New initiatives in EMS Transport Safety: Where is the State-of-the-Art?

Nadine Levick MD. MPH.
Executive Director, Objective Safety

www.objectivesafety.net

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This morning's Scope

Key Issues

- Crash and Safety Data
- Oversight – guidelines – standards
- Transport safety management
  -To the need of a new
    -Transportation
  -To Public Health
  -To the regulation

Future

- New Safety Devices
- New Medical Advances
- New Technologies
- New Practices
- New Standards

A tragic emergency health care intervention outcome

It does happen....

Key Issues

- Mythology
  - That Emergency Medical Service personnel are safe
- Injury Hazards
  - Biological
  - 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
    - Epidemiology, Bio/Chem Hazards and Ergonomics
    - Risk Management
  - Automotive Safety
    - Epidemiology, Engineering and Impact Biomechanics
  - EMS Industry
    - OCC, CDC, State, Occupational, Clinical & Fiscal
    - Practice Policy, Risk Management and Fleet Safety
  - Academia
    - Independent and collaborative
    - R&D and evaluation of all of the above

USA EMS

- EMS Systems - >15,000
- Personnel - ~1 million (~90% F/T professional & 70% volunteer)
- Vehicles - ~50,000
(Type I, II, III, Freightliners, motorcycles)
- Transports - ~30 million patients
- Cost - ~$5 Billion annually
- Safety Oversight - ? Disparate

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

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Ground EMS Transport Safety
A complex automotive safety environment

- Transport Safety is part of a system
  - Driver skill and performance
  - Monitoring and feedback
- Vehicle design
  - Vehicle Crashworthiness
  - Impact attenuating interior design (non-hostile surfaces, padding, netting)
  - Seat/seat belt design
  - Equipment lockdown
- Occupant personal protective devices
  - Head protection

This is not acceptable
- ~ One fatality each week#
  - ~ 2/3 pedestrians or occupants of other car
  - Approximately 4 child fatalities per year
- ~10 serious injuries each day
- Cost estimates > $500 million annually
- USA Crash fatality rate/capita 35x higher than in Australia

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

Background: Problems
- No reporting system or database specifically for identifying ambulance crash related injury
- Rear passenger compartment, > 60cm behind driver - exempt from FMVSS
- Cost estimates > $500 million annually
- USA Crash fatality rate/capita 35x higher than in Australia

USA Ambulances: FMVSS Exempt

Ambulance Safety Research: A New Field

Predictable risks
- More often at intersections, & with another vehicle (p < 0.001)
- Most serious & fatal injuries occurred in rear (OR 2.7 vs front) & improperly restrained occupants (OR 3.5 vs restrained)
- 82% of fatally injured EMS rear occupants unrestrained
- 74% of EMT occupational fatalities are MVC related
- 70% of fatal crashes EMS crashes during Emergency Use
- More likely to crash at an intersection with traffic lights (37% vs 18%, p<.001) & more people & injuries/crash than similar sized vehicles

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

Firstly!

▶ An accident?
▶ or a predictable and preventable event

“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)


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....

Protective devices/concepts

In the event of a crash
- Vehicle crashworthiness
- Seatbelt systems
- Equipment lock downs
- Padding
- Head protection

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

This is where automotive safety is happening – where is EMS???

Enhanced Safety of Vehicles (ESV) – The Definitive Vehicle Safety Forum

Ambulance vehicle safety has only been presented at one ESV meeting, the 17th ESV in 2001

Arizona, September 11th 2001

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

Global EMS Standards

- Australia & New Zealand ASA 4535
- Common European Community EN1789
- “USA KKK & NTEA – AMD”
- [Aviation - FAA/CAA/JAA]
- CAMTS
- CASS
- International Joint Commission on Medical Transport
- Draft ANSI/ASSE Z15
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

The ‘workplace’ IS a vehicle

- Providers often in vulnerable positions during transport.
  - Bench seat
  - Captains chair
  - Standing or kneeling

Hazards

- View of Ambulance interior from rear

But what about 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
The difference having data makes?

Head protection developments
- Head protection is an accepted, standard and standardized aspect of PPE for all Emergency Services, except for ground EMS personnel.
- In a setting of new enhancements to ambulance transport safety – and a realistic understanding of time frames for such changes to fleet vehicles – head protection is a simple and cost effective initiative.
- As a result of this study a collaborative relationship has been established with International Safety Equipment Association (ISEA) to support the development of a standard for ground EMS head protection.

Crash Prevention
- EVOC
- Tiered Dispatch
- The "Black Box"
- Intelligent vehicle design
- Appropriate policy

The "Black Box"
Driver behavior monitoring and feedback device

Implementing Black box technology in Pinellas
- Introduced by Chuck Kearns, Pinellas County EMS/Fire Exec Director
- Paid for itself in 8 months in reduced maintenance costs alone
- Reduced crash rate by 90%

MEMS Road Safety Average Between Count Miles 2003/2005

302 Accident 3 July, 2003

Unit 302 Accident

Improved safety, performance and decreased costs
- No increase in response times
- Pays for itself in 6 months in reduced maintenance costs alone
- Improved safety proxies by orders of magnitude and sustained with no in-service
- Reduced crash rate by up to 90%
- Well accepted
- Is it ethical NOT to have these devices in all vehicles now?
Other monitoring devices
- Primarily to record events during and immediately preceding a crash
- Give no driver crash prevention feedback
- Administratively burdensome
- Intrusive
- Not demonstrated to be as effective in improving vehicle maintenance costs or as effective in modifying driver behavior long term

Safety for EMS Transport Goals
- Standards for safety
- Policy based on Science
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Air EMS is a role model for safety initiatives and focus

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

Creating a Safety Culture
within a company must start with upper management’s commitment to safety
- Awareness
- Training
- Incentive

USA EMS Risk/Hazards
- Predictable risks
- Serious occupational hazard
- Predictable fatal injuries

Multidisciplinary collaboration and the way forward
- Development of interdisciplinary teams
  - Healthcare professionals
  - Safety engineering expertise
  - Regulatory bodies
  - Manufacturers
- Safer practices save lives, time and money
Full Vehicle Crash Tests - 2000

- **Test 1 – Right side impact**
  1. **Target vehicle**, Type I ambulance
  2. **Bullet vehicle**, Type II ambulance
  Closing speed 44 mph

- **Test 2 – Frontal**
  1. **Bullet vehicle**, Type III ambulance
  2. **Target vehicle**, Type II ambulance
  Closing speed 34 mph

**Preparation of test vehicles**

**Pre-impact CTD positioning**

**USA design initiatives**

**concept vehicles I & II**

**New Swedish vehicles**

**New Australian vehicles**
New UK London Ambulance/neonatal vehicles

Other successful models

A glimpse of the future

Current and Future Research
- Epidemiology
- Ergonomic hazards
- Bio/Chem/Radiation hazard
- PPE & Head protection
- Transport
  - Vehicle/Occupant automotive testing
  - Vehicle design innovation
  - Driver behavior (Real time and Simulated)
  - Intelligent Transportation Systems
- Operations tracking
- Data systems/reporting systems
- Enhanced Practice policies

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

PREDICTABLE PREVENTABLE and NO ACCIDENT

Conclusion
- Major advances in EMS transport safety research, infrastructure and practice over the past 5 years
- New technologies for vehicle design, occupant PPE and equipment restraint and driver performance are now available
- Development of substantive safety standards is a necessity and a reality
- Enhanced cross disciplinary collaboration in development of safety initiatives now exist
- EMS is still way behind the state of the art in vehicle safety and occupant protection

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

Thank you! Any Questions??
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