Emergency Medical Service (EMS) Transport Safety: Where is the state of the art?

Nadine Levick, MD MPH
CEO, Research Director
EMS Safety Foundation
Objective Safety LLC
New York, New York

Introduction

Emergency Medical Services – (EMS)
▶ Important interface between public health, public safety and emergency and acute care and the community
▶ Unique challenges - patient, provider and public safety and transportation safety
▶ Unique needs of this important part of our health care and transportation system

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
▶ driver performance monitoring
▶ roadside and road design
▶ integrated traffic safety technologies
▶ scene safety and visibility
▶ safety data capture
▶ safety oversight

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?

A tragic emergency health care intervention outcome
It does happen....
Occupant protection... Transportation systems safety??

July 5, 2007

I'd like to know what can be done so this never happens again....

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Friday July 20th 2007...
The worst ambulance crash in USA history

Five Killed in Crash of Ambulance and Semi

July 21, 2007 09:20 AM EDT

Van Wert, OHIO USA — The Ohio State Highway Patrol continues to investigate the crash of an ambulance that killed five people Friday night, including three emergency medical technicians, a transport nurse and the driver. The crash occurred on I-75 north of Van Wert.

The ambulance, with four emergency medical technicians and a nurse aboard, was traveling in the right lane of the three-lane highway when it collided with a tractor-trailer at the intersection of County Road 179 and County Road 47Y. The ambulance then went off the road into a median.

The highway patrol says three EMS workers were killed. They were identified as 41-year-old Alvin E. Miller, 25-year-old Kelly McLaughlin, and 24-year-old Dwayne Meece. The driver and the nurse were also killed. They were identified as 41-year-old Robert Jeffs, 32-year-old Michelle Williams and 42-year-old Jennifer Smith, respectively.

Another emergency medical technician, Matt McLaughlin, and the truck driver, David Queener, Jr., of Indiana, were both taken to the hospital. It's not yet clear whether they suffered any injuries.

Some odd facts

- Ambulances are generally not built by the automotive industry
- Intelligent Transportation Systems (ITS), transportation safety engineering and transport systems engineering are 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

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 – (<3% are critical)
Why now?

- Operating optimally in a transportation environment that is largely devoid of specific safety standards for the hazards and risks present
- Opportunities for increasing the profile of EMS transportation safety research needs within the transportation industry

EMS Transport Safety

- ‘patient safety’ AND also
- ‘provider’ and ‘public safety’

A devastating tragedy...

- An ETT down the wrong hole may kill your patient and be a terrible burden for the pts family and for the medic involved
- BUT an EMS crash can kill all involved AND wipe out an EMS systems response capacity......

Negative Impact of an ambulance crash

- In contrast to every other highway crash, an ambulance crash results in a number of serious outcomes that occur with no other vehicle crash scenario
  - A crash en route to a medical emergency call – response time is prolonged and emergency care is delayed
  - When a patient onboard en route to the hospital – that patient (and providers) are at risk of serious injury or death.
  - As well as taking an emergency vehicle and its personnel out of service, the ambulance crash itself requires an EMS response, and often a more overwhelming response than for a routine vehicle crash.
  - EMS is a scarce resource, particularly in the rural setting – and the replacement personnel and ambulance vehicle may not be available or may have to come from a nearby region diminishing the EMS response capacity of more than one region.
Scope

- Safety data on EMS transport and its oversight
- EMS vehicle crash rates are in excess of similar sized vehicles
- EMS worker transport fatality rates are above other emergency services
- Is a part of the transportation system that is largely exempt from most of the Federal Motor Vehicle Safety Standards (FMVSS), and not covered by other national transportation system safety oversight (ie. FMCSA)
- The findings of limited research conducted to date suggest EMS transportation safety is in need of urgent focus and has been left behind commercial truck and bus safety.

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

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

The Emergency Department (ED)

An ambulance is not an ED / ICU on wheels
EMS Transport Safety IS Complex AND Multidisciplinary

- Epidemiological Data Collection
- Risk Management
- Public Safety
- Ergonomic Research
- EMS Policy
- PPE
- Biomechanical Automotive Safety
- EMS Practice
- Regulations and Standards
- Fleet Safety Program
- Driver Training
- Biohazard/Chem Research
- Communications technology

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

A very serious gap in data, performance and oversight

- FMCSA Truck safety goals – to decrease the fatality rate of 2.8 per 100 million truck-miles in 1996 to 1.65 by 2008
- EMS crash fatality estimates are - 7.66 - 41.93 fatalities per 100 million ambulance-miles

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
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

Is there an acceptable rate of morbidity and mortality for pre-hospital transport systems??

Vision Zero: An ethical approach to safety and mobility
- Claes Tingvall

Vision Zero is a philosophy of road safety that eventually no one will be killed or seriously injured within the road transport system. Vision Zero describes the view that safety cannot be traded for mobility. Sweden’s Vision Zero is aimed at eliminating all deaths or long-term health losses arising from road crashes. The mobility in the road transport system should be a function of the safety and not vice versa.

This is not acceptable

- In the USA*
  - ~ 5,000 crashes a year
  - ~ 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

Is it your services tragic year?

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

*FARS/BTS 2004-5
EMS Provider Fatalities

- 12.7 fatalities/100,000 EMS workers
- Greater than 2 X the national average (5.0 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


So does it make sense?

- Gloves and universal precautions?...
  - good biohazard protection BUT aren’t going to give much protection in an ambulance crash

A word about occupational transportation fatalities..

- WE HAVE A BIG PROBLEM HERE

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 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##

EMS Research /Data Vacuum

- What data is collected nationally?
  - We have no denominator data
  - We have incomplete numerator data
- Absent population based national injury data or injury mechanics data
- Absent structured transportation safety engineering input
  - 1+2+3 = resultant inability to design and evaluate efficacy of injury interventions
- What oversight is there?
- Which organizations would determine policy?
EMS ground transport safety data

- FMCSA – EMS is exempt
- NTSB – one investigation – 1979, no system wide data capture (unlike aviation EMS)
- Some states (PA, MO, NY) have fatality reporting systems – but data incomplete
- FARS – incomplete mortality data
- GES/NASS/CDS – sample of low #
- NEMS Memorial – incomplete – voluntary – verified
- EMSClosecalls.com, EMSNetwork.org – voluntary, anecdote

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.

FMCSA – Summary

- Established Jan 2000 as a separate administration within the U.S. DOT, pursuant to the Motor Carrier Safety Improvement Act of 1999
- Primary mission is to reduce crashes, injuries, and fatalities involving large trucks and buses.

FMCSA’s Objectives

- Produce Safer Drivers:
- Improve Safety of Commercial Motor Vehicles:
- Produce Safer Carriers:
- Advance Safety Through Information-Based Initiatives:
- Improve Security Through Safety Initiatives:
- Enable and Motivate Internal Excellence:

FMCSA - safety mandate

- Develops and enforces data-driven regulations that balance motor carrier (truck and bus companies) safety with industry efficiency
- Harnesses safety information systems to focus on higher risk carriers in enforcing the safety regulations
- Targets educational messages to carriers, commercial drivers, and the public
- Partners with stakeholders including Federal, State, and local enforcement agencies, the motor carrier industry, safety groups, and organized labor on efforts to reduce bus and truck-related crashes.
FMCSA - Exceptions

Unless otherwise specifically provided, the rules do not apply to:

(f)(1) All school bus operations as defined in §390.5;
(f)(2) Transportation performed by the Federal government, a State, or any political subdivision of a State, or an agency established under a compact between States;
(f)(3) The occasional transportation of personal property by individuals not for compensation nor in the furtherance of a commercial enterprise;
(f)(4) The transportation of human corpses or sick and injured persons;
(f)(5) The operation of fire trucks and rescue vehicles while involved in emergency and related operations;

FMCSA reportable crash

Must involve:
- a truck (a vehicle designed, used, or maintained primarily for carrying property, with a gross vehicle weight rating or gross combination weight rating of more than 10,000 lbs.) or
- bus (a vehicle with seats for at least nine people, including the driver)

The crash must result in:
- at least one fatality
- one injury where the person injured is taken to a medical facility for immediate medical attention; or
- one vehicle having been towed from the scene as a result of disabling damage suffered in the crash.

Valuable information... EMS exempt

Why isn’t EMS ground transport data captured by FMCSA?

FMCSA - Crash Statistics
FMCSA - Hours of Service Regulations

Summary of the New Hours of Service Regulations Effective October 1, 2007

Hours of Service

- 11 hours driving
- 14 hours on-duty
- 34 hours off-duty
- Rest period
- 15 hours on-duty
- 20 hours off-duty

Major crash investigation - NTSB comprehensive analysis for commercial vehicles

The National Transportation Safety Board (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 other modes of transportation -铁路, 公路, 水路, and pipeline — as well as accidents in the operation of nuclear power plants. The NTSB Board determines the probable cause of:

- Civil aviation accidents and incidents involving commercial aircraft;
- Commercial aviation accidents and incidents involving civil aircraft;
- Marine accidents and incidents that result in loss of life or substantial damage to vessels or in a substantial loss of life;
- Pipeline transportation accidents that result in substantial loss of life or substantial damage to property;
- Railroad transportation accidents that result in substantial loss of life or substantial damage to property.

The NTSB also conducts investigations into certain other types of accidents, including accidents involving local, regional, and international transportation systems. The NTSB has jurisdiction over the investigation of all accidents involving commercial aircraft, as well as all accidents involving non-commercial aircraft, if the accident occurs in the United States. The NTSB also investigates accidents involving commercial space transportation and commercial space transportation accidents that result in loss of life or substantial damage to property.

Valuable information... EMS exempt

These folks know what we need to know...

The National Transportation Safety Board (NTSB)

Major crash investigation - NTSB comprehensive analysis for commercial vehicles

Why ISN'T EMS on the NTSB's “Most Wanted List”??
30 years later, ~ 1,600 fatalities and still the same problem

Law enforcement and Fire data

Having access to that technical knowledge supports changes to improve safety practice
Air EMS is a role model for safety initiatives and focus

Technical information that drives changes in practice

From this..... to this

Very cool – AND visible!!!
But what about those red trucks
Another excellent example - From this to ... this!

Policy and practice ignorant of existing technical safety data

Under Way...
Emergency Vehicle Visibility and Conspicuity Study

The 'workplace' is also a crash scene

Today's news
Caught On Video: EMT Struck By Car

State Strategic Highway Safety Plans

- Required as part of the SAFETEA-LU legislation
  *(Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users)*

- Effective October 1st 2007

- Focus is the 4 'E's
  *Engineering*
  *Education*
  *Enforcement*
  *Emergency Medical Services*

- EMS is a core theme
We can learn from non-EMS industries....

Balance of concerns and risk during transport

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

The Ostrich Syndrome?

Goals

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

Challenges to Optimizing EMS Transport Safety

- Disparate and fragmented safety infrastructure
- Lack of a centralized EMS Safety oversight or data
- A large number of small groups of end users, with a mix of volunteers and professionals
- Ambulances are hybrid non-standard vehicles, a truck chassis and an after market box or a modified van
- EMS vehicle safety is not integrated as a part of the transport safety industry
Challenges to Optimizing EMS Transport Safety

- Rear compartment exempt from FMVSS
- Complex automotive safety area bridging acute clinical care, public health, public safety and automotive safety
- Very recent history as a research issue
- Limited fiscal support for cross-disciplinary EMS transport safety research

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

Automotive Injury Triangle and Safety Development

Intelligent Transport Safety Systems
Increasing awareness ...

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

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

Hot off the press… from the IAFC and USFA

The IAFC and the USFA Develop Model Policy and Procedures Guide for Emergency Vehicle Safety

Tips for Emergency Vehicle Operations

Fleet Mix?

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

**Thank you!**

**Any Questions??**

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