Ambulance Transport Safety: Where is the state of the art? Mitigating Risk and Improving Fleet Safety

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In the Spirit of Prevention, MHSAO, October 3rd, 2007

This is an important week

Drive Safely Work Week

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

Safety is Good Business

Thursday July 5th

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

Friday July 20th 2007...
The worst ambulance crash in USA history
A tragic emergency health care intervention outcome

It happens….

A devastating tragedy…

➤ An medical error may kill the patient and be a tragic 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……

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www.objectivesafety.net

This WILL be FAST!!

No need to take any notes – all text slides will be awaiting you in your online Handout

http://www.objectivesafety.net

A very serious gap in data, performance and oversight

➤ FMCSCA 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

Unique workplace

➤ In vehicles

➤ At roadside and other emergency scenes

The ‘workplace’ IS a vehicle

➤ “The best driver safety device is a rear view mirror with a cop in it”

Dudley Moore
The 'workplace' is also a crash scene

Some odd facts
- Ambulances are generally not built by the automotive industry
- Intelligent Transportation Systems (ITS), transportation safety engineering is 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

Firstly!
- An accident?
- or a predictable and preventable event

EMS Transport Safety
- 'patient safety'
- AND also
- 'provider' and 'public safety'

C45 - A criminal offence to not act in a way that protects the worker

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

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....

June 2007

The Huntsville Times

Ambulance suit gets $3.1 million

Indirect Costs
- Estimated to be 10X direct costs!

Benefit of Safety
- Safe practices save lives, time and money

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
- 150 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

Tragedy you don’t want to be involved in

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

Risk/Hazards
- Predictable risks
- Predictable fatal injuries
- Serious occupational hazard
- Public safety hazards

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

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 ?

What are the solutions?
- Training?
- Practice Policy?
- Transportation Systems Engineering?
- Automotive Engineering?
- Education of other road users??
“Ripoff and Duplicate”

- Avoid reinventing the wheel at all costs
- Where are the best practices that we need to transfer knowledge from

EMS Best Practice, Sept 2006

EMS in Ontario Canada

- Of 1.6 million calls and 1.1 million transports
  - 1 in 7 providers were injured resulting in a Worker Compensation claim
  - 69% reported having been assaulted by patients
  - 85% experienced the death of a child
  - 91% exposed to a multi-casualty situation
  - Only 4% of the profession over the age of 55 represent

Because one injury is one too many...

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Sept 18th, 2007

Determined the victim was an 18-year-old male. The victim was pronounced dead at the scene.

Sept 26th, 2007

Charged with Vehicular Homicide

- By driving a vehicle in an unsafe manner and at a speed deemed excessive, the victim was killed.
- The driver was charged with 1st degree murder.

Seat belts save lives!

Car ACC: 2 Dead in Marshall Township

- 2 people were killed in a head-on collision on Highway 7, near Marshall Township.
- The driver of the other vehicle was also injured.

Your colleagues in EMS...

-座 belt saves lives!
Key Elements to Safety
- Data Capture
- Vehicle Biomechanics and Crashworthiness
- Ergonomics and Biohazards
- Transportation Environment
- Safety Management - evaluation and analysis

the EMS transport process
- communications/dispatch
- the patient
- restraining device/gurney
- paramedics/transport nurses, doctors & family
- patient monitoring equipment
- clinical care & interventions
- protective equipment
- the vehicle
- the driving/vehicle 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

And what's really not new...
- "Fleet transport has a death toll...."

September 2007, Its not magic.....
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


So does it make sense?

- Gloves and universal precautions?...
- … good biohazard protection but not going to give much protection in a ambulance crash

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)!
- 42% of fatally injured EMS rear occupants unrestrained**
- 74% of EMS occupational fatalities are MVC related***
- Serious head injury in >65% of fatal occupant injuries#
- 5.8 x that of health services personnel
- 7 x the national average

*Kahn CA, Pirrallo RG, Kuhn EM, Prehosp Emerg Care 2001 Jul-Sep;5(3):261-9
**Becker, Zaloshnja, Levick, Li, Miller, Acc Anal Prev 2003
#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

EMS Injuries*

- Higher than the injury rate for any private industry published by DOL
- 34.6 injuries/100 fulltime workers per year
- 1.5 x that of fire fighters
- 5.8 x that of health services personnel
- 7 x the national average

*Maguire, Hunting, Guidotti & Smith, Occupational Injuries among Emergency Medical Services Personnel, Prehospital and Emergency Care Oct/Dec 2005

Hmm…

- 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???

So why is it…

- It isn’t like this outside of the USA
Occupational Health and Safety.....?

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

“Ambulance transport has a death toll.....”
Carl Craigle EMT-P, Chief Platte Valley Ambulance

‘Workplace’ Hazards

It does happen....

But what about head protection?

and who’s life was he racing to save?
**This is not acceptable**

In the USA:
- ~5,000 crashes a year
- ~one fatality each week
- ~20 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

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

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**Safety oversight of what and by whom**

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

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**With many aspects in addition to crashworthiness**

- Human factors and ITS
- Crash avoidance technologies
- Predictors of crash risk
- Policy

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**And keep focus on 'All hazards' in addition to crashworthiness**

- Driver age?
- Driving history?
- Driver impairment?
- Patient condition?
- Dispatch?
- Vehicle stability?
- Driver feedback technologies?

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**The Crash Event - Crash Testing**

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

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**Intrusion vs Deceleration**

- Intrusion
  - vehicle to vehicle or vehicle to fixed narrow object
- Deceleration
  - sudden stop – ie. sled test

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**Dynamic Safety Testing**

- requires sophisticated, expensive equipment
- measurably demonstrates forces generated during collision
- accepted international standard for vehicle restraint systems
And this all takes place in 60 millisecs – the blink of an eye

And very Predictable...

- Intersections are lethal environments

“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 (78% vs 81%, p<0.001)

*Comparison of Crashes Involving Ambulances with those of similarly sized vehicles – Adam Ray, Douglas Kupas, PhD. 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.....

The real world

Intersection passenger car stopping distance* at 40 mph dry and wet

* Stopping distance: Perception time + Reaction time + Vehicle braking time (varies with age, skill, agility, alertness + vehicle type, tire pressure, road etc)

Driver issues

Fleet Driver Training...

What about changing driver behavior in the real world??

The Driver

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

Driver Issues

Conclusion: When considering the risk of accidents and victimizing the older driver, it appears that the risk is significantly higher than for non-elder drivers. This is an area that deserves further attention and study.
Demonstrated Effectiveness
- Change driver behavior
- Carrot not stick
- Vehicle maintenance improvement
- Decreased administrative burden
- Insurance benefits

Technology is a rapidly moving target

Positive attitudes

Which one is best and for what environment??

Purpose of a real-time monitoring and auditory feedback program
- Enhance Safety
- Improve Driver Performance
- Save Maintenance Dollars
- Aid Accident / Incident Investigation

How the Device Works
- Computerized monitoring device installed on each vehicle to measure parameters
- Each driver has individual key “fob”
- Data collected every second including: vehicle speed and performance, driver behaviors and emergency mode
- Auditory feedback of warning ‘growls’, and penalty tones
- Data downloaded automatically every day

Demonstrated Effectiveness

And when a rare crash happens....
Unit 302 Accident

Crashes

There were:
- 19 vehicle incidents in 2004
- 11 in 2005
- No major vehicle crash during the fully implemented phase of the study period.

Direct Cost savings

- Decreased crashes
- Cost saving in vehicle maintenance expenses:
  - $271,091 in 2004
  - $242,965 in 2005
  - $237,193 in 2006

Extensive Indirect cost savings

- Fewer out of service vehicles
- Improved transport times
- Decreased administrative lost in managing unsafe behaviors
- Decreased legal burden
- Automatic system wide data
- Insurance benefits

An ideal technology tool for improving driver behavior and enhancing safety

- Implementation of feedback and monitoring system over 2 years
- Safety performance improvement
- Cost savings
- Improved transport times

Demonstrated clearly

- Driver risk behavior can be substantially modified and improved with monitoring device, with real time auditory feedback.

A key to safe transport

You want a system that works!!

- Does the system really work
- Is it going to be a major burden on your staff to implement
- What are the real costs
- Are you going to have video of your company vehicle on you tube??

The jury is out on

- Opticon
- Simulators
**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

**Policy makes a difference…**

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

**Systems Safety Engineering - Z.15…..**

**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

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

**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

Active Projects, 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

Knowledge transfer

July 2007

August 2007
An excellent model

Tips for Emergency Vehicle Operations

News we don't want to see

Caught On Video: EMT Struck By Car

May 21st, 2007, Seattle

Help is on the way ???

November 24th 2008

This looks cool AND SAFE!
Science not, next best guess

‘Safety’ approaches being driven by manufacturers claims and sales rather than by science and data

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

No ‘a’… then NO ‘F’ !!!!!

- F = ma
  - where F = force
  - m = mass
  - a = acceleration

A few key words about restraint systems…
NOT new technical data...

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....

So....

› Which vehicle do you want to be in ?
› Which vehicle is the best for efficient, and effective patient care?
› Which vehicle provides optimal risk management ?
› What is the optimal fleet mix?

An interhospital transport ? “Do no harm....”?

Innovation
Safety at the scene

eg: Scandinavia Innovation in Vehicles, and Equipment

Automotive Injury Triangle and Safety Development

Host
- Field Data
- Scholarly Research
- Technology, invention & development
- Environment

Vehicle
- Technology initiatives
- Regulatory initiatives
- Countermeasures
- Regulations

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
- Seatbelt systems
- Equipment lock downs
- Padding
- Head protection

Tiered Dispatch

Intelligent Transport Safety Systems

Back up Camera..... Shouldn't all vehicles have one of these?
High speed crash, rolled and the occupants (patient and medics) had only minor scratches.

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

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…”


Were we safer in the Cadillac???

Air EMS is a role model for safety initiatives and focus.
USA design initiatives

New Australian vehicles

UK Ambulance vehicles

Clear safety message

Sweden initiatives

Fleet Mix?

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

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
small changes can make a BIG DIFFERENCE

- PREPARE – TEACH – REACH – RESPOND
  - Look at your own safety record
  - Teach safety and hazard awareness
  - Reach out with safety information to all your EMS providers
  - Respond with the best safety practices

PREDICTABLE PREVENTABLE and NO ACCIDENT

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??
Electronic handout available online
http://www.objectivesafety.net