Public Comment,
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Key Concerns regarding the Maryn Draft Document

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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.

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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

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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.

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

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Ambulance Transport SAFETY IS A SYSTEM

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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

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- 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.

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However there is substantial technical information available

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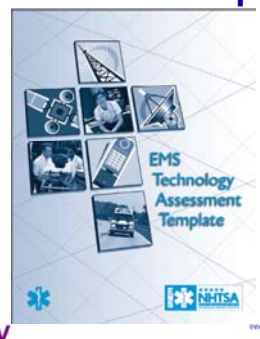
EMS Technology Assessment Template



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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

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Southern Health Care Network, Dandenong Hospital, Melbourne, Australia
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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

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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

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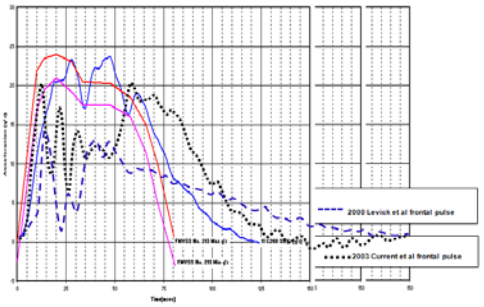
Is 213 appropriate for the ambulance setting?



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SAE TECHNICAL PAPER SERIES

2008-01-2695

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 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 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.

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

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During impact

Impact residue

CTD dynamics

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Post Impact

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
11. 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-nrd.nhtsa.dot.gov/pdf/esv/esv21/09-0471.pdf
11. Pilkey, 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.
12. 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.
13. Shaw, CG (2000) Wheelchair rider risk in motor vehicles: A technical note. Journal of Rehabilitation Research and Development. 37(1).
14. Shaw, CG, Gillispie, T (2003) Appropriate protection for wheelchair riders on public transit buses. Journal of Rehabilitation Research and Development, 40(4).
15. 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.

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SAE J2917 Ambulance Sled pulse

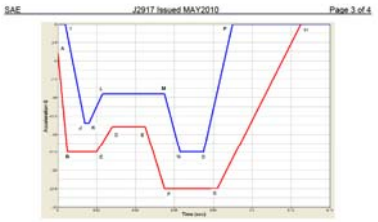

FIGURE 1 - DYNAMIC SLED CORRIDOR

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	-19.5

We should use the best safety practices demonstrated in engineering


Development of an Effective Ambulance Patient Restraint

ABSTRACT

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

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

…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

2009-01-2832

USA AMBULANCE CRASHWORTHINESS FRONTAL IMPACT TESTING

Protection for Infants Transported in Incubators

Ambulance Vehicle Crashworthiness and Passive Safety Design: A Comparative Evaluation

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Raphael Grzebieta
Injury Risk Management Research Centre (2)
University of New South Wales
Australia
Paper Number 09-0471

ABSTRACT

and in ergonomics


INDUSTRIAL ERGONOMICS

Ergonomics in the rescue service—Ergonomic evaluation of ambulance cots

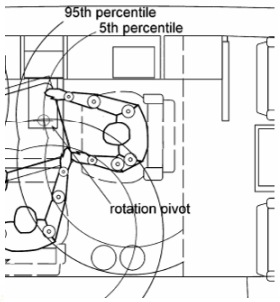
Karsten Kluth*, Helmut Strasser

Reviewing ambulance design for clinical efficiency and paramedic safety

Jeremy Ferreira, Sue Hignett*

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

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)

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Laws of Physics

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Science behind Policy

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

  Richard P. Feynman 1988

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The laws of physics prevail…

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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

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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.

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

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So what do we know?

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

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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

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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

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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

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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"

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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."

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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

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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

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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

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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

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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

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- 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

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- 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

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