Emergency Medical Services: A Critical Condition in Transportation Safety – It does happen....

What are the solutions?
- Training?
- Practice Policy?
- Transportation Systems Engineering?
- Automotive Engineering?
- Education of other road users???

EMS
- Emergency Medical Services (EMS) - an important and unique aspect of the transportation system, it encompasses public safety, public health and an emergency service.
- What are the system wide transportation safety issues and challenges faced by the Emergency Medical Services?

In a nutshell
- Comprehensive perspective on:
  - system wide data
  - the challenges
  - the cutting edge
  - the gaps in knowledge and application of transportation systems safety in the big picture of Emergency Medical Services transportation

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**Transport related aspects of EMS**

- dispatch of EMS vehicles
- transport policies and protocols
- vehicle fleets and vehicle design
- vehicle purchase standards
- Intelligent Transportation Systems technology
- driver training
- driving simulation
- driver performance monitoring
- roadides and road design
- integrated traffic safety technologies
- scene safety and visibility
- safety data capture
- safety oversight

**USA EMS**

- EMS Systems - >15,000
- Personnel - ~1 million
  (~30% F/T professional & 70% volunteer)
- Vehicles - ~50,000
  (Type I, Type II, Type III, Freightliners, motorcycles)
- Transports - ~50 million
  (to Emergency Depts ~ 50%, < 1/3 emergent)
- Cost - ~$8 Billion annually
- Safety Oversight - ? Disparate

**Transport oversight?**

- In contrast to the bus and truck industries, which have comprehensive safety oversight, and transportation safety interventions, as well as transportation safety data capture via the Federal Motor Carrier Safety Administration (FMCSA) - EMS has been focused more as an acute health care delivery and emergency service and largely outside of much of the other transportation oversight infrastructure that exists.

- This is an opportunity for transportation planners, engineers, and system operators to see a comprehensive overview some of the multidisciplinary transportation challenges faced by Emergency Medical Services.

**What is EMS?**

- Emergency care, public health, public safety and patient transport
- Bridge between the community and the hospital
- Volunteer – professional
- Urban – rural
- Disaster response
- Majority of transports NOT critical or life threatening

**Emergency Medical Service (EMS) vehicles - Ambulances**

- What are the transport safety issues that pertain to this important public service and public safety industry?
- What do we know of the risks and hazards and how can we measure these?
- How can the safety of this transport system be optimized?

**EMS Definition**

- An Emergency Medical Services system is –
  - A coordinated arrangement of resources (including personnel, equipment, and facilities) which are organized to respond to medical emergencies, regardless of cause. (ASTM, 1988).
- EMS –
  - The services provided to accident victims and patients suffering from severe acute illness and psychiatric emergencies.
  - Detection and reporting of medical emergencies, initial care, transportation and care for patients in transit to health care facilities, medical treatment for the acutely ill and severely injured within emergency departments, and the provision of ongoing inpatient, outpatient, and home care services. (EMS Research Agenda 2001)

**History of EMS**

- EMS is a relatively new industry
- An unusual history of beginnings within the mortician industry.
  - Early ambulances were hearses, once mortuary services were conducted in a Cadillac, a vehicle in which an occupant could be transported in the recumbent position
  - Over the past 100 years, the sophistication of EMS medical care has advanced dramatically
  - EMS communications and transportation technology have not kept up with that pace

**Crashes Take Toll on EMS**

- Crashes are a common foe to EMS workers:
  - In 2000, 100,000 EMS vehicles were involved in crashes, resulting in 934 deaths and 28,601 injuries.
  - The leading cause of death was collision, followed by medical errors, road accidents, and workplace injuries.

- EMS workers are at high risk for injury:
  - In 2000, 28,601 injuries were reported, with 13,719 serious injuries and 4,770 hospital admissions.
  - The leading cause of injury was collision, followed by falls, being struck, and being hit by vehicles.
**Firstly!**

- An accident?
- or a predictable and preventable event

**This IS a transportation safety issue**

- Systems engineering
- Where do ambulance crashes occur?
- What transportation safety engineering interventions
- ITS –
- Does opticom work effectively in this environment given the traffic density and emergency vehicle density?
- Merit of emergency vehicles being fitted with early warning technologies
- Proper design of emergency vehicle traffic flow
- Fleet mix to match anticipated transport environmental challenges (ie police model – bicycle, motorcycle, horse, three wheeled, cruiser, van, truck?)

**Balance of concerns and risk during transport**

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

**Goals**

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

**the EMS transport process**

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

**“Nation’s Emergency Care System is fragmented, unable to respond to disasters”, says Institute of Medicine, June 14, 2006**

**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

**EMS Transport Safety IS Complex AND Multidisciplinary**

**This is not acceptable**

In the USA*

- ~ 5,000 crashes a year
- ~ One fatality each week
- ~30 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

*FARS/BTS 2004-5
Is it your services tragic year?

- ~ 50 fatalities a year
- 15,000 EMS services
- Each year one in 300 services experiences a fatality

Safety oversight of what and by whom

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

A Simple Question...

The NTSB

Active Projects
(all due late 2006)

- Commercial Motor Vehicle Driver Training Curricula and Delivery Methods and Their Effectiveness
- Commercial Motor Vehicle Carrier Safety Management Certification
- The Role of Safety Culture in Preventing Commercial Vehicle Crashes
- The Impact of Behavior-Based Safety Techniques on Commercial Motor Vehicle Drivers
- Health and Wellness Programs for Commercial Motor Vehicle Drivers

What about FMCSA’s Mission

- Office of Research and Analysis is committed to reducing the large truck-related fatality rate from 2.8 per 100 million truck-miles in 1996 to 1.65 by 2008.

Mission
- The mission of FMCSA’s Office of Research and Analysis is to reduce the number and severity of commercial motor vehicle (CMV) crashes and enhance the efficiency of CMV operations by:
  - Conducting systematic studies directed toward fuller scientific discovery, knowledge, and understanding
  - Adopting, testing, and deploying innovative driver, carrier, vehicle, and roadside best practices and technologies
  - By expanding the knowledge and portfolio of deployable technology, this research and technology program will help FMCSA reduce crashes, injuries, and fatalities and deliver a program that contributes to a safe and secure commercial transportation system.
USA Ambulances: FMVSS Exempt

Ambulances must comply with some of the existing safety and performance standards applicable to vehicles in the United States. All motor vehicles generally operated on public roads and highways must conform to Federal Motor Vehicle Safety Standards (FMVSS) contained in the Code of Federal Regulations (57 1). These standards are administered and enforced by the National Highway Traffic Safety Administration (NHTSA) and are intended to ensure that vehicles are designed, manufactured, tested, and operated to minimize in-vehicle and post-accident injuries. Ambulances are subject to these standards, which address various aspects of vehicle safety, including but not limited to, structural integrity, occupant protection, braking systems, and vehicle performance.

A peer reviewed tragedy

Persistent disconnect between automotive safety science and EMS transport safety approach

- Prehospital and Emergency Care 2004
  - “EMS vehicle drivers are advised to approach the intersection, slowing to ensure that traffic has stopped and making eye contact with other drivers before entering the intersection.”

In the modern era of road safety to suggest that a strategy of “eye contact” to be made at an intersection with a driver traveling at ~40mph in the hope that this would result in a safety intervention, is at best frightening.
Increasing awareness of the need for a focus on patient, provider, and public safety.

Some challenges:
- No accepted national safety standards for EMS fleet management or safety practice.
- Ambulance vehicle rear compartment design and performance.
- Provider occupational injury protective equipment.
- Yet convincing data for injury risk and hazard.
- Need for patient, provider, and public safety focus.

Safety oversight of what and by whom:
- Vehicle Safety
- Vehicle Design
- Safety Equipment Design
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An important and unique system:
- Public safety, public health and emergency service
- Is there to save lives
- A more recent service compared to Fire and Police

Data:
- What national statistics are there for EMS transport safety
- What is known about ‘wake effect’
**EMS Best Practice, Sept 2006**

**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) & to improperly restrained occupants (OR 2.5 vs restrained)
- 82% of fatally injured EMS rear occupants unrestrained**
- 74% of EMS occupational fatalities are MVC related**
- Serious head injury in >65% of fatal occupant injuries#
- > 74% of EMT occupational fatalities are MVC related***
- 82% of fatally injured EMS rear occupants unrestrained**
- 0.001)*

**EMS Provider Fatalities**
- 12.7 fatalities/100,000 EMS workers
- Greater than 2 X the national average (5.6 fatalities/100,000)
- Similar to Police (14.2/100,000) and Fire Fighters (16.5/100,000)

**and what is killing EMS ?**
EMS personnel fatalities*
- 74% transportation related
- 1/5 of ground transport fatalities were struck by moving vehicles
- 11% were cardiovascular
- 9% were homicide
- 4% needle sticks, electrocution, drowning and other

**A word about occupational transportation fatalities..**

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


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EMS Research /Data Vacuum

- ? total no. of ambulances
- ? total no. of medics
- ? total no. of runs (per age & severity)
- ? total pt. miles (per age & severity)
- ? true crash fatality rate per mile
- ? crash injury rate
- ? adverse events

Full Vehicle Crash Tests

Test 1 - Right side impact

Test 2 - Frontal

Johns Hopkins University

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

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

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

EMS Risk/Hazards

- Predictable risks
- Predictable fatal injuries
- Serious occupational hazard
- Public safety hazards

What’s new

- New automotive safety technologies
  - EVS
  - ITS
  - Monitoring and feedback enhancements
- New expertise
  - TRB
  - ASSE
  - SAE
  - UTRC
  - Ergonomics
  - Industrial Design

Regional University Transportation Research Centers

Protective devices/concepts

To prevent a crash
- Driver feedback
- Driver monitoring
- Driver training
- Vehicle Intelligent Transportation System (ITS) technologies
- Tiered dispatch
- Appropriate policies

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

Back up Camera..... Shouldn't all vehicles have one of these?

The “Black Box”
Driver behavior monitoring and feedback device

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

Data, but is it generalizable
- Traffic Speed Enforcement For Emergency Vehicles
- A case study for a new law

EMS is emerging in the transport safety arena
- First and only presentation of ambulance safety research at ESV Congress was 2001
- SAE Toptec on Military and Emergency Vehicles, USA, September 2001
- Emergency Vehicle Symposium, Australia, Melbourne, May 2003
- Sporadic Ambulance safety research presented at peer reviewed AAAM, ITMA, SAEM, Safe America, World Injury, Asia Pacific Injury Conferences 1999-2005
- Next week at inaugural meeting at 2007 TRB Congress in DC

Global EMS Vehicle Safety Standards
- EMS Safety and Performance Standards
  - Australia & New Zealand 4835
  - Common European Community (CEN) EN1789
- Non EMS Specific USA Standards
  - FAA/CAA/JAA
  - Z15 – Fleet vehicles safety management
- USA EMS Specification & Guidelines
  - Purchase Specifications: KKK & NTEA – AMD
  - Guidelines: EMSC Dos and Don’ts
  - ASTM, CAAS and CAMTS

USA ambulance purchase specifications
GSA-KKK-A-1822E, 2002
- Static Pull test
- 2200 Lbs. (8G’s) in Longitudinal and Lateral
- No dynamic test
- No definition to manikin mass
- No restraint for equipment
- Voluntary

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

Legal Perspectives on Z15

- Importance of safety as an organizational value
- Proactive approaches to safety management and leadership
- Prevention of accidents, injuries
- Presents authoritative data from OSHA, EPA, NFPA, NRC, and JCAHO
- EMS Transport Safety? – Not a mention

Healthcare Safety

- Importance of safety as an organizational value
- Proactive approaches to safety management and leadership
- Prevention of accidents, injuries
- Presents authoritative data from OSHA, EPA, NFPA, NRC, and JCAHO
- EMS Transport Safety? – Not a mention

Hot off the press… from the IFAS and USFA

NAEMT July 2006 Position statement

Tips for Emergency Vehicle Operations

Sit Down for EMS Safety!

USFA Emergency Vehicle Safety Initiative

VFIS Summer 2006
What we need to consider, where is the ‘bang for buck’ in ambulance transport safety:

1. What data is collected nationally?
   - We have no denominator data
   - We have incomplete numerator data
2. Absent population based national injury data or injury mechanics data
3. Absent structured automotive safety engineering input
4. What oversight is there
5. Which organizations would determine policy

Future

- Meaningful Goals
- New policies
- New practices
- New standards
- New vehicles
- New technologies

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

Conclusion

- Major advances in EMS 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 EMS transport 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 transport and vehicle safety and occupant protection

And….

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

PREDICTABLE PREVENTABLE and NO ACCIDENT

Any Questions??

Electronic handout available online
http://www.objectivesafety.net
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Thank you!

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