10th National Outreach Education Conference 'Building Partnerships in Perinatal Care, Chicago, IL 2006

Ambulance Safety: All you need to know

Moving Sick Kids Safely - Optimizing Transport Safety

Nadine Levick, MD MPH

A tragic emergency health care intervention outcome

Rollover Crash Kills Medical Technician

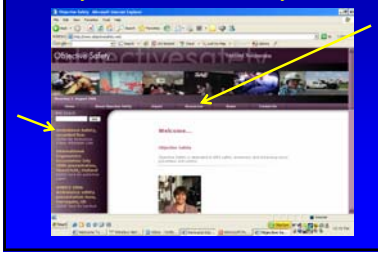
It does happen….

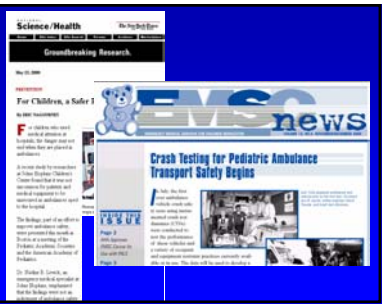
Outline

I. Review data on ambulance transport safety
II. Highlight important predictable and preventable occupant risks and hazards during neonatal and pediatric transport
III. Demonstrate what happens during an ambulance crash
IV. Review of guidelines, standards and innovation
V. Outline practices and strategies to enhance occupant safety and reduce risks of crash-related injury

http://www.objectivesafety.net

and your electronic handout awaits you online!





Science/Health

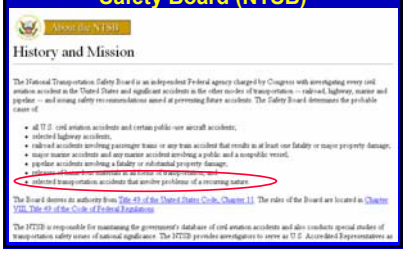
Groundbreaking Research.

For Children, a Safer I

EMS news

Crash Testing for Pediatric Ambulance Transport Safety Begins

The National Transportation Safety Board (NTSB)



About the NTSB

History and Mission

The National Transportation Safety Board is an independent Federal agency charged by Congress with investigating every civil aviation accident in the United States and significant accidents in the other modes of transportation -- railroad, highway, marine and pipeline -- and issuing safety recommendations aimed at preventing future accidents. The Safety Board determines the probable cause of:

- all U.S. civil aviation accidents and certain public-use aircraft accidents;
- selected highway accidents;
- railroad accidents involving passenger trains or any train accident that results in at least one fatality or major property damage;
- major marine accidents and any marine accident involving a public and a nonpublic vessel;
- pipeline accidents involving a fatality or substantial property damage;
- [illegible]; and
- selected transportation accidents that involve problems of a recurring nature.

The Board derives its authority from Title 49 of the United States Code, Chapter 11. The rules of the Board are located in Chapter VIII, Title 49 of the Code of Federal Regulations.

The NTSB is responsible for maintaining the government's database of civil aviation accidents and also conducts special studies of transportation safety issues of national significance. The NTSB provides investigators to serve as U.S. Accredited Representatives at

Key Issues

- **Mythology**
  - That Emergency Medical Service personnel are safe
- **Injury Hazards**
  - Biohazard
  - Chemical/Radiation
  - Physical/Mechanical trauma – THE BIG PROBLEM
- **Motor Vehicle Crashes are the highest cause of death at work – EMS has > 2X the mean national rate**
- **An R & D and Regulatory Gap**
  - Occupational Health and Safety
    - the workplace is in a vehicle – exposure data are scant
  - Automotive Safety
    - a vehicle is the work place – 'exempt' from automotive research and regulation

Safety oversight of what and by …. whom

- Vehicle Safety
- Vehicle Design
- Safety Equipment Design
- Vehicle and Safety Equipment Testing and Standard development
- Safety policies

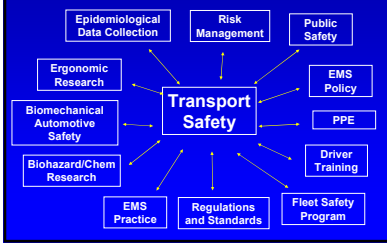
Goals

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

Safety in Pediatric/Neonatal Ambulance Transport

- Is part of a SYSTEM

Perinatal Transport Safety IS Complex AND Multidisciplinary



the Peds EMS/transport process

- communications/dispatch
- policies and procedures
- the pediatric patient
- restraining device/seat
- transporting device/gurney
- paramedics/transport nurses, doctors & family
- patient monitoring equipment
- clinical care & interventions
- the vehicle
- the driver/driving skill
- the road

TIME & PLACE

Firstly!

- An accident ?
- or

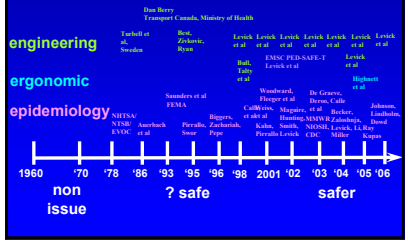
a predictable and preventable event

This is not acceptable

- ~ One fatality each week#
  - ~ 2/3 pedestrians or occupants of other car
  - ~ 4 child fatalities per year (>2X airbags 2004-2005)
- ~10 serious injuries each day
- Cost estimates > $500 million annually
- USA Crash fatality rate/capita 35x higher than in Australia

*FARS/BTS 2004

Ambulance Safety Research: A New Field



Peds Transport

- Collisions/crashes among pediatric transport teams
  - are unusual
  - have resulted in deaths, injuries, and disability.
  - appear to be caused by the actions of a team member and/or those of third parties
- Collision-free teams attributed their safety record to specific policies of the team and/or the vehicle owner or vendor and to luck.
- Specific safety policies on the part of the team and/or vehicle owner or provider may prevent or decrease collisions/crashes.

* Pediatric critical care transport--the safety of the journey: a five-year review of vehicular collisions involving pediatric and neonatal transport teams: GA Woodward, EW Fleegler - Pediatr Emerg Care, 2002

Neonatal Transport

- The continuous process of critical incident reporting and review can reduce the number of adverse events during the transfer of critically ill infants.

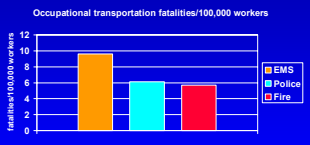
* Towards safer neonatal transfer: the importance of critical incident review: Moss SJ, D Embleton N, Fenton AC Archives of Disease In Childhood 90 (7): 729-732 JUL 2005

Predictable risks

- More often at intersections, & with another vehicle ($p < 0.001$)*
- 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#
- 70% of fatal crashes EMS crashes during Emergency Use#
- 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, Pirralo 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
###NHTSA, 49 CFR Parts 571, 572 & 589 Docket no. 92-28; notice 7

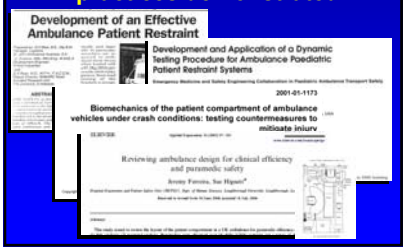
A word about occupational transportation fatalities..



- WE HAVE A BIG PROBLEM HERE

** Maguire, Hunting, Smith & Levick, Occupational Fatalities in Emergency Medical Services: A Hidden Crisis, Annals of Emergency Medicine, Dec 2002*

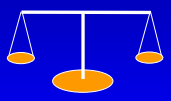
We should use the best safety practices demonstrated



What do we know now??

- Intersection crashes are the most lethal
- There are documented hazards, some which can be avoided
- Occupant and equipment restraint with standard belts is effective. (Over the shoulder harnesses for patients should be used, with the gurney in the upright position where medically feasible)
- Some vehicle design features are beneficial - automotive grade padding in head strike areas, seats that can slide toward the patient
- Electronic Driver monitoring/feedback systems appear to be highly effective
- Head protection??

Balance of concerns and risk during transport

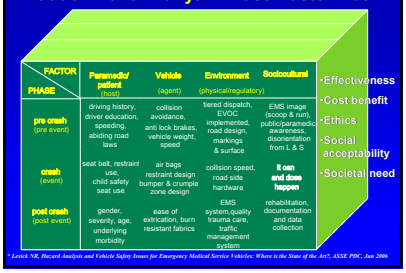


- Response and transport time
- Clinical care provision
- Occupant safety/protection
- Public Safety

Benefit of Safety

- Any cost of addressing these issues is dwarfed in contrast to the huge burden of not doing so - in financial costs let alone the personal, societal, ethical and litigation costs

Haddon/Baker/Runyan Phase-Factor Matrix



** Levick NR, Hazard Analysis and Vehicle Safety Issues for Emergency Medical Service Vehicles: Where is the State of the Art?, ASSE PDC, Jan 2006*

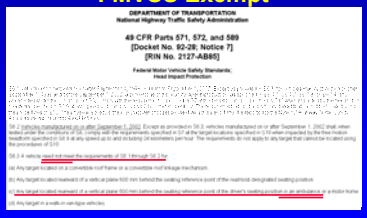
Concerns

- 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
- Much uncertainty amongst providers as to what is safe and what is unsafe occupant protection practice
- 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

What are the risks?

- Lack of tiered dispatch systems
- Frequent use of high speed
- Issues of adherence to road laws
- High use of L & S.
- Rear cabin
  - not subject to any automotive safety regulation
  - minimal structural crashworthiness features
  - inadequate and poorly studied occupant and equipment restraint utilization and safety
- The only design standards that are written specifically for ambulance vehicles (KKK specs) are purchase specifications, not performance specifications

USA Ambulances: FMVSS Exempt



DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration

49 CFR Parts 571, 572, and 589
[Docket No. 92-28; Notice 7]
[RIN No. 2127-AB85]

Federal Motor Vehicle Safety Standards;
Head Impact Protection

Identifying predictable and preventable transport related risks and hazards

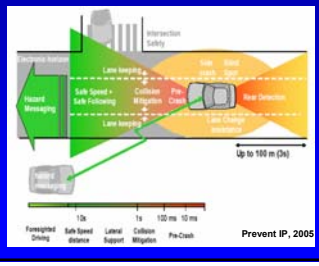
- Systems approach
  - Communications
  - Personnel
  - Transport
  - Equipment
  - Environment

Protective devices/concepts

In the event of a crash
- Vehicle crashworthiness
- Seat/seat belt systems
- Equipment lock downs
- Padding
- Head protection

To prevent a crash
- Driver feedback
- Driver monitoring
- Driver training
- Vehicle and other technologies
- Tiered dispatch
- Appropriate policies

Intelligent Transport Safety Systems



Prevent IP, 2005

"Are our policies killing people?"

- 1991-2000, 302,969 Emergency vehicles were involved in MVCs - 1,565 involving fatalities*
- In PA 1997-2001, ambulances were more likely than similar sized vehicles to be involved in*:
  - 4 way intersection crashes (43% vs 23%, p=0.001)
  - Collisions at traffic signals (37% vs 18%, p=0.001)
  - MVCs with more people injured (76% vs 61%, p=0.001)

**Comparison of Crashes Involving Ambulances with those of similar sized vehicles – Adam Ray, Douglas Kupas, PEC Dec 2005;9:412-415*

So.. The real world for an EMS vehicle approaching a red light

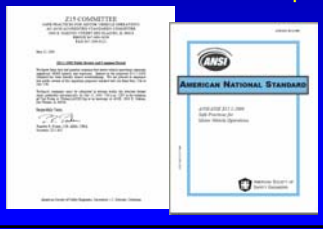
- You think they heard you…
- You know they must have seen you..
- And maybe they did
- ….. But..
- There is NO way humanly possible that they could stop…..

Global EMS Vehicle Safety Standards v Specifications and Guidelines

- EMS Safety and Performance Standards
  - Australia & New Zealand 4535
  - Common European Community (CEN) EN1789
- Non EMS Specific USA Standards
  - [Aviation - FAA/CAA/JAA]
  - [New ASSE/ANSI Z15 – fleet vehicles]
- USA Other
  - Purchase Specification: KKK & NTEA – AMD
  - Guideline: EMSC Dos and Donts, and (CAAS and CAMTS)

American National Standard ANSI/ASSE Z15.1-2006

Safe Practices for Fleet Motor Vehicle Operations



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

Z15 Incident Rates

- Incident rate based on number of vehicles operated:
  Incident rate = Number of incidents x 100 / Number of vehicles
- Incident rate based on vehicle mileage:
  Incident rate = Number of incidents x 1,000,000 / Vehicle mileage
- Injury incident rate based on vehicle mileage:
  - Injury incident rates, the most frequently used indicator of incident severity, are useful for tracking events that have the potential to affect financial or operational performance of the operating unit.

  Injury incident rate = Number of incidents with injury x 1,000,000 / Vehicle mileage
- Incident rates based on service activity:
  - Motor vehicle operations that pose injury risks other than those associated with driving should also use the service activity as the basis of a safety performance rate. The number of deliveries, stops, or loads should be considered as appropriate indicators of performance.

  Incidents per 10,000 transports = Number of incidents x 10,000 / Number of transports
- Vehicle injury rates based on work hours:
  Vehicle incidents per 200,000 hours = Number of incidents x 200,000 / Number of hours worked

Safety Management

- A Safety Culture
- Protective Policies
- Protective Devices
  - In the event of a crash
  - To prevent a crash
- Continuous Education and Evaluation

Risk to who?

- Health care interventions that are a risk to:
  - Patients (their families?)
  - Providers
  - Public

USA EMS Risk/Hazards

- Predictable risks
- Serious occupational hazard
- Predictable fatal injuries

The 'workplace'

- Transport provider's often in vulnerable positions during transport.
  - Bench seat
  - Captains chair
  - Standing or kneeling

View of Ambulance interior from Rear

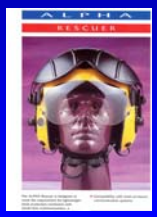
Air EMS is a role model for safety initiatives and focus

Rollover Crash Kills Medical Technician

Ambulance Runs Off I-66 and Rolls Over, Injuring Two Employees and a Patient

It does happen….

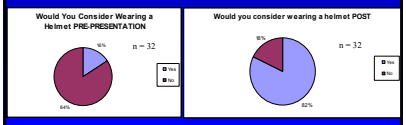
head protection?



Role of a head protective device

- A simple, immediate and inexpensive adjunct – a protective device -
  - To protect occupants from hazardous interiors
  - As vehicle crashworthiness design advances
  - As driver training advances
  - For when equipment becomes unsecured
  - As EMS Safety Standards are developed, for both EMS vehicles and EMS occupational safety

Preliminary Study:
Attitudes to Head Protection in EMS



Crash Occupant Protection

- collision speed
- direction of impact
- vehicle stiffness and mass
- compartment size & projectiles
- intelligent vehicle technology
- passive protection
- head protection
- occupant restraint/belts

in a collision at 35 mph (60 km/hr), an unrestrained 15 kg child is exposed to the same forces* as in falling from a 4th story window

*550 kg/force in 0.03 sec

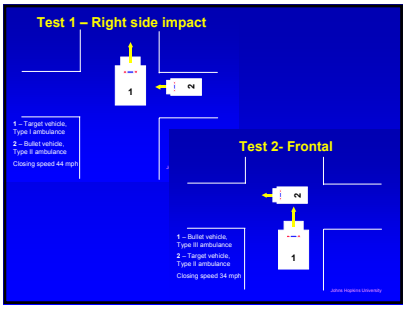
Creating a Safety Culture

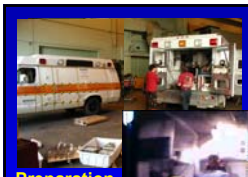
within a company must start with upper management's commitment to safety

- Awareness
- Training
- Incentive

Identifying predictable and preventable transport related risks and hazards

- Systems approach
  - Communications
  - Personnel
  - Transport
  - Equipment
  - Environment





Pre-impact CTD positioning

Preparation of test vehicles

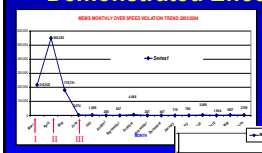
New concepts out there now

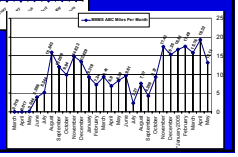
- Black Boxes
- Tiered dispatch
- Helmets
- Enhanced ambulance vehicle design
- Intelligent Transport Technologies - ITS
- New Safety Standards

The "Black Box"

Driver behavior monitoring and feedback device

Demonstrated Effectiveness

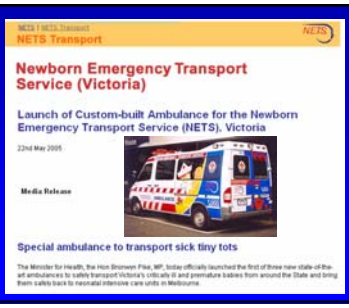




I – blind data, no growls

II – growls & tones ON unidentified data capture

III – identified data



NETS Transport

Newborn Emergency Transport Service (Victoria)

Launch of Custom-built Ambulance for the Newborn Emergency Transport Service (NETS), Victoria

22nd May 2005

Media Release

Special ambulance to transport sick tiny tots

The Minister for Health, the Hon Bronwyn Pike, MP, today officially launched the first of three new state-of-the-art ambulances to safely transport Victoria's critically ill and premature babies from around the State and bring them safely back to neonatal intensive care units in Melbourne.

Important Principles !

1. Ambulances are NOT standard passenger vehicles

Important Principles !

2. Pediatric patients in ambulances have needs which differ from children in passenger cars

Important Principles !

3. Design, performance and practice policy should be based on properly conducted science

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

Very Important Principles !

1. A culture of safety
2. Drive cautiously
3. Wear your belts & restrain all occupants
4. Secure all equipment
5. Integrate scientific data into your policies and procedures

- Unrestrained occupants and equipment are a potential injury risk to all occupants

PREDICTABLE PREVENTABLE and NO 'ACCIDENT'

Future

- Goals
- New vehicles
- New technologies
- Futuristic vehicles
- New policies
- New practices
- New Standards

Conclusions

- Prevention is key - the transport environment includes predictable and preventable risks.
- Every member of a transport program must play a role to actively manage risk and to avoid taking unnecessary risk.
- Focus on safety of ALL aspects of the transport environment
- New technologies for vehicle design, occupant PPE and equipment restraint and driver performance are now available: be ready to integrate them into your practice
- There is a need for a defined pathway for translation of problem identification to resolution and policy implementation

Conclusions

- Major advances in EMS transport safety research, infrastructure and practice over the past 5 years BUT patient transport safety is still way behind the state of the art in vehicle safety and occupant protection
- Development of substantive safety standards is a necessity and a reality
- The absence of any national infrastructure for safety oversight in patient transport is not an acceptable situation
- And WE NEED DATA

And….

- It is no longer acceptable for patient transport to be functioning outside of automotive safety and PPE safety standards for prevention of and protection of EMS/transport providers and the public from injury or death

Electronic Info:

www.objectivesafety.net

- Electronic Handout of today's presentation
- "Ambulance Safety: Where is the State of the Art?" Webinar - Recorded online - Free access via the internet
- Comprehensive Reference List on EMS Safety