009 - 2010

- Subcommittees of the Working Group were formed to focus on specific aspects of the recommendations and to draft language for the report.
- Maryn Consulting provided staff support to the Working Group in drafting the report and recommendations, according to Working Group direction.
- Teleconferences and internet meetings in 2010 focused on determining the best way to present recommendations for implementation by the EMS community.
- Working Group members reviewed and edited draft report and recommendations.
- Additional teleconferences were held as the date for today's meeting approached.

Public Meeting to Review & Seek Comment on Draft Recommendations:

- NHTSA publicized draft report and recommendations in *Federal Register* on July 19, 2010
- Working Group is seeking public review, comments and endorsement of the draft recommendations
- All questions and comments will be reviewed by the Working Group as the report and recommendations are finalized.



Finalization and Publication of Final Recommendations Report:

- Working Group to complete Final Report with Recommendations by August 31, 2010.
- To the maximum extent possible, comments from today's meeting will be incorporated.
- NHTSA will conduct an internal review of the report and recommendations prior to public release.



Recommendations for the Safe Transportation of Children in Emergency Ground Ambulances

Overview of Recommendations

Topic Presenters:

Cynthia Wright-Johnson, RN, MSN (representing the Emergency Nurses Association)

Mr. Michael Aries (representing the International Association of Firefighters)

Mr. Kenneth Knipper (representing the National Volunteer Fire Council)

John Russell, MD, FAAP (representing the American Ambulance Association)



The Ultimate Goal is to:

1. Prevent forward motion/ejection;
2. Secure the torso; and
3. Protect the head, neck, and spine of all children transported in emergency ground ambulances.

Achieving this Goal ensures that:

The safety of transporting children from the scene of a crash or medical emergency in all situations will be greatly improved.

For each situation, there are two options presented.

- The Ideal - This is the ultimate goal for safely and appropriately transporting children in emergency ground ambulances and is the first option for transporting a child in each of the five situations.
- “If the Ideal is not Practical or Achievable” - This recommendation provides guidance to EMS professionals for the safe transportation of children if the Ideal can not be achieved.

Identifying the “Situations” for Transporting Children in Emergency Ground Ambulances

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

Review of Key Operational Issues To Consider Along With Recommendations

To ensure the safe transportation of children in emergency ground ambulances, make everything as safe as possible.

Following this principle includes, but is not limited to:

- Seatbelt and restraint use for **all** ambulance occupants all of the time,
- Securing of movable equipment,
- 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,

Review of Key Operational Issues To Consider Along With Recommendations (continued)

- 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.

It is anticipated that EMS professionals and their organizations will implement operational policies and procedures which address these factors to the maximum extent possible.

Situation 1 - For a Child who is uninjured/not ill

The Ideal

Transport using a size-appropriate child restraint system that complies with FMVSS 213 in a vehicle other than a ground ambulance.

If the Ideal is not Practical or Achievable

- Transport in a size-appropriate CRS that complies with FMVSS 213 appropriately installed in the front passenger seat (with air bags off) of the emergency ground ambulance; or
- Transport in the forward-facing EMS provider's seat (currently rare in the industry) in a size-appropriate CRS that complies with FMVSS 213 inside ambulance; or
- Transport in the rear-facing EMS provider's seat in a size-appropriate CRS that complies with FMVSS 213 (convertible or combination seat but not infant only seat, using a forward facing belt path) or in an integrated CRS (certified by manufacturer) to meet the injury criteria FMVSS 213; or
- Consider delay of transport of the child with appropriate adult supervision until additional vehicles are available (patient is transported in EMS vehicle separately); or
- Per the judgment of EMS personnel on the scene (and in consultation with medical control, when possible), consider delay of transport (to the extent the patient's safety and medical condition are not in any way compromised), patient care continued on scene (monitoring) until an additional vehicle is available for transport.

Situation 2 - For a Child who is ill and/or injured and whose condition does not require continuous and/or intensive medical monitoring and/or interventions

The Ideal

Transport child in a size-appropriate child restraint system that complies with the injury criteria of FMVSS 213—secured appropriately on cot.

If the Ideal is not Practical or Achievable

1. Transport child in the EMS provider's seat in a size-appropriate child restraint system that complies with the injury criteria of FMVSS 213 or an integrated seat in the EMS provider's seat that is certified by the manufacturer to meet the injury criteria of FMVSS 213; or
2. Transport child on cot using three horizontal restraints across the child's torso (chest, waist, and knees) and one vertical restraint across each of the child's shoulders.

Situation 3 - For a Child whose condition requires continuous and/or intensive medical monitoring and/or interventions

The Ideal

Transport child in a size-appropriate child restraint system that complies with the injury criteria of FMVSS 213—secured appropriately on cot.

If the Ideal is not Practical or Achievable

- Secure the child to the cot; 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 vehicle operator is urged to consider stopping the ambulance during the interventions.
- If spinal immobilization of the child is required, see the recommendation for Situation 4.

Situation 4 - For a Child whose condition requires spinal immobilization and/or lying flat

The Ideal

- Secure the child to a size-appropriate spineboard 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.

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.

Situation 5 - For a Child or Children requiring transport as part of a multiple patient transport (newborn with Mother, multiple children, etc.)

The Ideal

- If possible, for multiple patients, transport each as a single patient according to the guidance shown for Scenarios 1 through 4.
- For mother and newborn, transport the newborn in an approved size-appropriate child restraint system that complies with the injury criteria of FMVSS 213 in the rear facing EMS provider seat with a forward-facing belt path that prevents both lateral and forward movement (convertible or integrated child restraint system and not an infant only seat), leaving the cot for the mother.

If the Ideal is not Practical or Achievable

- When available resources prevent meeting the criteria shown for 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.
- If additional units may be needed based upon preliminary reports, backup units should be put on standby.

Important Issues for all Situations for Transporting Children in Emergency Ground Ambulances

- The Working Group recommends that all EMS systems “pre-plan”, i.e., plan in advance 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.
- 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.



Recommendations for
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Additional Recommendations and General Considerations Outside the Scope of this Project

Topic Presenter:

Cynthia Wright-Johnson, MSN RNC
EMSC Program Director @ MIEMSS



- In the course of the Working Group's deliberations, a number of issues outside of the purview of the effort were identified.
- These issues led to recommendations for further study by the appropriate governmental, medical, professional, or other entities.
- The Working Group categorized these recommendations into two Groups:
 - For Governmental and Other Entities
 - For Manufacturers

Selected Recommendations for Governmental and Other Entities:

- Expedite efforts to enhance the National EMS Information System (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.
- Encourage State EMS Agencies to share data with the State Highway Safety Office(s) and NEMSIS by collaborating on modifications to or an exemption from the Health Insurance Portability and Accountability Act (HIPAA) of 1996 to facilitate the development of NEMSIS.



Selected Recommendations for Governmental and Other Entities *(continued)*

- Develop dynamic crash test standards for all seats and occupant restraint systems appropriate for use in the occupant compartment of emergency ground ambulances.
- Develop dynamic crash test standards for the structural stability and restraint of cots and other transport devices (including incubators) used for transporting children in emergency ground ambulances.



Recommendations for
the Safe Transportation
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Selecting Child Restraint Systems (CRS) for Ground Ambulance Transport

Topic Presenter:

Marilyn J. Bull, MD, FAAP
Morris Green Professor of Pediatrics
Riley Hospital for Children
Indianapolis, IN



Important Issues:

- Identify the CRS that is most appropriate for transporting the child or children in each of the five situations.
- All EMS agencies should have seats and CRSs that are capable of safely securing the child or children.
- Selecting CRSs for EMS in Appendix C provides criteria correlating to the safety and efficacy of the system being considered.



Keys to Remember:

- Using the appropriate CRS must not compromise the child's medical condition.
- CRS must never be attached to a side facing seat or bench seat unless the CRS and ambulance manufacturers document that the seat meets or exceeds the injury criteria of FMVSS 213 for the child restraint and FMVSS 208 for the adult seats.
- Never transport a child unrestrained or held in an adult's arms.



Caution:

- Swiveling seats should be tested for use in every position in which they are able to be locked when a child restraint is present.
- Ensure the ambulance is equipped with a cot and fastener system that meets vehicle crash conditions of a least 10g.



Important Considerations:

- Current Federal regulations and testing requirements for child restraints do not apply to emergency ground ambulances.
- The CRS devices may be tested to meet FMVSS 213 in passenger vehicles or not tested at all.
- The CRS devices may be designed for a use different than ambulance transport.
- While it is outside of the purview of the Working Group to recommend specific products, criteria for determining the best CRS to use are provided.



CRS Options Available to EMS Agencies Include:

- Integrated seats
- Conventional CRSs designed for use in passenger vehicles
- Cot mounted devices
- Board and harness systems



Criteria for Selecting CRS Devices for Use by EMS

Category	A	B	C	D	
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“Best Option”

- Seats and restraints specifically designed to either be permanently mounted in an ambulance or secured in rear facing cot or seats.
- Seats and restraints dynamically tested in the same configuration as they are expected to be used in the ambulance:
 - Directly mounted or secured in actual ambulance seats or cots.
 - Testing using FMVSS 213 forward facing sled is not acceptable.
- Manufacturer documents third party testing proving seat meets or exceeds the standards for test pulse and ATD injury criteria of FMVSS 213:
 - Document compliance in a rear facing test for both infant and child seat configurations (if applicable).
 - Test forward facing for children over two years old if allowed to be installed in a swiveling seat.

Note: **Computer modeling or testing is not acceptable**

Criteria for Selecting CRS Devices for Use by EMS

Category	A	B	C	D
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- Devices in this category are proven to be safely secured based on at least one published , peer reviewed study. Must meet all the following criteria to ensure compliance:
 - Convertible child restraints for children up to 40 pounds (approx. 18kg) and infant car beds that are designed for passenger cars/trucks and are FMVSS 213 tested and certified.
 - Restraint system must be able to be attached to cot or seat using two belt paths to prevent both forward and rearward motion.
 - 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.

Criteria for Selecting CRS Devices for Use by EMS

Category	A	B	C	D
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- 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 213 tested and certified using a standard, forward facing test sled.

Criteria for Selecting CRS Devices for Use by EMS

Category	A	B	C	D	“Worst Option”
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- All other seats and restraints that are not FMVSS 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 213.
- *While this is the “worst,” it is important to remember that it is better to use a CRS in Category D to transport a child than to transport unrestrained or held in an adult’s arms.*

Recommendations for Manufacturers to Consider:

- Develop CRS that meet or exceed the injury criteria for FMVSS 213 to accommodate child patients of various heights (or lengths including newborn/ infant patients) for use in ground ambulances.
- Develop an integrated cot restraint system that meets or exceeds the injury criteria for FMVSS 213 to accommodate child patients whose conditions require continuous and/or intensive medical monitoring and/or interventions.
- Develop and provide instructions that improve correct ease of use of products designed for ambulance use.
- Develop crash-tested CRS for use in the rear- or forward-facing EMS provider's seat of ground ambulances.



Recommendations for Manufacturers to Consider (continued):

- Develop a forward facing dynamically tested EMS provider's seat that will accommodate convertible or rear facing only CRS (and adult passenger with three point belt).
- Develop improved crashworthy methods of seating for all occupants in the rear of the emergency ground ambulance compartment.



Recommendations for Governmental and other Entities to Consider:

- Develop dynamic crash test standards for the structural stability and restraint of cots and other transport devices (including incubators) used for transporting children in emergency ground ambulances.
- Develop standards for CRS that meet the unique medical needs during the transportation of term and pre-term neonates.
- Develop standards for CRS that meet the medical needs of children with special health care and/or complex medical problems.
- Develop dynamic crash test standards for emergency ground ambulance construction.



Riley Hospital Automotive Safety Program

Improving Occupant Protection for Non-Critical Pediatric Patients in Ambulances: A Training Curriculum for EMS Personnel

Information can be requested via the following:

- 1- 800-KIDNCAR (1-800-543-6227)
- preventinjury.org
- Partial funding support provided by NHTSA





Meeting Break

15 Minutes

Recommendations for
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Ambulances

Comment Period



Speakers (via pre-registration)

- Mr. Charlie Vits, IMMI
- Dr. Nadine Levick, EMS Safety Committee, Transportation Research Board
- Mr. Grayson “Gregg” Lord, Member, National Commission on Children and Disasters





SafeGuard ®

NHTSA Public Meeting Draft Recommendations for Safe Transportation of Children in Ground Ambulances

August 5, 2010

Crash Test Video

**III 6 Year Old
with adult cot
restraints**



Pre-test set-up

30 MPH Sled Test

Cot straps do not conform to KKK-A-1822 protocol due to hip configuration of ATD



Crash Test Video

**III 6 Year Old
with SafeGuard
Transport**



Pre-test set-up

30 MPH Sled Test

ATD restrained on
SafeGuard Transport™
Pediatric Restrained



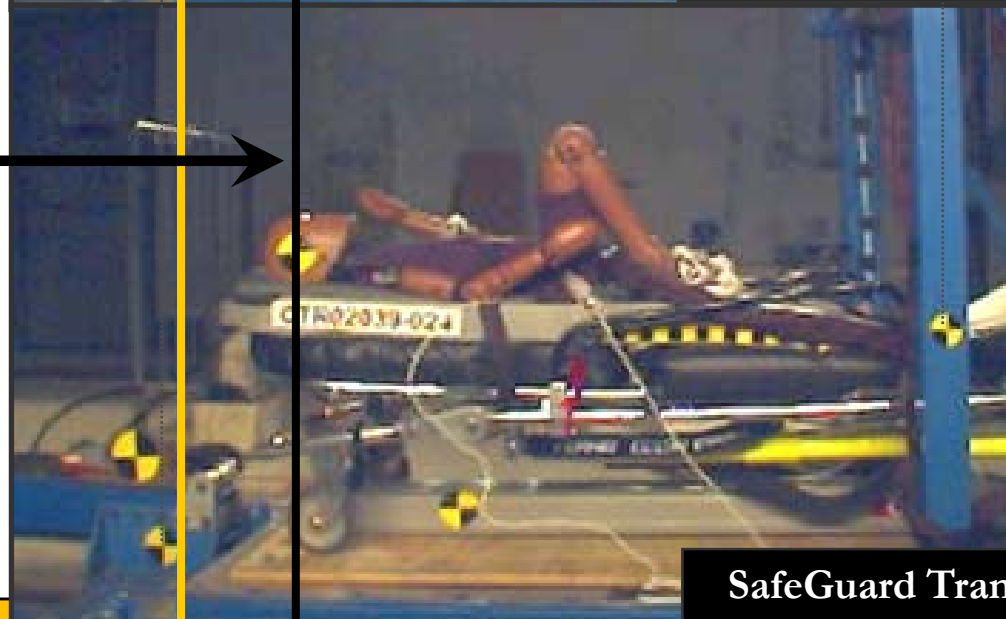
Testing: HIII 6 Year Old

Head excursion
with adult
cot restraint



Adult cot restraint


Head excursion
with SafeGuard
Transport



SafeGuard Transport

Conclusions

- **There is a need for an updated and standardized protocol for all those in EMS on how to safely transport children in ground ambulances.**
- **An FMVSS 213 child restraint device designed specifically for use in ambulance cots provides better crash protection to a child than use of cot adult restraints.**
- **Draft recommendations should also provide guidelines of applicability including child age and weight.**



Dr. Nadine Levick, EMS Safety
Committee, Transportation
Research Board

Public Comment,
June 9th, 2010

Key Concerns regarding the Maryn Draft Document

Nadine Levick MD, MPH

Research Director, EMS Safety Foundation, USA

Chair, National Academies Transportation Research Boards
EMS Safety Subcommittee

Background

- Unique challenges to crashworthiness, safety performance analysis and oversight of ambulance vehicles
- Is an interdisciplinary field, where the science of crashworthiness and occupant protection safety engineering interacts with acute medical care delivery, clinical ergonomics and also public health, public safety, transportation safety and safety data capture.

Introduction

- Recent epidemiological studies have identified USA ambulances as high risk passenger transport vehicles, particularly the rear compartment
- We should be applying accepted and technically sound approaches to identifying solutions to optimize the safety of these vehicles

Do we ask automotive safety engineers to develop cardiac arrest protocols?

- Then why are a group of health care providers, with no technical qualifications or training in automotive safety engineering and occupant protection engineering - developing technical recommendations for occupant protection of children.

- And in a setting that is considered highly complex even for the most skilled technical automotive safety engineers and occupant protection engineering expertise

Ambulance Transport SAFETY IS A SYSTEM

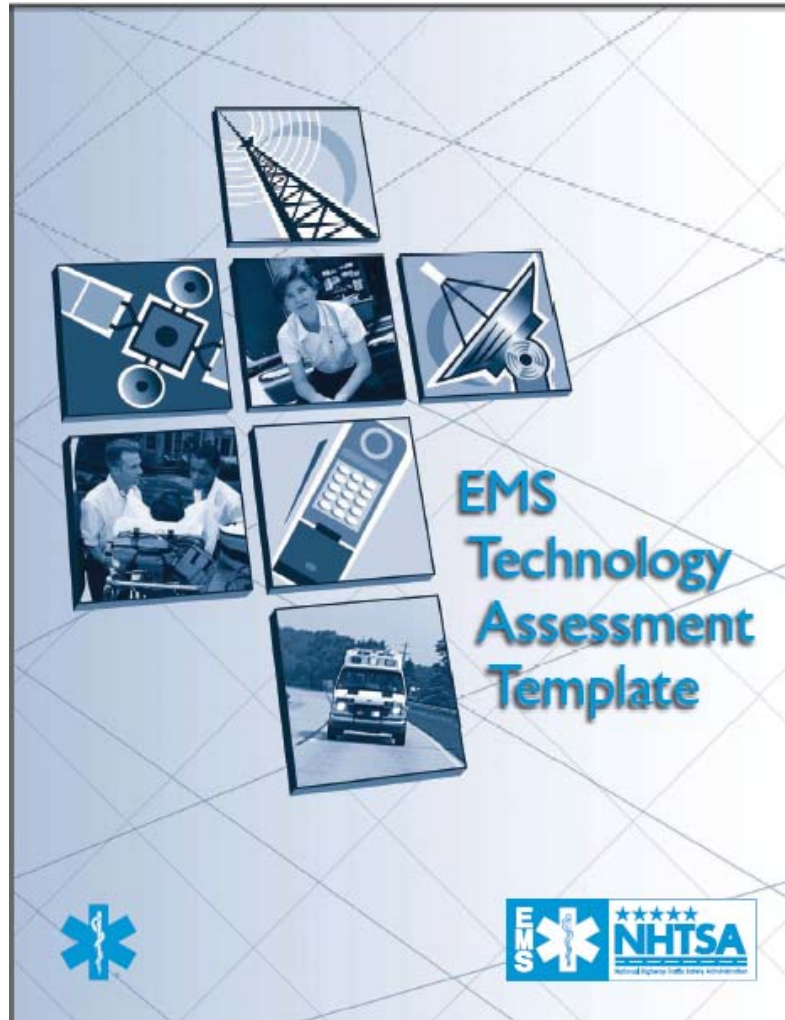
EMS right now needs to know what works and what doesn't:

- We have a moral and ethical responsibility to provide technically sound guidance based on the technically sound scientific and engineering information that does exist

- Whilst spending Federal dollars on improving the safety of ambulance transport is highly commendable
- This draft 'Recommendations for the Safe Transportation of Children in Ground Ambulances' project has been conducted outside of accepted technical automotive occupant protection safety practice, and also in many ways in conflict with safe operational EMS practice.

**However there is substantial
technical information
available**

EMS Technology Assessment Template



April 1998

Development and Application of a Dynamic Testing Procedure for Ambulance Paediatric Patient Restraint Systems

Emergency Medicine and Safety Engineering Collaboration in Paediatric Ambulance Transport Safety

Nadine Levick

Johns Hopkins University School of Medicine, Baltimore, USA
formerly Royal Melbourne Hospital and Royal Childrens Hospital, Melbourne, Australia

Flaura Winston

TraumaLink, Childrens Hospital of Philadelphia, University of Pennsylvania, Philadelphia, USA

Stephen Aitken, Russell Freemantle

formerly Transport Service, Royal Melbourne Hospital, Melbourne, Australia

Francine Marshall

Southern Health Care Network, Dandenong Hospital, Melbourne, Australia

Gordon Smith

Johns Hopkins University School of Public Health, Baltimore, USA

ABSTRACT

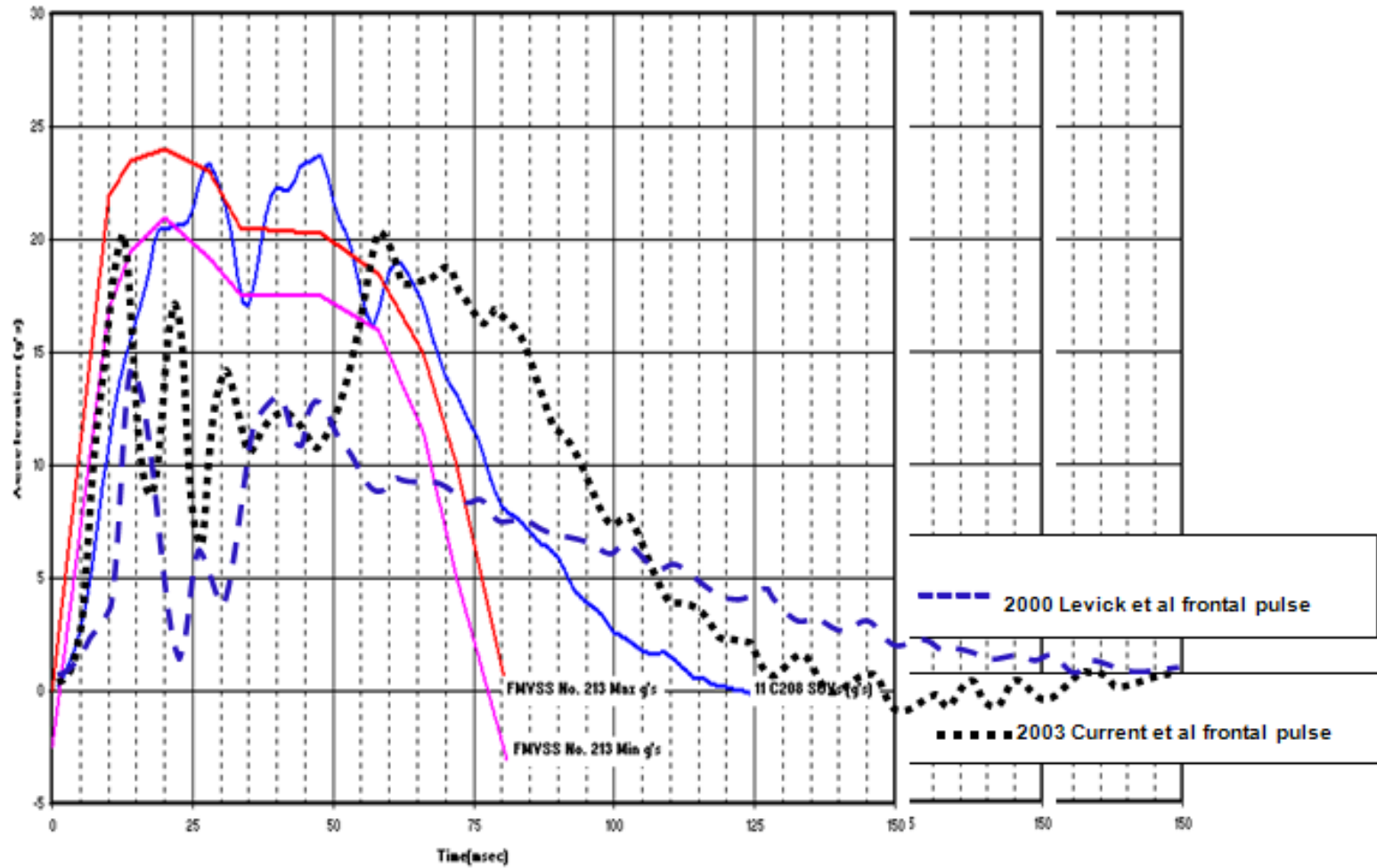
The goal of Emergency Medicine Service (EMS) systems is to enhance the care and transport safety of ill and injured patients [1,2,3,4].

INTRODUCTION

Safe ambulance transport is fundamental in EMS training

Existing Technical Literature

1. EMS Technology Assessment: <http://www.ems.gov/pdf/810873.pdf>
2. Levick NR, Winston F, Aitken S, Freemantle R, Marshall F, Smith G. Development and Application of a Dynamic Testing Procedure for Ambulance Pediatric Restraint Systems, Society of Automotive Engineering Australasia March/April 1998;58:2:45-51
3. Richardson S.A., Grzebieta R. H. and R. Zou, Development of a Side Facing Seat and Seat Belt System for the Australian Army Perentie 4 x 4, Int. J. of Crash., Vol. 4 No. 3, pp. 239 – 259, 1999.
4. Levick NR, Li G, Yannaccone J, Development of a dynamic testing procedure to assess crashworthiness of the rear patient compartment of ambulance vehicles, Enhanced Safety of Vehicles, Technical paper series Paper # 454, May 2001, <http://www-nrd.nhtsa.dot.gov/pdf/nrd-01/esv/esv17/proceed/00053.pdf>
5. Levick NR, Schelew WB, Blatt A, Gillespie G, Li G, Occupant Injury Hazards in Ambulance Transport, Findings from Full Vehicle Crash Testing, Academic Emergency Medicine Volume 8, Number 5 527, 2001
6. Levick NR, MD MPH, Grzebieta R, BE MEngSci PhD, Development of Proposed Crash Test Procedures for Ambulance Vehicles, International Enhanced Safety of Vehicles Technical Paper 07-0074, Lyon, France June 2007 <http://www-nrd.nhtsa.dot.gov/pdf/esv/esv20/07-0074-O.pdf>
7. Levick NR, MD MPH, Grzebieta R, BE MEngSci PhD, Crashworthiness Analysis of Three Prototype Ambulance Vehicles, International Enhanced Safety of Vehicles Technical Paper 07-0249, Lyon, France June 2007 <http://www-nrd.nhtsa.dot.gov/pdf/esv/esv20/07-0249-W.pdf>
8. Levick NR, Emergency Medical Services: Unique Transportation Safety Challenge, Report No. 08-3010, Transportation Research Board, January 2008, www.trb.org or <http://www.objectivesafety.net/LevickTRB08-3010CD.pdf>





Ambulance Vehicle Crashworthiness and Passive Safety Design: A Comparative Evaluation

Nadine Levick
EMS Safety Foundation

Raphael Grzebieta
University of NSW

Additionally there was a serious concern about a further systems failure in the design of the USA vehicles. This was the seating design that included a seating configuration in the rear facing seating position that could be modified to provide a small restraint system for use for a child. The concerns of the authors address the safety of a child in that seating design. Firstly, given that the modified seat did not offer lateral protection (as a standard child safety seat would offer) and thus it also exposed the child to serious head strike hazards in the setting of a side or offset impact. Secondly, should a child patient be seated in that position that then there would be two further increases in hazard. One that medical care access is not practical with a child seated in that manner with their back against the wall, and second, there was no safe way for an ambulance provider to provide medical care to a child patient in that position without putting both the child patient and the provider at risk. This is due to the provider having no seating position that would allow access to the child with the provider restrained. Thirdly, that once a child was seated in that modified seating position, the provider would be forced to be seated in the only other available seating positions. These seating positions in the USA vehicles were only side facing orientations. Furthermore, in each of the USA study vehicles the side facing seating was fitted with four or five or even six point harness systems (see above). These types of systems safety issues, where the positioning of one occupant limits the safety options for other occupants such as this, demonstrates that the interaction between occupants and their positioning can create more hazards. This appeared to be a repeated design failure aspect of the USA vehicles.

Hazards of harnessing devices in side facing occupants even in the absence of cabinetry





During impact

CTD dynamics

EMSSafety
FOUNDATION Post Impact

Impact residue



Existing Technical Literature

10. Levick NR, MD MPH, Grzebieta R, BE MEngSci PhD, Ambulance vehicle crashworthiness and passive safety design: A comparative vehicle evaluation, Society of Automotive Engineering, ComVec Technical paper, October, 2008-01-2695, www.sae.org
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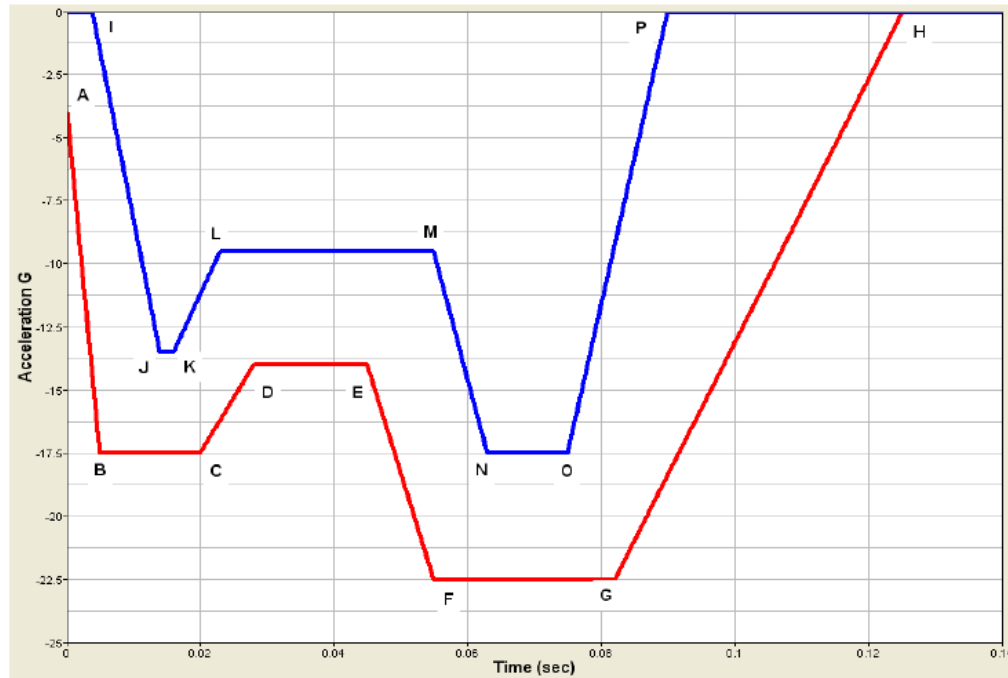


FIGURE 1 - DYNAMIC SLED CORRIDOR

TABLE 1 - DYNAMIC SLED CORRIDOR BREAK POINTS

Position	Time (sec)	Acceleration (g)	Position	Time (sec)	Acceleration (g)
A	0.000	-4.0	I	0.004	0.0
B	0.005	-17.5	J	0.014	-13.5

We should use the best safety practices demonstrated in engineering

Development of an Effective Ambulance Patient Restraint

Prepared by: G.H. Best, B.E., Dip.B.M.,
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Development Engineer,
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Deputy Director, NH&MRC Road
Accident Research Unit,
The University of Adelaide.

ABSTRACT

THE SAFETY of fittings in ambulances involved in road accidents has been reviewed in the light of a recently adopted national standard. Concerns about the strength of stretcher brackets led to the development of brackets which were subjected to tests at 48km/h. The test results showed other weaknesses and it

was found that, in particular, stretchers are required to withstand these forces when loaded with a 97.5Kg (95th percentile adult male) patient. Static load testing of the brackets is acceptable.

Inspection of the South Australian 'Twin Life' ambulance showed that most fittings should meet the standard.



Development and Application of a Dynamic Testing Procedure for Ambulance Paediatric Patient Restraint Systems

Emergency Medicine and Safety Engineering Collaboration in Paediatric Ambulance Transport Safety

Nadine Levick

Johns Hopkins University School of Medicine, Baltimore, USA

2001-01-1173

, USA

Biomechanics of the patient compartment of ambulance vehicles under crash conditions: testing countermeasures to mitigate injury

Nadine Levick, Guohua Li
Johns Hopkins University

John Yannaccone
ARCCA Inc

It is fundamental in EMS training

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...in automotive safety engineering

CRASHWORTHINESS ANALYSIS OF THREE PROTOTYPE AMBULANCE VEHICLES

Nadine Levick
Objective Safety LLC
USA
Raphael Grzebieta
Monash University

DEVELOPMENT OF PROPOSED CRASH TEST PROCEDURES FOR AMBULANCE VEHICLES

Nadine Levick

USA AMBULANCE CRASHWORTHINESS FRONTAL IMPACT TESTING

Nadine Levick
EMS Safety Foundation (1)
USA
Raphael Grzebieta
Injury Risk Management Research Center (2)
University of New South Wales
Australia
Paper Number 09-0471

ABSTRACT

Recent epidemiological studies have identified ambulances as high risk passenger transport vehicles.

Protection for Infants Transported in Incubators

2009-01-2832
Gary P. Whitman, David L. Gushue and Larry Sicher
ARCCA Inc.

Ambulance Vehicle Crashworthiness and Passive Safety Design: A Comparative Evaluation

2008-01-2695

Nadine Levick
EMS Safety Foundation

Raphael Grzebieta
University of NSW

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ABSTRACT

Ambulances are largely exempt from crashworthiness testing. A transport incubator, was seriously injured. In addition, it

performance record for ambulance vehicles does not appear to be uniform globally – and the estimates comparing ambulance crash fatality rates for the USA

motor vehicles including involved in crashes.^{1,2,3,4,5,6}

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Ergonomics in the rescue service—Ergonomic evaluation of ambulance cots

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Reviewing ambulance design for clinical efficiency and paramedic safety

Jeremy Ferreira, Sue Hignett*

Hospital Ergonomics and Patient Safety Units (HEPSU), Dept. of Human Sciences, Loughborough University, Loughborough, Le

Received in revised form 30 June 2004; accepted 14 July 2004

Abstract

This study aimed to review the layout of the patient compartment in a UK ambulance for paramedic efficiency: (1) Ergonomics (2) patient loading. Paramedics were observed over 16 shifts (120h) carrying out a series of

Ergonomic Evaluation of the Ambulance Interior to Reduce Paramedic Discomfort and Posture Stress

Issachar Gilad and Eyal Byran, Technion - Israel Institute of Technology, Haifa, Israel

Objective: This study aims to evaluate safety and accessibility of an advanced life support (ALS) ambulance interior. **Background:** The standard ambulance's interior design is unsatisfactory based on perceived discomfort and postures that constrain paramedics and medical staff, resulting in unsafe treatment of patients, mainly when being transported. **Methods:** Two procedures were used to evaluate performance during a wide range of rescue tasks: a survey, based on questionnaires, interviews, and observation of paramedics performing routine tasks; and upper body and back posture analysis, based on postural considerations. **Results:** Findings revealed that 74% of the paramedics stated that the location of the paramedic's seat is inefficient while they perform

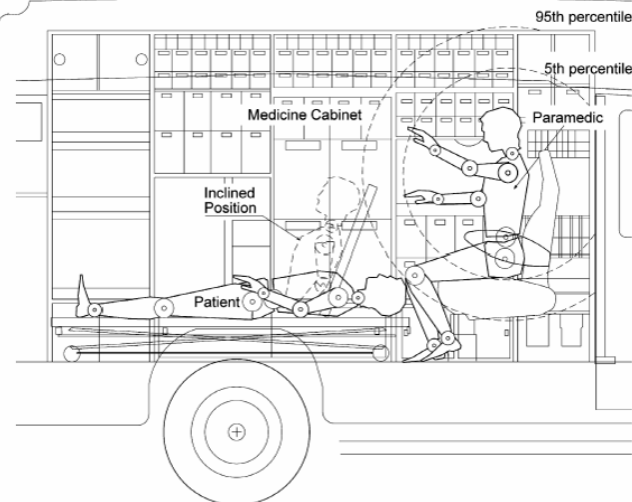
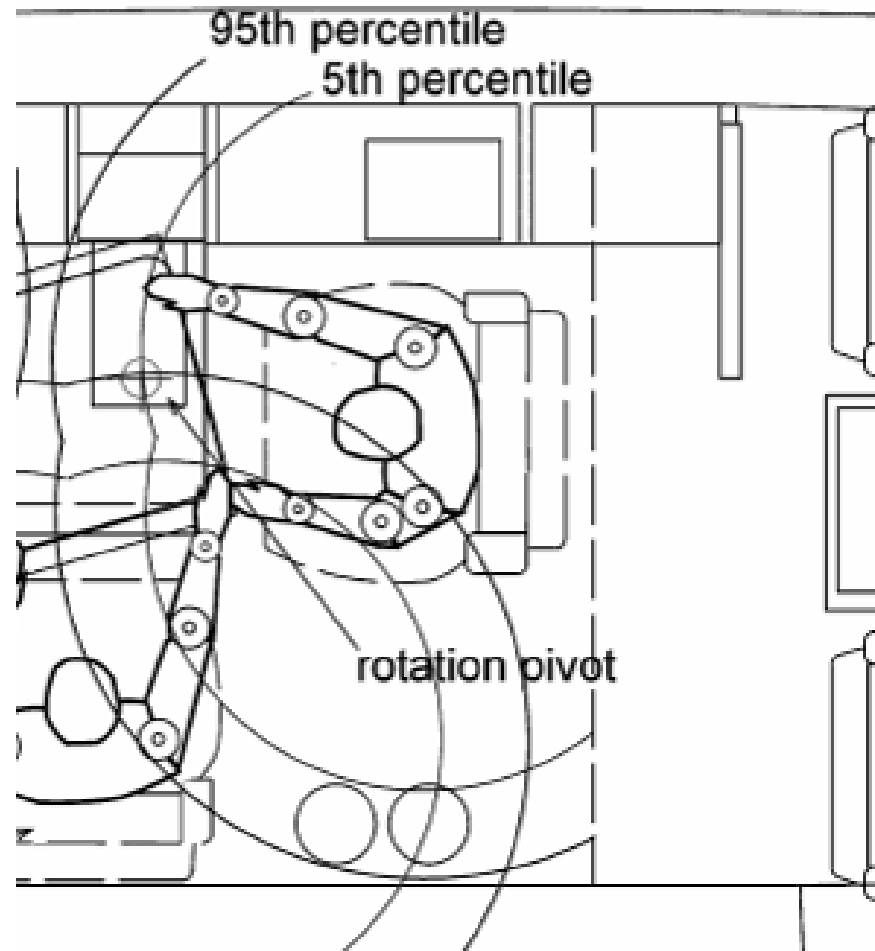


Figure 3. Latitudinal section (left) and longitudinal section (right) of the ambulance's interior showing a paramedic and a patient. Dotted circle represents hand reach range for the 5th and 95th percentiles of the participants.

Range of reach.. This is a well defined technical science



Key Issues

To quote Robert S. Salzar, PhD, Principal Scientist Center for Applied Biomechanics University of Virginia:

- “First, the restraint systems for any vehicle are only as strong as the weakest part
- AND current practices do not always mean best practices”

(Remember Galen and “laudable pus”)

In the USA AND Canada there are more safety standards for moving cattle than for moving patients



Ambulances are exempt from:

- Federal Motor Carrier Safety (FMSCA)
- Most occupant protection requirements of the Federal Motor Vehicle Safety Standards (FMVSS)

Laws of Physics

Science behind Policy

- “For successful technology, reality must take precedence over public relations, for Nature cannot be fooled.”

Richard P. Feynman 1988

The laws of physics prevail...





Ambulance Transport Safety

- Is part of a SYSTEM
- A fleet within an EMS operations system and within a general public transportation system
- A vehicle within a fleet

Occupant Systems Safety

- Occupant Safety in EMS is driven by both operational and biomechanical systems.
- Systems Safety integrating these two issues is key
- There is interaction of occupants with the system, with each other and with available seating options and vehicle interior, equipment and operational tasks.

- Addressing one occupant in isolation of the other occupants can increase the hazard to that occupant and the other occupants

So what do we know?

- Where are predictable injuries occurring in ambulance vehicles and what are they?

So what are safer practices?

- Ambulances are NOT routine passenger sedans/vehicles, and have unique hazards that do not exist in passenger vehicles
- Based on current existing technical and full vehicle testing data on the interaction of occupants and known hazards in ambulance vehicles, use of child safety seats secured to the squad bench is likely to minimize hazard and harm to all occupants

Known hazards!

- Securing a child to the rear facing Captains Chair – exposes that child to increased hazard as projectiles from within the ambulance vehicle have been demonstrated to be a hazard in that seating position in a sudden deceleration or crash.
- Additionally suboptimally restrained other occupants have been shown in full vehicle studies to strike this region of the interior of the ambulance

The engineering and injury technical data demonstrates that:

- The rear facing Captains chair is a frequent site of moderate injury to the lower body of adult occupants in that seating position
- Increasing the number of adult seated occupants on the squad bench increases the hazard to all occupants
- Any child positioned on the rear facing Captains Chair is at increased hazard - and also increases the hazard of the system as a whole

Center for Applied Biomechanics University of Virginia

- “Appropriate technical expertise should be central to the collection and analysis of the relevant technical information
- Representative crash scenarios should be the basis of all restraint evaluations
- In no instance should an unrestrained occupant be transported in an ambulance”

Center for Applied Biomechanics University of Virginia

- “Child safety seats should be evaluated in a real world setting, considering the system as a whole in laboratory tests in each of the suggested transport configurations before any recommendations are made;
- Occupant interaction with structural intrusion during common collisions should be evaluated before patient positioning recommendations are made.”

EMS Safety Foundation Suggestions

- Support the Public Comment of the Virginia University Automotive Engineering team
- Assemble an appropriately automotive and biomechanical technically skilled team
- Conduct an acceptable technical scientific literature review by that team
- Identify the key technical issues

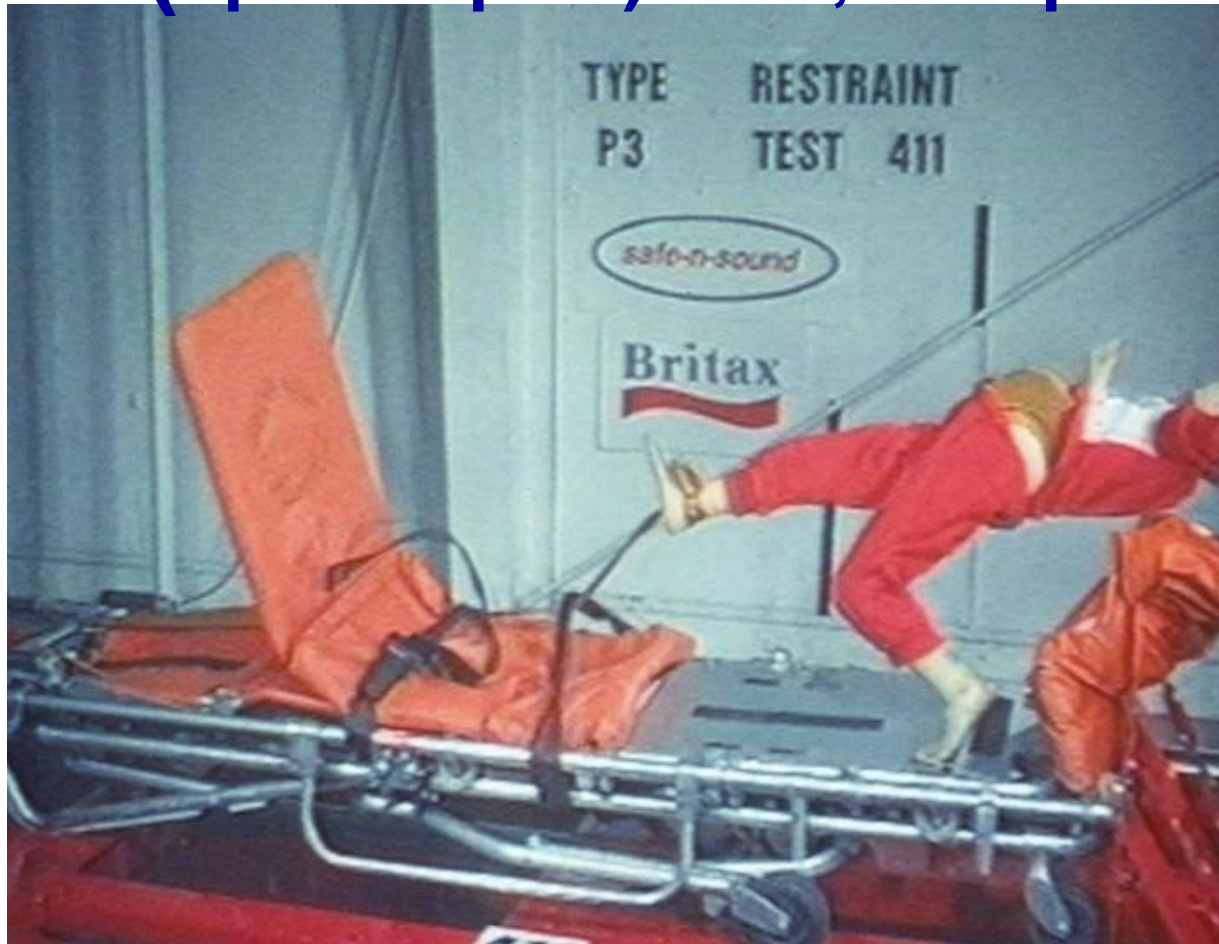
EMS Safety Foundation Suggestions

- Identify the key technically sound evidenced based safety approaches
- Compile the optimal practices and recommendations based on an appropriate and sound review of the technical literature and input from automotive engineering expertise skilled in occupant safety and the issues that pertain to safe ambulance practice

Data Capture

- Traffic Records data exists at a state level we should be using this resource– we need to work closely with them
- NEMSIS is not designed to be nor does it claim to be a traffic records data base
- Federal Motor Carrier Safety Data bases should be capturing ambulance vehicles – EMS exemptions should be removed

Deceleration Sled tests (upon impact) 24 G, 30mph



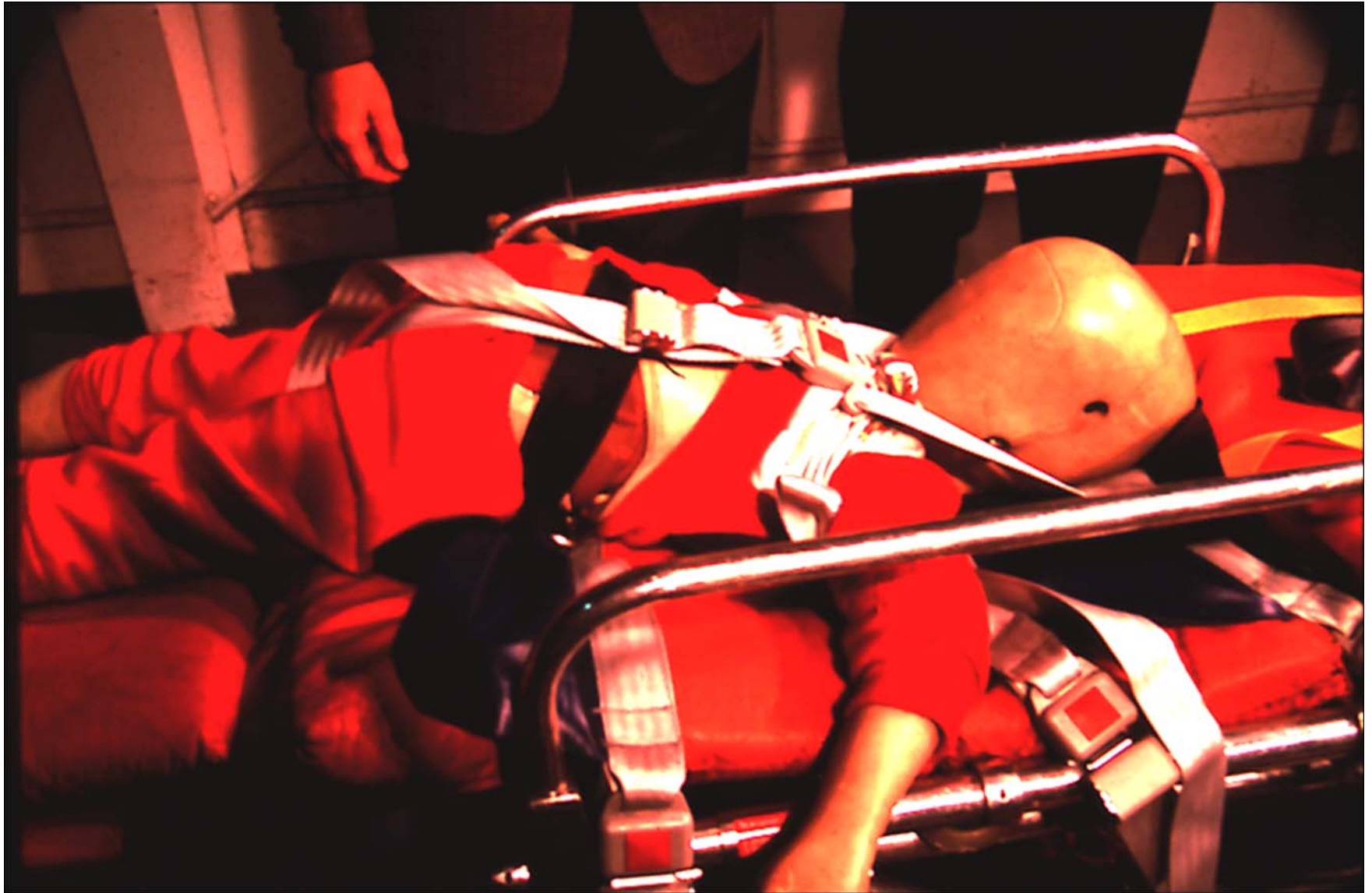
Levick NR, et al. Development and Application of a Dynamic Testing Procedure for Ambulance Pediatric Restraint Systems, SAE Australasia 1998;58:2:45-51

Stretcher straps

- Increasing horizontal stretcher straps beyond two horizontal straps has not been demonstrated to have any safety advantage.
- Use of the existing stretcher shoulder straps has been demonstrated to enhance safety

- A number of these recommendations in this Maryn Draft document are in direct conflict with the published peer reviewed science and with described mechanisms of injury that occur in the EMS setting

- Neither the EMS Safety Foundation nor the National Academies TRB EMS Subcommittee can in anyway support a document developed in the manner outlined in this Maryn document, and that makes a number of it conclusions





Mr. Grayson “Gregg” Lord,
Member, National Commission
on Children and Disasters

Public Meeting on Draft Recommendations for Safely Transporting Children in Specific Situations in Emergency Ground Ambulances.

August 5, 2010
1:30 – 4:30pm

Department of Transportation
1200 New Jersey Avenue, SE
Washington, DC 20590

Audience: NHTSA Working Group for “Solutions to Safely Transport Children in Emergency Vehicles”

Talking Points

Franklin once said.....

My name is Gregg Lord and I serve as Commissioner of the National Commission on Children and Disaster.

The National Commission on Children and Disasters was created by Congress as an independent, bipartisan body to identify gaps in the preparation for, response to, and recovery of children from all hazards.

Children are 25% of the population in the US. As such the Commission is deeply concerned that during an MCI EMS in this nation fundamentally lacks capability and capacity to manage children. Given that we know there is a huge gap in children’s equipment on EMS units it is unreasonable to expect that the child capable restraint systems will be available as well. In 2007, only 18% of BLS units and 16% of ALS units reported meeting EMSC performance measures for essential pediatric equipment and supplies as outlined in the national guidelines.

Let me elucidate our thoughts based upon the Commission’s research over the past two years on EMS response issues for children involved in disasters. At this point I would remind everyone that a disaster definition, although very specific in the Federal Register, is variable in the real world....As we saw in the NTSB/IOM review of the Mexican Hat incident of January 2008 one EMS system’s disaster is another systems normal event.

The Commission is disappointed that the only reference to the multiple child patient care event is the statement: "Some situations EMS Systems and their partners need to pre-plan for are: Multiple patient events involving infants and/or children who need to be transported (to include labor with the mother and one or more newborns)." It is unfortunate that the working group did not provide any other recommendations for this issue.

In October we will deliver to the President and Congress several recommendations specific to EMS which if implemented will improve the EMS response to children involved in disasters across our nation. These recommendations will build upon last years report. The Commission recognizes that emergency care training, equipment and regulatory oversight varies widely across localities, regions, states, territories and tribal nations. Yet we believe that many of these would go to support the fundamental gap in child transport safety for EMS that you have admirably identified.

So here is a preview:

- Clearly designate and appropriately resource a lead Federal administration/agency for emergency medical services (EMS), with primary responsibility for the coordination of grant programs, research, policy and standards development, and implementation.
- Improve the capability of EMS to transport pediatric patients and provide comprehensive pre-hospital pediatric care during daily operations and disasters by adhering to existing EMSC standards and developing regulations at the state, territorial and tribal level which insure compliance.
- Establish stronger pediatric EMS performance measures within relevant Federal emergency preparedness grant programs (i.e. the HHS Hospital Preparedness Program, the DHS Homeland Security Grant Program)

- HHS, as the coordinator and primary agency in charge of ESF #8 and NDMS, would recommend that DOT/NHTSA work collaboratively with HHS to develop a national strategy to improve the safety and capability for safe emergency transport and care of pediatric patients during disasters. Inherent in this issue is the need to include a national assessment of pediatric transport capacities across HHS, DoD, Coast Guard, National Guard and the private sector.

We believe that there are areas of opportunity for improvement. Principally the need to create an environment whereby the regulatory entities responsible for EMS Transport at a state, territory and tribal levels have the necessary incentive to insure compliance. Call it a carrot or call it a stick, from the Commissions stand point this is about protecting our children. We have successfully reduced morbidity and mortality by creating an environment whereby states required seatbelt use. We can do this for EMS systems as well. DOT/NHTSA is actually in one of the best positions to take on this issue given its long standing history of improving safety on our Nation's roadways. So we would ask that as part of this working group's recommendations that you use this opportunity to require the improvement of safety restraint systems for children on a daily basis thereby insuring some level of improvement during times of disasters.

Thank you for your time and your effort to improve safety for our children.

Recommendations for
the Safe Transportation
of Children in
Emergency Ground
Ambulances

Summary of Comments & Questions Received

Topic Presenters:

Sandy Sinclair

NHTSA Occupant Protection Division

Dave Bryson

NHTSA Office of Emergency Medical Services





Recommendations for
the Safe Transportation
of Children in
Emergency Ground
Ambulances

Next Steps: What's Next and Closing Remarks

Topic Presenters:

Sandy Sinclair

NHTSA Occupant Protection Division

Dave Bryson

NHTSA Office of Emergency Medical Services



- Next Steps
- Closing Remarks

