

Public Comment,  
August 5th, 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



Innovation, Collaboration & Knowledge Transfer  
[www.EMSSafetyFoundation.org](http://www.EMSSafetyFoundation.org)

## 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.



Innovation, Collaboration & Knowledge Transfer  
[www.EMSSafetyFoundation.org](http://www.EMSSafetyFoundation.org)

## 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



Innovation, Collaboration & Knowledge Transfer  
[www.EMSSafetyFoundation.org](http://www.EMSSafetyFoundation.org)

## 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.



Innovation, Collaboration & Knowledge Transfer  
[www.EMSSafetyFoundation.org](http://www.EMSSafetyFoundation.org)

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



Innovation, Collaboration & Knowledge Transfer  
[www.EMSSafetyFoundation.org](http://www.EMSSafetyFoundation.org)

## Ambulance Transport SAFETY IS A SYSTEM



Innovation, Collaboration & Knowledge Transfer  
[www.EMSSafetyFoundation.org](http://www.EMSSafetyFoundation.org)

## 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

**EMSSafety**  
FOUNDATION

Innovation, Collaboration & Knowledge Transfer  
[www.EMSSafetyFoundation.org](http://www.EMSSafetyFoundation.org)

- 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 is in many ways in conflict with safe operational EMS practice.

**EMSSafety**  
FOUNDATION

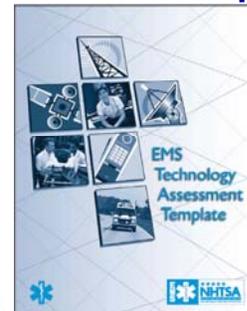
Innovation, Collaboration & Knowledge Transfer  
[www.EMSSafetyFoundation.org](http://www.EMSSafetyFoundation.org)

## However there is substantial technical information available

**EMSSafety**  
FOUNDATION

Innovation, Collaboration & Knowledge Transfer  
[www.EMSSafetyFoundation.org](http://www.EMSSafetyFoundation.org)

## EMS Technology Assessment Template



**EMSSafety**  
FOUNDATION

Innovation, Collaboration & Knowledge Transfer  
[www.EMSSafetyFoundation.org](http://www.EMSSafetyFoundation.org)

### 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

**Fauna 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 Services (EMS) systems is to enhance the care and treatment of ill and injured patients (1,2,3,4).

**INTRODUCTION**

Safe ambulance transport is fundamental in EMS training

**EMSSafety**  
FOUNDATION

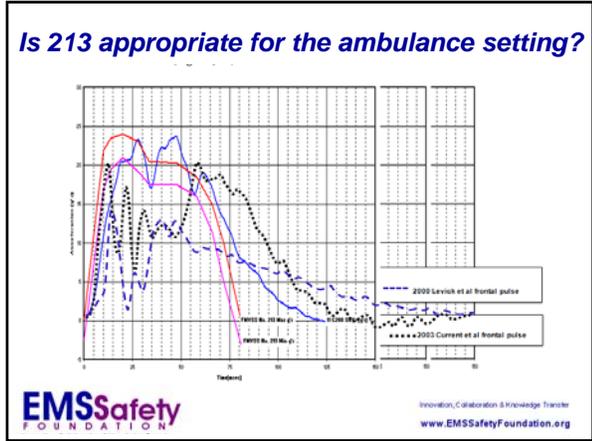
Innovation, Collaboration & Knowledge Transfer  
[www.EMSSafetyFoundation.org](http://www.EMSSafetyFoundation.org)

## 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, Yannacone 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/esv2007-0074-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/esv2007-0249-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>

**EMSSafety**  
FOUNDATION

Innovation, Collaboration & Knowledge Transfer  
[www.EMSSafetyFoundation.org](http://www.EMSSafetyFoundation.org)



SAE TECHNICAL PAPER SERIES  
2008-01-2695

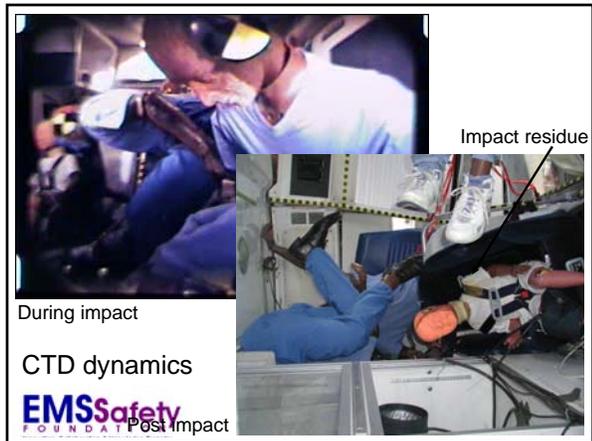
### Ambulance Vehicle Crashworthiness and Passive Safety Design: A Comparative Evaluation

Madine Levick  
EMSS 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 this seating design. Firstly, given that the modified seat did not offer lateral protection (as a standard child safety seat would offer) and that it also exposed the child to various head and neck hazards in the event of a side or offset impact. Secondly, should a child patient be seated in that position that there would be too 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 secondly, 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 kneeling position that would allow access to the child with the provider kneeling. Thirdly, that since 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 most of the USA utility 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, when 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 occurred to be a repeated design failure aspect of the USA vehicles.

EMSSafety FOUNDATION

Innovation, Collaboration & Knowledge Transfer  
www.EMSSafetyFoundation.org



### Existing Technical Literature

- 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](http://www.sae.org)
- Levick NR, MD MPH, Grzebieta R, BE MEngSci PhD, USA Ambulance Crashworthiness Frontal Impact Testing, International Enhanced Safety of Vehicles Technical Paper, 09-0471, Stuttgart, Germany June 2009, <http://www.nhtsa.gov/html/ncsa/ncsa/ncsa/09-0471.pdf>
- Pikey, WD, Kang, W, Shaw, CG. (1994) Crash Response of Wheelchair Occupants with Different Sitting Postures in Transport. Proceedings of the Annual Rehabilitation Engineering Society of North America (RESNA) Conference.
- Shaw, CG. (1997) The need to establish appropriate levels of crash protection for wheelchair riders in public transit vehicles. Proceedings of the Annual Rehabilitation Engineering Society of North America (RESNA) Conference.
- Shaw, CG (2000) Wheelchair rider risk in motor vehicles: A technical note. Journal of Rehabilitation Research and Development, 37(1).
- Shaw, CG, Gillispie, T (2003) Appropriate protection for wheelchair riders on public transit buses. Journal of Rehabilitation Research and Development, 40(4).
- Sherwood, CP, Shaw, CG, van Rooij, L, Kent, RW, Gupta, P, Crandall, JR, Orzechowski, K, Eichelberger, M, Kallieris, D. (2003) Prediction of cervical spine injury risk for the 6-year-old child in frontal crashes. Traffic Injury Prevention, 4(3): 206-213.

EMSSafety FOUNDATION

Innovation, Collaboration & Knowledge Transfer  
www.EMSSafetyFoundation.org

## SAE J2917 Ambulance Sled pulse

SAE J2917 issued MAY2010 Page 3 of 4

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	1	0.004	0.0
B	0.005	12.5	2	0.016	0.0

Innovation, Collaboration & Knowledge Transfer  
www.EMSSafetyFoundation.org

## We should use the best safety practices demonstrated in engineering

### Development of an Effective Ambulance Patient Restraint

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

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

2001-01-1173

Nadine Levick, Guohua Li, John Yannaccone

ARCA Inc

Innovation, Collaboration & Knowledge Transfer  
www.EMSSafetyFoundation.org

## ...in automotive safety engineering

### CRASHWORTHINESS ANALYSIS OF THREE PROTOTYPE AMBULANCE VEHICLES

DEVELOPMENT OF PROPOSED CRASH TEST PROCEDURES FOR AMBULANCE VEHICLES

USA AMBULANCE CRASHWORTHINESS FRONTAL IMPACT TESTING

Protection for Infants Transported in Incubators

Ambulance Vehicle Crashworthiness and Passive Safety Design: A Comparative Evaluation

2009-01-2822

Nadine Levick, EMSSafety Foundation (1), UKA, Raphael Graciano, Monash University

Marilyn J. Bull, West Virginia University

Raphael Graciano, University of Utah

Innovation, Collaboration & Knowledge Transfer  
www.EMSSafetyFoundation.org

## and in ergonomics

### Ergonomics in the rescue service—Ergonomic evaluation of ambulance cots

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

Reviewing ambulance design for clinical efficiency and paramedic safety

2008-01-1088

Jeremy Ferreira, Sue Hignett

ARCA Inc

Innovation, Collaboration & Knowledge Transfer  
www.EMSSafetyFoundation.org

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

95th percentile  
5th percentile  
rotation pivot

Innovation, Collaboration & Knowledge Transfer  
www.EMSSafetyFoundation.org

## 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”)

Innovation, Collaboration & Knowledge Transfer  
www.EMSSafetyFoundation.org

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



EM  
FOUN

**Ambulances are exempt from:**

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

EMSSafety  
FOUNDATION

Innovation, Collaboration & Knowledge Transfer  
www.EMSSafetyFoundation.org

**Laws of Physics**

EMSSafety  
FOUNDATION

Innovation, Collaboration & Knowledge Transfer  
www.EMSSafetyFoundation.org

**Science behind Policy**

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

Richard P. Feynman 1988

EMSSafety  
FOUNDATION

Innovation, Collaboration & Knowledge Transfer  
www.EMSSafetyFoundation.org

**The laws of physics prevail...**

EMSSafety  
FOUNDATION

Innovation, Collaboration & Knowledge Transfer  
www.EMSSafetyFoundation.org



EMSSafety  
FOUNDATION

Innovation, Collaboration & Knowledge Transfer  
www.EMSSafetyFoundation.org



**EMSSafety**  
FOUNDATION

Innovation, Collaboration & Knowledge Transfer  
[www.EMSSafetyFoundation.org](http://www.EMSSafetyFoundation.org)

## 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

**EMSSafety**  
FOUNDATION

Innovation, Collaboration & Knowledge Transfer  
[www.EMSSafetyFoundation.org](http://www.EMSSafetyFoundation.org)

## 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.

**EMSSafety**  
FOUNDATION

Innovation, Collaboration & Knowledge Transfer  
[www.EMSSafetyFoundation.org](http://www.EMSSafetyFoundation.org)

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

**EMSSafety**  
FOUNDATION

Innovation, Collaboration & Knowledge Transfer  
[www.EMSSafetyFoundation.org](http://www.EMSSafetyFoundation.org)

## So what do we know?

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

**EMSSafety**  
FOUNDATION

Innovation, Collaboration & Knowledge Transfer  
[www.EMSSafetyFoundation.org](http://www.EMSSafetyFoundation.org)

## 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

**EMSSafety**  
FOUNDATION

Innovation, Collaboration & Knowledge Transfer  
[www.EMSSafetyFoundation.org](http://www.EMSSafetyFoundation.org)

### 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



Innovation, Collaboration & Knowledge Transfer  
www.EMSSafetyFoundation.org

### 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



Innovation, Collaboration & Knowledge Transfer  
www.EMSSafetyFoundation.org

### 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”



Innovation, Collaboration & Knowledge Transfer  
www.EMSSafetyFoundation.org

### 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.”



Innovation, Collaboration & Knowledge Transfer  
www.EMSSafetyFoundation.org

### 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



Innovation, Collaboration & Knowledge Transfer  
www.EMSSafetyFoundation.org

### 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



Innovation, Collaboration & Knowledge Transfer  
www.EMSSafetyFoundation.org

## 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

**EMSSafety**  
FOUNDATION

Innovation, Collaboration & Knowledge Transfer  
[www.EMSSafetyFoundation.org](http://www.EMSSafetyFoundation.org)

## 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

**EMSSafety**  
FOUNDATION

Innovation, Collaboration & Knowledge Transfer  
[www.EMSSafetyFoundation.org](http://www.EMSSafetyFoundation.org)

## 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

**EMSSafety**  
FOUNDATION

Innovation, Collaboration & Knowledge Transfer  
[www.EMSSafetyFoundation.org](http://www.EMSSafetyFoundation.org)

- 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

**EMSSafety**  
FOUNDATION

Innovation, Collaboration & Knowledge Transfer  
[www.EMSSafetyFoundation.org](http://www.EMSSafetyFoundation.org)

- 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

**EMSSafety**  
FOUNDATION

Innovation, Collaboration & Knowledge Transfer  
[www.EMSSafetyFoundation.org](http://www.EMSSafetyFoundation.org)



**EMSSafety**  
FOUNDATION

Innovation, Collaboration & Knowledge Transfer  
[www.EMSSafetyFoundation.org](http://www.EMSSafetyFoundation.org)