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

Five Killed in Crash of Ambulance and Semi
July 21, 2007 06:20 AM EDT

Another tragic incident in a series of recent ambulance crashes that have brought safety concerns to the forefront of the public's mind. The crash occurred in rural Missouri, killing five people and injuring several others.

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......

Charged with Vehicular Homicide

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Outline
1. Review of data on ambulance crashes and safety standards and guidelines that exist for the ground EMS
2. Identification of ground EMS transport safety issues, hazards and areas of risk to patients, providers and public
3. Highlight unacceptable mythology and challenges to advancing EMS transport safety
4. Profile innovation, new safety technologies and strategies and knowledge transfer to enhance safety and reduce risks of ground EMS and patient transport

Drive Safely Work Week
- Data Capture
- Vehicle Biomechanics and Crashworthiness
- Ergonomics and Biohazards
- Transportation Environment
- Safety Management – evaluation and analysis

Key Elements to Safety
- Data Capture
- Vehicle Biomechanics and Crashworthiness
- Ergonomics and Biohazards
- Transportation Environment
- Safety Management – evaluation and analysis

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

A week ago...
- An accident?
- or a predictable and preventable event

Testing the real world
In contrast to the bus and truck industries, which have -
- comprehensive safety oversight
- transportation safety interventions
- 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 medical service and largely outside of much of the other transportation oversight infrastructure that exists

Firstly!
- A passenger vehicle - sure
- A 'laundry or mail truck' - ?
- A passenger vehicle – yes!
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

Recent adverse EMS transport outcomes

UPS and Laundry trucks have very similar design and even more stringent safety requirements to EMS vehicles
BUT
very different cargo......
People are passengers and NOT packages or parcels

Safety is Good Business

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

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

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

1960 to 2007
- A passenger vehicle - sure
- A Laundry or mail truck - ?

"Ambulance transport has a death toll...."
Carl Craigle EMT-P, Chief Platte Valley Ambulance
This is not acceptable

In the USA*
- ~ 5,000 crashes a year
- ~ One fatality each week
- ~ 1/3 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

*FARS/BTS 2005-6

So for EMS personnel...
- What’s going to kill you?
- What’s going to injure you?

‘Workplace’ Hazards

It does happen....

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

New EMS helmet prototypes for 2006-2007
Hmm…

So why is it...

- That the EMS providers -
  - Were wearing navy blue – one of the most difficult colors to see at night
  - Had no head protection, when all other emergency personnel at the scene did
  - Had no protective clothing, when other emergency personnel at the scene did???

EMS Transport Safety

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

the EMS transport process

- communications/dispahl
- 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

Ground Transport Safety IS Complex AND Multidisciplinary

OCCUPATIONAL HEALTH AND SAFETY

- Epidemiological Data Collection
- Biomechanical Automotive Safety
- Biomedical/Chem research
- Communications technology
- Safety Technology
- Regulations and Guidelines
- Fleet Safety Program

Transport Safety

- Risk Management
- Public Safety
- Transport Policy
- FME
- Driver Training

This IS a Transportation and Automotive Safety issue
This is a Systems safety issue

Occupational Health and Safety......?
What are the solutions?

- Training?
- Practice Policy?
- Transportation Systems Engineering?
- Automotive Engineering?
- Education of other road users???

EMS Best Practice, Sept 2006

- Enhanced Safety of Vehicles (ESV), June 2007
- American Society Safety Engineers (ASSE), June 2006 & June 2007
- Transportation Research Board – EMS Public Comments, July 2007
- NHTSA, August 2007
- OSHA, September 11, 2007 Federal Register
- SAFER Act, June 2007
- (Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users)
- Transportation Research Board – Inaugural EMS Safety Subcommittee meeting Jan 2008
- OSHA EMS best practices late 2008
- Worker visibility Act, to be implemented, Nov 2008

Ambulance Safety Research: A New Field

EMS Provider Fatalities

- 12.7 fatalities/100,000 EMS workers
- Greater than 2X 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

Occupational transportation fatalities

- WE HAVE A BIG PROBLEM HERE

Goals

- Standards for safety
- Policy based on science
- Databases to demonstrate outcome
**Balance of concerns and risk during transport**

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

**A problem**

2007 Insurance data –

- 27 fold more likely to have a claim based on transport than related to medical care

**A few weeks ago...**

*The Huntsville Times*  
**Ambulance suit gets $3.1 million**

May 27, 2007

A family lawyer said the $3.1 million judgment in a trial involving a Huntsville, Texas, resident was expected to set a new standard for personal injury claims related to ambulances in Canada.

**This month...**

Injured Ambulance Passengers Awarded $4.4 Million  
Huntsville, Ont. – A full-size van carrying the people from the back of a smaller vehicle veered off the road and struck a tree, causing serious injuries to four of the passengers. The driver, who lost control of the van, was later arrested for drunk driving.

**What do ambulance crashes really cost?**

- Loss of life and injury
- Negative impact on EMS system
- Collisions are the largest liability cost and exceeds malpractice or negligence

Besides the direct financial costs of replacing a damaged ambulance and equipment, there are additional hidden costs incurred:

- Investigating the ambulance collision
- Litigation/settlement/lawsuit
- Medical/disability costs of injured EMTs
- Hiring of new employees to replace injured personnel
- Retraining and psychological counseling of personnel involved and others
- Increased insurance rates

**June 2007**

**Indirect Costs**

- Estimated to be 10X direct costs!

**Safety saves time, lives AND money**

Canada, Nova Scotia

- Since 2000 working towards a goal of zero loss ratio with insurance provider
- 10 million kilometers per year
- 18 emergency response ambulance units
- Collision claim history measured in dollars per 100,000 kilometers traveled:
  - 2000/2001: $1725.00
  - 2001/2002: $1049.00
  - 2002/2003: $751.00
  - 2003/2004: $416.00
  - 2004/2005: $229.00

**Benefit of Safety**

- Safe practices save lives, time and money
This is about you and your safety

What safety practices do you use?
- Seat belts?
- EVOC training?
- Equipment lock down?
- Helmets?
- “Black Box” technology?
- Tiered dispatch?

Global EMS Vehicle Safety Standards & Specifications and Guidelines
- EMS Safety and Performance Standards
  - Australia & New Zealand 4536
  - 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
    - Guidelines: EMSC Dos and Dons, and (CAAS and CAMTS)

Transport Safety Guidelines
EMSC/NHTSA fact sheet
- DO drive cautiously at safe speeds observing traffic laws.
- DO tightly secure all monitoring devices and other equipment.
- DO ensure available restraint systems are used by EMTs and other occupants, including the patient.
- DO transport children who are not patients, properly restrained, in an alternate passenger vehicle, whenever possible.
- DO encourage utilization of the DOT NHTSA Emergency Vehicle Operating Course (EVOC), National Standard Curriculum.

Don’ts
- DO NOT drive at unsafe high speeds with rapid acceleration, decelerations, and turns.
- DO NOT leave monitoring devices and other equipment unsecured in moving EMS vehicles.
- DO NOT allow parents, caregivers, EMTs or other passengers to be unrestrained during transport.
- DO NOT have the child/infant held in the parent, caregiver, or EMT’s arms or lap during transport.
- DO NOT allow emergency vehicles to be operated by persons who have not completed the DOT EVOC or equivalent.

The National Transportation Safety Board (NTSB)?
- Recommendations
  - EVOC
  - LICENSE RECORDS
- NTSB 1979 Accident Report
- NTSB: 1979 Recommendations never implemented
  - To NHTSA – Class II & III Priority Action
  - Extend Federal Motor Vehicle Safety Standards (220, 221, 301) to include ambulances and other emergency vehicles
  - Extending FMVSS re: padding and restraints
  - To GSA – Class II Priority Action
  - Maintenance of handling
  - Loading instructions
  - Body structural integrity
  - Anchorage for all equipment
  - Occupant protection
  - To National Committee on Uniform Traffic Laws
  - Mostly criteria
30 years later and still the same problem

USA Ambulances: FMVSS Exempt

DOT NHTSA, FMVSS 49 CFR Parts 571, 572 & 589 Docket no. 92-28; notice 7

USA ambulance purchase specifications

Static Pull test
2200 Lbs. (8G’s) in Longitudinal and Lateral
No dynamic test
No definition to manikin mass
No restraint for equipment
Voluntary

Occupant protection……??
July 2007

Unacceptable, and ridiculous current 2007 USA ambulance ‘safety testing’ practices !?!

No ‘a’… then NO ‘F’ !!!!!

F = ma

where
F – force
m – mass
a – acceleration

FMVSS exempt……
Identifying predictable and preventable transport related risks and hazards

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

Haddon/Baker/Runyan Phase-Factor Matrix
as applied to EMS Safety

The Driver
- Driver selection
- Driver monitoring and feedback
- Driver Impairment
- Driver training

Air EMS is a role model for safety initiatives and focus

An Aviation Safety Plan

Ground Transport Safety

American National Standard
ANSI/ASSE Z15.1-2006
Safe Practices for Fleet Motor Vehicle Operations

Systems Safety Engineering - Z.15....

www.ASSE.org
http://www.objectivesafety.net/TransActions%20Z15.pdf
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

Incident Rates
- Incident rate based on number of vehicles operated:
  \[ \text{Incident rate} = \frac{\text{Number of incidents}}{\text{Number of vehicles}} \times 100 \]
- Incident rate based on vehicle mileage:
  \[ \text{Incident rate} = \frac{\text{Number of incidents}}{\text{Vehicle mileage}} \times 1,000,000 \]
- Injury incident rate based on vehicle mileage:
  \[ \text{Injury incident rate} = \frac{\text{Number of incidents with injury}}{\text{Vehicle mileage}} \times 1,000,000 \]
- 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.
  \[ \text{Incidents per 10,000 transports} = \frac{\text{Number of incidents}}{10,000} \times 100 \]
- Vehicle injury rates based on work hours:
  \[ \text{Vehicle incidents per 200,000 hours} = \frac{\text{Number of incidents}}{200,000} \times 100 \]

September 2007, its not magic.....

Seat belts save lives!
- 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 (e.g., 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

EMS Transport General Concerns
- 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??

The Crash Event - Crash Testing
- An introduction
- What one needs to know
- What do the tests really mean
- And, what tests are meaningful

If we know this – and its published....

Why do we do this?
Vehicle Crash Testing
Test 1 – Right side impact

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

CTD dynamics
During impact
Post impact

Vehicle design and safety

The principles of automotive safety involve a complex science, engineering technical skill, expertise, training and knowledge

“Give the engineers a working list of our needs and let them tell us how it should be built to accomplish those tasks.”
Rash of "Safety Concept" vehicles.....
Devoid of substantive automotive safety engineering input or testing?

NO automotive safety engineer
NO crashworthiness engineer
NO ergonomist
NO reference to ANY existing or relevant automotive safety or crashworthiness technical publications....
yet multiple occupant fatalities and injuries annually....

concept vehicles I & II ??

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 for side-facing occupants are potentially lethal – and is in NO WAY SUPPORTED BY ANY DATA OR AUTOMOTIVE SAFETY EXPERTISE

Were we safer in the Cadillac???

BHP - Key learnings for the organization were:
- Fatalities often have similar underlying causes
- High near miss reporting often correlates with declining injuries or fatalities
- Leadership visibility in the field is vital
- Hazard identification and risk awareness are fundamental to success.

Safety Improvement Roadmap
No need to reinvent the wheel...
Valuable information from the transportation industry

These folks know what we need to know...

Transportation Research Board is an excellent resource… we should be using it!!

The truck and bus industry is on the right track at the TRB

Knowledge transfer

July 2007

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

An excellent model

http://www.EveryoneGoesHome.com
Tips for Emergency Vehicle Operations

Help is on the way???
November 24th 2008

Coming Soon!
Traffic Incident Management Systems (TIMS)
- USFA report to be released any day
- Research and writing by IFSTA
- Covers setting up safe roadway incident work areas and using unified command at these incidents
- Will be available in a downloadable format

Recent Visibility Webinar
www.GlobalEMSForum.org

This looks cool AND SAFE!

Not rocket science..
We've known for 10 years that red fire trucks are twice as likely as lime yellow trucks to crash at an intersection.

- 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

And very Predictable...

- Intersections are lethal environments

Day visibility

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.....
The real world
Intersection passenger car stopping distance* at 40 mph dry and wet

- Perception time
- Reaction time
- Vehicle braking time

Dry
Stopped at 176 feet

Wet
Stopped at 220 feet

* Stopping distance: Perception time + Reaction time + Vehicle braking time (varies with age, skill, agility, distance, weather, road etc)

What's new
- New automotive safety technologies
  - Crashworthiness
  - EVS
  - ITS
- Monitoring and feedback enhancements
- New expertise
  - TRB
  - ASSE
  - SAE
  - UTRC
  - Ergonomics
  - Industrial Design

Safety at the scene
Patients must be in the over the shoulder harness, medics restrained in seat belts, equipment secured

What about changing driver behavior in the real world??
- Demonstrated Effectiveness
  - Change driver behavior
  - Carrot not stick
  - Vehicle maintenance improvement
  - Decreased administrative burden
  - Insurance benefits

Driver behavior monitoring and feedback device
Levick NR, Swanson J, Proceedings - 49th Annual Conf. of the Assoc. for the Advancement of Automotive Med, September 2005
AMBER-999 Research Forum 2006 – Research most likely to change practice award


**Demonstrated Effectiveness**

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**A key to safe ambulance transport**

- Driver feedback
- Driver monitoring
- Vehicle Intelligent Transportation System (ITS) technologies
- Tiered dispatch
- Appropriate policies

**Protective devices/concepts**

To prevent a crash
- Defensive tactics
- Driver monitoring
- Vehicle Intelligent Transportation System (ITS) technologies
- Training

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

**Intelligent Transport Safety Systems**

**Back up Camera….. Shouldn’t all vehicles have one of these?**

**Vehicle visibility and conspicuity**

**Policy Changes**

**CPR?**

**EMSNetwork**

The concept of the advanced transport systems and mobile health services

- The need for an advanced transport system and mobile health services
- The benefits of advanced transport systems and mobile health services
- The implementation of advanced transport systems and mobile health services
- The evaluation of advanced transport systems and mobile health services

The EMSNetwork is a network of emergency medical services providers

- The network includes emergency medical services providers from various regions
- The network provides a coordinated approach to emergency medical services
- The network facilitates the sharing of resources and information

The EMSNetwork is a critical component of the emergency medical services system

- The network is designed to improve the outcomes of emergency medical services
- The network is focused on providing high-quality emergency medical services
- The network is committed to continuous improvement and quality assurance

The EMSNetwork is a dynamic and continuously evolving system

- The network adapts to changing needs and circumstances
- The network is responsive to new technologies and innovations
- The network is dedicated to providing the best possible emergency medical services
Important changes underway

Integration and Collaboration

USFA Emergency Vehicle Safety Initiative

March 2007 - FHWA

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

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

Major events for innovation sharing
- but regional and often language isolation

Vehicle Occupant Safety design
2007 European design
Safety technology is a key focus

Ergonomic design
New Australian vehicles

Flexibility to manage two patients

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

New UK London Ambulance/Neonatal Vehicles

Clear safety message

Securing equipment

Creating a Safety Culture

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

- Awareness
- Training
- Incentive

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’**

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

- 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

- Safer patient transport practices exist & should be used

- 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**

- Prevention is key - ambulance transport environment includes predictable and preventable occupant risks

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

- 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

- Safer patient transport practices exist & should be used

- 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

**small changes can make a BIG DIFFERENCE**

- PREPARE – TEACH – REACH – RESPOND

  - **PREPARE**
    - Look at your own safety record

  - **TEACH**
    - Teach safety and hazard awareness

  - **REACH**
    - Reach out with safety information to all your EMS providers

  - **RESPOND**
    - Respond with the best safety practices

**And…**

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

**Thank you!**

Any Questions??

a handout and a recording of this presentation awaits you at

www.objectivesafety.net