Helen DeVos Children's Hospital
Transport Safety Seminar
July 1, 2010

The Ride of Your Life: Ambulance Transport Safety - *Separating Fact from Fiction*

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CEO, Objective Safety
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Very Important Principle

Ambulance transport safety is part of a SYSTEM, the overall balance of risk involves the safety of all occupants and the public

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EMS Transport Safety

- 'patient safety'
  AND also
- 'provider' and 'public safety'

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Ambulance transport a serious transport safety problem…

In the USA

- the most lethal vehicle on the road both per mile travelled and per vehicle
- is exempt from commercial fleet safety oversight from Federal Motor Carrier Safety Administration (FMCSA)
- 2/3 fatalities not in the ambulance
- Exempt from most FMVSS standards

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Some odd facts

- Ambulances are generally not built by the automotive industry
- Intelligent Transportation Systems (ITS), transportation safety engineering is not generally integrated into EMS systems
- Although all EMS systems have medical direction and oversight, it is rare for there to be transportation expertise oversight

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Data…

- What is your transport safety record in your service?
- How can you improve if you don't have a meaningful measure of safety performance?
- Transport safety is not guesswork, it is a science

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…and

- Is your ambulance crashworthy?
- Do you have a telematics feedback system?
- Enhanced Stability Control (ESC) – Does your ambulance have it??
  - An estimated >16% decrease in vehicle crashes
- and what is your loading height??
  - …is it less than 27 inches (68cm)??

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Absence of USA standards and oversight

- Challenges in identifying best practice
- Myriad of unregulated commercial products
- No safety performance standards
- Absent national safety oversight

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Predictable risks

- Fatal crashes more often at intersections, & with another vehicle (p < 0.001)*
- 70% of fatal crashes EMS crashes during Emergency Use*
- Most serious & fatal injuries occurred in rear (OR 2.7 vs front) & to improperly restrained occupants (OR 2.5 vs restrained)**
- 82% of fatally injured EMS rear occupants unrestrained**
- > 74% of EMT occupational fatalities are MVC related***
- Serious head injury in >65% of fatal occupant injuries#
- More likely to crash at an intersection with traffic lights (37% vs 18% p=0.001) & more people & injuries/crash than similar sized vehicles##

*Kahn CA, Pirrallo RG, Kuhn EM, Prehosp Emerg Care 2001 Jul-Sep;5(3):261-9
**Becker, Zaloshnja, Levick, Li, Miller, Acc Anal Prev 2003
***Maguire, Hunting, Smith, Levick, Annals Emerg Med Dec 2002
#NIOSH, 2003
##Ray AM, Kupas DF, Prehosp Emerg Care 2005 Dec; 9:412-415

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EMS Transport General Concerns

- Consequences can be predictable & likely preventable
- Costs of these adverse events are high in loss of life, financial burden and negative impact on delivery of EMS care
- Other high speed vehicles (eg. racing cars) have a different safety paradigm
- Design of interventions to mitigate injury is predicated on a valid testing model
- Complex both engineering and public health issues

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A tragic emergency health care intervention outcome

It does happen….

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- Transport Medicine

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Key elements

- Impact Biomechanics
- Transport Ergonomics
- Fleet Safety

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Impact biomechanics

- Crashworthiness
- Vehicle design
- Occupant protection

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Transport Ergonomics

- Operational tasks
- Human factors analysis
- Range of reach
- Patient loading and unloading

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Fleet safety

- Operational policies – dispatch, safety
- Fleet mix
- Vehicle selection – safety, ESC, loading height
- Driver performance and monitoring
- Scene safety
- Visibility and conspicuity
- Safety measurement and management

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Real world answers to real world questions -

- What features will enhance safety of my new vehicle purchase?
- What color scheme do I want on my vehicle to make it safest?
- What policies offer the safest system?
- How do I get my team to address safety issues?
- Do I need a helmet, and if so which one?
- What data should I collect when something goes wrong, and how to analyze it?

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

The Emergency Department (ED)

An ambulance is not an ED /ICU on wheels

The laws of physics prevail…

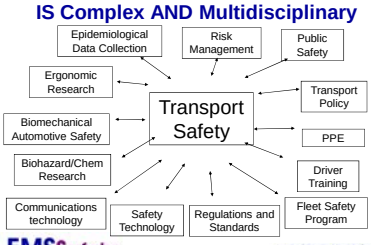
- and they don't care what your job title is or if you are a patient, a provider or a member of the public

Science behind Policy

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

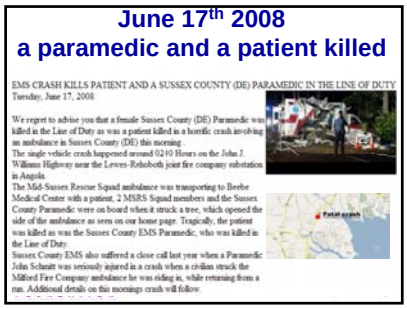
  Richard P. Feynman 1988

Ground Ambulance Transport Safety IS Complex AND Multidisciplinary



Do we ask vehicle builders to write cardiac arrest protocols…? Vehicle design and safety is not what we are trained to do!!!!

June 17th 2008
a paramedic and a patient killed


EMS CRASH KILLS PATIENT AND A SUSSEX COUNTY (DE) PARAMEDIC IN THE LINE OF DUTY
Tuesday, June 17, 2008

We regret to advise you that a female Sussex County (DE) Paramedic was killed in the Line of Duty as was a patient killed in a horrific crash involving an ambulance in Sussex County (DE) this morning.
The single vehicle crash happened around 0240 Hours on the John J. Williams Highway near the Lewes-Rehoboth joint fire company substation in Angola.
The Mid-Sussex Rescue Squad ambulance was transporting to Beebe Medical Center with a patient. 2 MSRS Squad members and the Sussex County Paramedic were on board when it struck a tree, which opened the side of the ambulance as seen on our home page. Tragically, the patient was killed as was the Sussex County EMS Paramedic, who was killed in the Line of Duty.
Sussex County EMS also suffered a close call last year when a Paramedic John Schmitt was seriously injured in a crash when a civilian struck the Milford Fire Company ambulance he was riding in, while returning from a run. Additional details on this mornings crash will follow.

In this vehicle…

October 31, 2008 - Kentucky

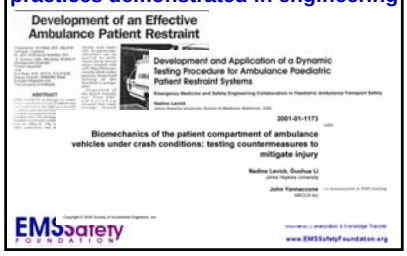
April 30, 2009 - Tennessee

And…

This is in a setting where

- transport safety is the major and most costly adverse event in EMS
- And there have been all sorts of major technical and informational developments since Jan 2006

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

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 AN ALYSIS 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

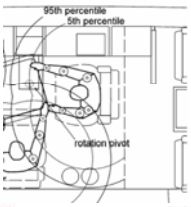
Ambulance Vehicle Crashworthiness and Passive Safety Design: A Comparative Evaluation

and in ergonomics


Ergonomics in the rescue service—Ergonomic evaluation of ambulance cots

Reviewing ambulance design for clinical efficiency and paramedic safety

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



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'Workplace' Hazards

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Bigger is not necessarily better……

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Goals

- Standards for safety
- Policy based on Science
- Databases to demonstrate outcome

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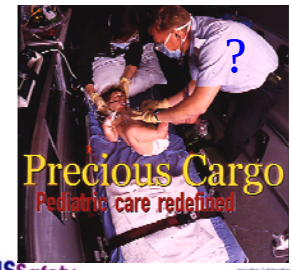

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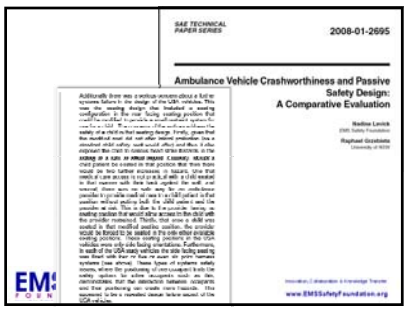
If we know this – and its published….

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

Why do we do this?



SAE TECHNICAL PAPER SERIES 2008-01-2695

Ambulance Vehicle Crashworthiness and Passive Safety Design: A Comparative Evaluation

Nadine Levick
EMS Safety Foundation

Raphael Gorbatkin
University of NSW

Immobilization board

Foldable

Choose the Best Option

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Vehicle Crashworthiness testing

USA - 2000 research

Europe - 2007 to meet CEN

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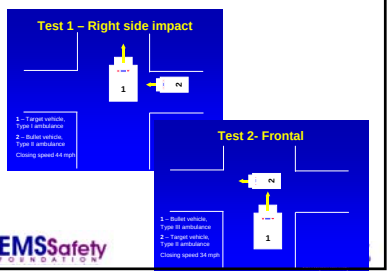
Full Vehicle Crash Tests



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2000 Full Vehicle Crash Testing

Pre-impact CTD positioning

Preparation of test vehicles

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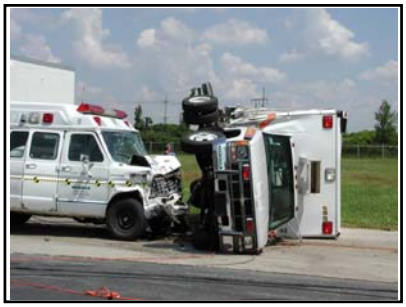
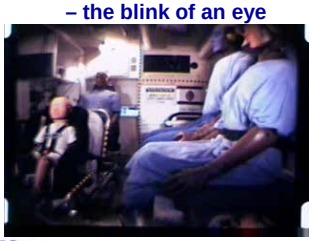


And this all takes place in 60 millisecs – the blink of an eye



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During impact

CTD dynamics

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Post impact

High speed crash, rolled and the occupants (patient and medics) had only minor scratches

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A few key words about restraint systems…

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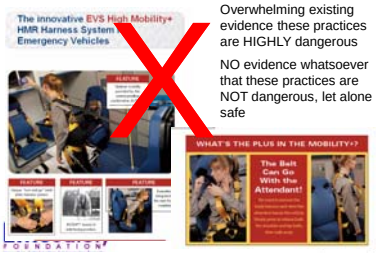
Systems safety failure AND dangerous



Overwhelming existing evidence these practices are HIGHLY dangerous

NO evidence whatsoever that these practices are NOT dangerous, let alone safe

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NOT new technical data…

Richardson S.A., et al, Int. J. of Crash., 4:3, 239 – 259, 1999

Side facing 4-point harnesses demonstrated to be lethal, even at slow ground vehicle speeds

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Side facing 4-point harnesses demonstrated to be lethal, even at slow ground vehicle speeds

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Being seated IN an automotive seat is what will protect you

- Anything that allows or encourages you to get up out of your seat will also encourage you to be injured or killed – it is potentially lethal to be out of your seat in any fashion
- 4 or 5 point harnesses over both shoulders for sidefacing occupants are potentially lethal – and in NO WAY SUPPORTED BY ANY DATA OR INDEPENDENT AUTOMOTIVE SAFETY EXPERTISE

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American National Standard ANSI/ASSE Z15.1-2006

Safe Practices for Fleet Motor Vehicle Operations

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What Z15 encompasses

- Safety Program
- Safety Policy
- Responsibilities and Accountabilities
- Driver Recruitment, Selection and Assessment
- Organizational Safety Rules
- Orientation and Training
- Reporting Rates and Major Incidents to Executives
- Oversight

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October 2008 JEMS Article "Rig Safety – 911"

http://www.objectivesafety.net/JEMSRigSafety911.pdf

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Invehicle technologies to enhance transport safety

- Aftermarket in vehicle electronic e-safety devices with monitoring and feedback

[November 02, 2008]

BusinessWire

inthinc Delivers tiwi Driving Safety and Fleet Management Solution

SALT LAKE CITY --(Business Wire)-- inthinc Technology Solutions (Pages - April), Inc. (www.inthinc.com), a developer and manufacturer of tiwi-branded solutions to improve driving safety, today announced its tiwi driving safety system is in full production for light commercial fleets as well as heavy duty and special purpose applications. With tiwi, companies get the only comprehensive system that changes driving behavior in real time to improve safety and fleet efficiency.

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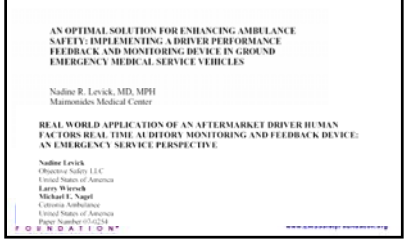
What about changing driver behavior in the real world??


AN OPTIMAL SOLUTION FOR ENHANCING AMBULANCE SAFETY: IMPLEMENTING A DRIVER PERFORMANCE FEEDBACK AND MONITORING DEVICE IN GROUND EMERGENCY MEDICAL SERVICE VEHICLES

Nadine R. Levick, MD, MPH
Maimonides Medical Center

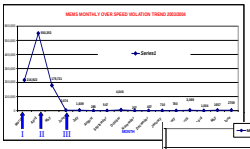
REAL WORLD APPLICATION OF AN AFTERMARKET DRIVER HUMAN FACTORS REAL TIME AUDITORY MONITORING AND FEEDBACK DEVICE: AN EMERGENCY SERVICE PERSPECTIVE

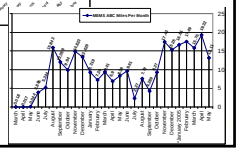
Nadine Levick
Objective Safety LLC
United States of America
Larry Wiersch
Michael E. Nagel
Cetronia Ambulance
United States of America
Paper Number 07-0234

The "Feedback Box" - A transportation safety monitoring and feedback device

This technology is conceptually like a vehicle safety 'pulse oximeter' – that with auditory feedback - can save your life, your coworkers life, your patients life, and others on the road

Demonstrated Effectiveness





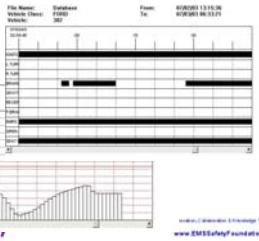
I – blind data, no growls

II – growls & tones ON unidentified data capture

III – identified data

And when a rare crash happens….

Unit 302 Accident



Monitoring and feedback devices

- Implementation well received by the providers.
- 20% cost saving in vehicle maintenance within 6 months.
- No increase in response times
- Fewer crashes and less severe crashes
- Sustained improvement in safety proxies, with no inservice or retraining after the initial introduction period.

Feedback box Summary

- The system works
- Objectively improved performance
- No increase in response times
- At fault accidents reduced
- Accepted into the culture

However:

- The system requires monitoring
- Must be reinforced by management
- Must be incentives for good performance
- Must be consequences for poor performance

A key to safe ambulance transport

Extensive Indirect cost savings

- Fewer out of service vehicles
- Improved transport times
- Decreased administrative lost in managing unsafe behaviors
- Decreased legal burden
- Automatic system wide data
- Insurance benefits

National Academies Transportation Research Board

- This is where the technical experts were, operational EMS providers and the government agencies too

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What could you learn from the National Academies – right NOW and gratis

- The realm of burden and benefit
  - measuring the safety of the system
  - determining the economic, ethical and risk benefit challenges
- Transport System Management
  - fleet safety and oversight technologies and policies
  - operations management – dispatch, congestion routing, deployment of resources, benchmarking
- Vehicle safety
  - occupant protection design and testing
  - Vehicle performance safety
  - vehicle and personnel human factors issues
- Dissemination and Policy
  - Knowledge transfer
  - Standards, specifications and policy

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Its out there NOW

- TRB 2009 Summit – addressed the key and interdisciplinary issues, in one day – please seek that information out.
- There have been two TRB Summits held, 2008, 2009 and both with vehicle engineering and transportation systems technical expertise
- See www.trb.org, and for the Summit archives: www.objectivesafety.net/TRBSummit2008.htm www.objectivesafety.net/TRBSummit2009.htm

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The EMS Safety Foundation: A practical and functional model

Interdisciplinary and Operational

- Innovation
- Collaboration
- Knowledge transfer

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The EMS Safety Foundation

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brings this presentation to you

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Background:

- EMS Safety Foundation has been established to fill a gap in
  - technical knowledge transfer
  - practical interdisciplinary R & D
  - evaluation and implementation of system safety enhancements for EMS and Medical Transport
- It is a not-for-profit institute

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RETTmobil is -

- A major European Emergency Rescue Congress, Trade show and Symposium
- Held in Fulda, Germany
- Established in 2001
- Attended by ~ 20,000 attendees
- Brainchild of Prof Peter Sefrin

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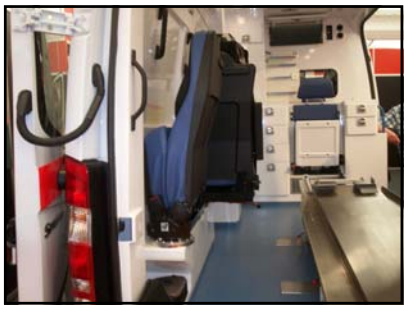

Vehicle Occupant Safety design

European design

Safety technology is a key focus

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Safe and Ergonomic design

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Collaboration and Outcomes

- Interdisciplinary Collaboration is what is key – not orthopedic folks talking to cardiologists – BUT collaboration between the health care folks appropriate automotive and occupant protection engineers and transportation system design and industry standards that make sense – and
- Meaningful measures of outcome and performance

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Texas' Careflite's new vehicles

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Careflite's new vehicle

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Careflite's new vehicle

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Technical Collaboration is key

- We are NOT the experts in this science
- We cannot afford to play the silo game here, it is costing lives, time and money
- We MUST have a meaningful evidenced based approach to operations and policy
- We must be outcomes driven
- We MUST cease to be a fiefdom in a discipline we have no technical background or expertise in

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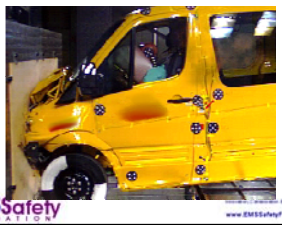
this vehicle is safety crash tested by automotive experts



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Unlike this vehicle

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So what do we need to do ??

- Reach out to the appropriate experts – they sure do want to help us
- STOP being philistines and be the scientists we are trained to be and at least seek a scientific approach
- Get your heads out of the sand – there is plenty of valid technical information – FMCSA, TRB, SAE
- Make policy and purchase decisions on technically sound data, not a marketing brochure
- HAVE MEANINGFUL AND TRANSLATABLE OUTCOME MEASURES FOR YOUR SERVICES SAFETY PERFORMANCE

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Very Important Principle

Ambulance transport safety is part of a SYSTEM, the overall balance of risk involves the safety of all occupants and the public

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Conclusion

- EMS transport has serious hazards and safety issues
- Major advances in EMS safety research, infrastructure and practice over the past 5 years
- Development of substantive EMS safety standards is a necessity and a reality
- Multidisciplinary safety issue that EMS cannot solve internally
- Failure to transfer knowledge from transportation and automotive safety is unacceptable and dangerous
- EMS is still way behind the state of the art in vehicle, transportation and occupational safety

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Thank you!

Any Questions??

Electronic handout available online

http://www.objectivesafety.net

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