The Ride of Your Life – Ambulance Safety

Maryland Volunteer Fireman’s Association Annual Conference
Ocean City, Maryland
June 13, 2010

Emergency Medical Service Transport

- 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?

Outline

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

Things can go wrong – but when there are sound safety technologies and policies in place, and the system is well prepared, you can minimize harm

Who am I?

- Nadine Levick, MD, MPH
- Emergency Medicine Physician and Public Health Academic, (USA-Hopkins, Harlem, Maimonides, Brookdale & Australia – Royal Melbourne, Royal Childrens Hospitals, Royal Australian Flying Doctor Service)
- Chair, National Academies Subcommittee TRB EMS Transport Safety, USA
- Founder of EMS Safety Foundation
- Recipient, International Society of Automotive Engineers, Women’s Leadership Award for EMS Safety

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

Emergency Medical Services (EMS)

An important and unique transport system

- Public safety, public health and emergency service
- Is there to save lives

EMS Transport Safety

- ‘patient safety’ AND also
- ‘provider’ and ‘public safety’
**Ambulance transport a serious transport safety problem…**

In the USA
- the most lethal vehicle on the road both per mile travelled and per vehicle
- is exempt from commercial fleet safety oversight from Federal Motor Carrier Safety Administration (FMCSA)
- 2/3 fatalities not in the ambulance
- Exempt from most FMVSS standards

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**Balance of concerns and risk during transport**

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

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**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

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**Data…**

- What is your transport safety record in your service?
- How can you improve if you don’t have a meaningful measure of safety performance?
- Transport safety is not guesswork, it is a science

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**…and**

- Is your ambulance crashworthy?
- Do you have a telematics feedback system?
- Enhanced Stability Control (ESC) – Does your ambulance have it??
  - An estimated >16% decrease in vehicle crashes
- and what is your loading height??
  - …is it less than 27 inches (68cm)??

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**Unique workplace**

- In vehicles
- At roadside and other emergency scenes

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**The ‘workplace’ IS a vehicle**

- EMT’s often in vulnerable positions during transport.
  - Bench seat
  - Captain’s chair
  - Standing or kneeling

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**The ‘workplace’ is also a crash scene**

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**Absence of USA standards and oversight**

- Challenges in identifying best practice
- Myriad of unregulated commercial products
- No safety performance standards
- Absent national safety oversight
Canada - Corporate Manslaughter
Corporate Homicide Act: 8th April, 2008

An interhospital transport
? “Do no harm….”?
April 2010, Resuscitation –
Going fast can hurt your patient clinically!

Golden Hour – not so hot
• March 2010
Annals EM

Golden Hour Summary
• This study suggests that in our current out-of-hospital and emergency care system time may be less crucial than once thought. Routine lights-and-sirens transport for trauma patients, with its inherent risks, may not be warranted.

May 13, 2010.. Last month

Two dead in Boone County truck-ambulance crash

Girl, medical injured in crash
Preventable…

James Woodman
- is a paramedic who, on his first day as a paramedic, suffered a severe TBI when the ambulance he was riding in (in the back) was t-boned and rolled onto its side.
- He remains in a persistent vegetative state in an ECF in Colorado.
- It is assumed that when the ambulance rolled onto its side, the lifepack 10 struck James in the head.

Fatal crashes more often at intersections, & with another vehicle (p < 0.001)*

70% of fatalities occur at an intersection (OR 2.7 vs front) & to improperly restrained occupants (OR 2.5 vs restrained)**

> 74% of fatal EMS crashes are MVC related***

> 74% of EMT occupational fatalities are MVC related

Serious head injury in >65% of fatal occupant injuries#

More likely to crash at an intersection with traffic lights (37% vs 18%; p < 0.001) & more people & injuries/crash than similar sized vehicles

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

A tragic emergency health care intervention outcome

Transport related aspects -
- Dispatch of EMS/Medical transport vehicles
- Transport policies and protocols
- Vehicle fleets and vehicle design
- Vehicle purchase standards
- Intelligent Transportation Systems (ITS) technology
- Driver training
- Driver performance monitoring
- Roadside and road design
- Integrated traffic safety technologies
- Scene safety and visibility
- Safety data capture
- Safety oversight

Key elements
- Impact Biomechanics
- Transport Ergonomics
- Fleet Safety

Impact biomechanics
- Crashworthiness
- Vehicle design
- Occupant protection

Transport Ergonomics
- Operational tasks
- Human factors analysis
- Range of reach
- Patient loading and unloading
**Fleet safety**
- Operational policies – dispatch, safety
- Fleet mix
- Vehicle selection – safety, ESC, loading height
- Driver performance and monitoring
- Scene safety
- Visibility and conspicuity
- Safety measurement and management

**Real world answers to real world questions -**
- What features will enhance safety of my new vehicle purchase?
- What color scheme do I want on my vehicle to make it safest?
- What policies offer the safest system?
- How do I get my team to address safety issues?
- Do I need a helmet, and if so which one?
- What data should I collect when something goes wrong, and how to analyze it?

**Creating a Safety Culture**
- Awareness
- Training
- Incentive

**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 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

**Safety oversight of what and .... by whom**
- Vehicle Safety
- Vehicle Design
- Transportation systems safety
- Safety Equipment Design
- Vehicle and Safety Equipment Testing and Standard development
- Safety policies

**In the USA AND Canada there are more safety standards for moving cattle than for moving patients**

**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**
and they don't care what your job title is or if you are a patient, a provider or a member of the public

The laws of physics prevail...

Science behind Policy

“For successful technology, reality must take precedence over public relations, for Nature cannot be fooled.”

Richard P. Feynman 1988

Ground Ambulance Transport Safety
IS Complex AND Multidisciplinary

Epidemiological Data Collection
Risk Management
Public Safety

Transport Policy

Transport Policy and Planning

Ergonomic Research

Biomechanical Automotive Safety

Behavioral/Chem Research

Communications Technology

Safety Technology

Regulations and Standards

Public Safety Program

Do we ask vehicle builders to write cardiac arrest protocols...?
Vehicle design and safety is not what we are trained to do!!!!

Are we designing vehicles that are difficult to see...?
What do we know now??

- Intersection crashes are the most lethal
- There are documented hazards, some which can be avoided
- Occupant restraint with standard belts is effective. (Over the shoulder belts for patients should be used, with the gurney in the upright position where medically feasible)
- All equipment should be locked down
- 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??

2008 - Air EMS on the NTSB’s “Most Wanted List”, where is ground EMS??

A Simple Question….

Safety is Good Business

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

The inevitable bottom line…

Are you self insured??

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Workers Compensation Rate increased by 26.5%
Was $5.86/$100 payroll in 2005-2006
Now it is $7.41 for 2006-2007
A problem

2007 Insurance data –
• 27 fold more likely to have a claim based on transport than related to medical care

2003 Insurance data –
• 10 fold more likely to have a claim based on transport than related to medical care

EMS CANNOT Afford to keep paying out like this….

Key Issues

• Mythology
  – That Emergency Medical Service personnel are safe
• Injury Hazards
  – Biohazard
  – 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
    • Exposure data are scant
  – Automotive Safety
    • ‘exempt’ from automotive research and regulation

Ambulance design & transport safety initiatives timeline

1960’s National Academies of Medicine – the Cadillac to the chassis and box truck, birth of the ambulance conversion industry (?? date of the FMVSS exemption)
1967 – First published test on Ambulance collisions and by an automated crash test system
1969 – First published test on Ambulance collisions
1979 – Swedish barrier crash tests
1980 – Swedish barrier crash tests
1987 – JAMA paper - Paul Auerbach
1995 – First published text on Ambulance collisions and by instrumented dummies
1998 – EMSC Pediatric Ambulance Transport Safety Grant
1999 – ASA and CEN ambulance safety standard in Australia and Europe
1999 - First ambulance rear compartment sled tests with instrumented dummies
2000 – First peer reviewed engineering publication on ambulance crashworthiness
2000 – First full vehicle ambulance crash tests
2001 – First SAE Emergency Vehicle Safety Symposium
2003 – Mobile Medical Transport Safety Task Force (MMTS) established
2004 - Morgantown program
2005 – First ambulance ergonomics paper
2006 – First NAEMSP ambulance safety keynote
2006 – First EMS Chiefs of Canada ambulance safety keynote
2007 – Inaugural TRB Ambulance Transport Safety Seminar

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 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

Firstly!

• An accident?
• or a predictable and preventable event

A tragic emergency health care intervention outcome
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.

Negative impact on system performance...
- BUT an EMS crash can kill all those involved AND wipe out a rural EMS system AND negatively impact a regions response capacity....

Ambulance Transport Safety
- Emergency care, public health, public safety, and patient transportation.
- Important Principle: Ambulance transport safety is part of a system, the overall balance of risk involves the safety of all occupants and the public.
- All get home safely.

Real world answers to real world questions -
- What features will enhance safety of my new vehicle purchase?
- What color scheme do I want on my vehicle to make it safest?
- Do I need a helmet, and if so which one?
- What policies offer the safest system?
- How do I get my team to address safety issues?
- What data should I collect when something goes wrong, and how to analyze it?

USA EMS
- EMS Systems - >15,000
- Personnel - ~1 million (~30% F/T professional & 70% volunteer)
- Vehicles - ~60,000 (Type I, Type II, Type III, Freightliners, ?motorcycles)
- Transports - ~50 million (to Emergency Deps ~ 50%, < 1/3 emergent)
- Cost - ~$8 Billion annually
- Safety Oversight - ? Disparate

What is a survivable impact?
- $E = \frac{1}{2}mv^2$
- $v^2 = 2as$
- ~ 30 mph - survivable
- ~ 60 mph - not survivable

A survivable impact??
A serious problem...

Tragedy you don’t want to be involved in

Thursday July 5th 2007...... Paramedic Allan Parson’s killed

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

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

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

Five Killed in Crash of Ambulance and Semi

Jan 28th, 2008

April 14th, 2008

1 dead, others injured in Sussex crash involving ambulance
April 20, 2008...??

June 17th 2008
a paramedic and a patient killed

In this vehicle...

October 31, 2008 - Kentucky

April 30, 2009 - Tennessee

Minnesota - June 20, 2009

August 2009 – Impaired...

October 22, 2009, TN
Patient and Provider killed, Attendant Critical
October 22, 2009
Provider and Patient Killed

December 2009

January 14, 2010

February 1, 2010

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

USA EMS transport safety data estimates

- ~ 50,000 vehicles
- ~ 9,000 crashes a year
- ~ One fatality each week
- ~ 2/3 pedestrians or occupants of other car
- ~ 10 serious injuries each day
- Cost estimates > $500 million annually

Is it your service’s tragic year?

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

So for EMS personnel...

- What’s going to kill you?
- What’s going to injure you?

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 a ambulance crash.

Occupational transportation fatalities:

WE HAVE A BIG PROBLEM HERE


Predictable risks:

- Fatal crashes more often at intersections, & with another vehicle (p < 0.001)
- 70% of fatal crashes EMS crashes during Emergency Use*
- 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#

Balance of concerns and risk during transport:

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

Data…

- What is your transport safety record in your service?
- How can you improve if you don’t have a meaningful measure of safety performance?
- Transport safety is not guesswork, it is a science.

The laws of physics prevail…

- and they don’t care what your job title is or if you are a patient, a provider or a member of the public.

Science behind Policy:

- “For successful technology, reality must take precedence over public relations, for Nature cannot be fooled.”

Richard P. Feynman 1988

Ambulance transport a serious USA transport safety problem…

- the most lethal vehicle on the road both per mile travelled and per vehicle
- is exempt from federal commercial fleet safety oversight (FMCSA)
- 2/3 fatalities not in the ambulance
- Exempt from most FMVSS standards

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

- The laws of physics prevail…”For successful technology, reality must take precedence over public relations, for Nature cannot be fooled.”
  Richard P. Feynman 1988
EMS Safety research is NOT EVEN ON THE

Ditto

Ditto drivers and driver/fleet safety technology

2001

transport system technologies are being

Current accepted safety design and

and many practices are in conflict with,

must be evidenced based

Firstly, the DANGER...

The state of EMS transport safety research is an

EMBARRASSMENT

Lags at least 30 years behind general automotive

and transportation safety research

EMS Safety research is NOT EVEN ON THE

PLAYING FIELD of state of the art automotive

safety research

‘Reinventing the wheel’ – should be avoided at all
costs

Then, The OPPORTUNITY

This is vehicles, and this is transportation safety

Vehicle and transportation safety technology and

research infrastructure exists

Ditto drivers, and driver/fleet safety technology

Collaboration, and the multidisciplinary model is key

Optimal use of very scarce resource

Current accepted safety design and

transport system technologies are being

ignored, and worse...

And...

This is in a setting where

transport safety is the major and most
costly adverse event in EMS

And there have been all sorts of major
technical and informational developments

since Jan 2006

A challenge we know now...

…is that there is a major problem with

the present approach and what is being
done currently

and many practices are in conflict with,

or not supported by, existing technical
engineering science

Ambulance Safety
Research: A New Field

We should use the best safety
practices demonstrated in engineering
...in automotive safety engineering

and in ergonomics

Range of reach. This is a well defined technical science

‘Workplace’ Hazards

Bigger is not necessarily better....

Creating a Safety Culture

USA EMS in 1917

- Awareness
- Training
- Incentive
1960 to 2009

A passenger vehicle - yes!

A laundry or mail truck - ??

Some recent adverse 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

- "Ambulance transport has a death toll...."
  Carl Craigie, EMT-P, Chief Platte Valley Ambulance

'Real world' head-on post crash

But what about head protection?
Attitudes to Head Protection in EMS

Would You Consider Wearing a Helmet PRE-PRESENTATION

16% Yes
84% No

Would you consider wearing a helmet POST-PRESENTATION

18% Yes
82% No

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

Levick NR, Garigan M, A Solution to Head Injury Protection for Emergency Medical Service Providers, International Association for Ergonomics (IAE), July 2006

New EMS helmet prototypes for 2006-2010

And very Predictable...

- Intersections are lethal environments

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 + Reaction time + Vehicle Braking time (wet)
- Perception + Reaction time + Vehicle Braking time (dry)

They CANT STOP IN TIME

Even at 30 mph & 100 feet away - dry and wet conditions-

What is known

- Ambulance transport is part of a system of integrated elements, as is an ambulance vehicle a microcosm safety system of interrelated occupant and safety issues
- The laws of physics prevail -

Would we....?

Seeing that we are health care providers – lets look at it this way –

- Would we use medical equipment that was built by folks who were not technically qualified or trained biomedical engineers and who just said – “this device is safe”?
- Or would we expect them to be qualified in this field and that their products were tested in a meaningful way to ensure that they were safe?
EMS Safety

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

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.

- This IS a Transportation and Automotive Safety issue

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

Important...

- Ergonomics and automotive safety issues are interrelated
- Crashworthiness priorities override the ergonomic issues

Air EMS is a role model for safety initiatives and focus

Air Safety Approach

- Safety Program Planning
- Evaluating
- Analysis of Safety Performance
- Analysis of Safety Information and Data
- Analysis of Risk Profiles and Plans

An Aviation Safety Plan

Duke Policies
Duke Risk Assessment Approach
Integrating Risk Assessment and Operational Practice!!

- Green
- Blue
- Yellow
- Red

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

1995- Deceleration Sled test (upon impact) 24 G, 30mph

Immobilization board

Foldable
Choose the Best Option

Vehicle Crashworthiness testing

USA - 2000 research
Europe - 2007 to meet CEN

Test 1 – Right side impact

1 Target vehicle, Type I ambulance
2 Bullet vehicle, Type II ambulance
Closing speed 44 mph

Johns Hopkins University

Test 2- Frontal

1 Bullet vehicle, Type III ambulance
2 Target vehicle, Type II ambulance
Closing speed 34 mph

Pre-impact CTD positioning

2000 Full Vehicle Crash Testing
Preparation of test vehicles

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

Impact residue
CTD dynamics
During impact
Which of these two vehicles would you want?
Sprinter v Ford Transit crash test
http://www.youtube.com/watch?v=C3kN6WF5vAA&feature=related

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

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

Rash of “Safety Concept” vehicles.....
Devoid of substantive automotive safety engineering input or testing

A few key words about restraint systems...

Systems safety failure AND dangerous
Overwhelming existing evidence these practices are HIGHLY dangerous
No evidence whatsoever that these practices are NOT dangerous, let alone safe

NOT new technical data...

Side facing 4-point harnesses demonstrated to be lethal, even at slow ground vehicle speeds

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 over both shoulders for sidefacing occupants are potentially lethal – and in NO WAY SUPPORTED BY ANY DATA OR INDEPENDENT AUTOMOTIVE SAFETY EXPERTISE

4 or 5 point harnesses over both shoulders for sidefacing occupants are potentially lethal – and in NO WAY SUPPORTED BY ANY DATA OR INDEPENDENT AUTOMOTIVE SAFETY EXPERTISE
Yet another potentially lethal example marketed as a “safety innovation” YET outside of automotive safety practice

Yes, the ride of your life….
- Sure… these vehicles all parade around the EMS and Fire shows
- BUT…
- NOT ONE of these vehicles has been to the automotive safety shows or scrutinized by the automotive safety industry

Ambulance Vehicle Standards??
- KKK?
- AMD?
- FMVSS?
- NFPA?
- SAE…?
- ASTM…?
- International — ASA — CEN

Global EMS Vehicle Safety Standards & Specifications and Guidelines
- EMS Safety and Performance Standards
  - Australia & New Zealand 4535
  - Common European Community (CEN) EN1789
- Non EMS Specific USA Standards
  - [Aviation - FAA/CAU/AA]
  - [Field vehicles - ASSE/ANSI Z15 ]
- USA Other
  - Purchase Specification: KKK
  - ”Standards” - NTEA - AMD, ASTM F 20
  - Guideline: EMSC Dos and Don’ts, and (ASTNA, CAAS and CAMTS)
- [Aviation - FAA/CAU/AA]
- [Fleet vehicles - ASSE/ANSI Z15 ]

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

NTSB 1979… and 30 years later and still the same problem

October 2008 JEMS Article “Rig Safety – 911”

What KKK-A-1822F, AMD and FMVSS state and don’t state…
USA Ambulances: FMVSS Exempt

- Specifications for the purchase of a Star of Life Ambulance
- SAE J2112 static stretcher test in longitudinal, lateral & vertical
- No dynamic test for vehicle, occupants or equipment
- No automotive test manikin

USA KKK ambulance purchase specifications


- FMVSS has a specific exemption for ambulance vehicles once you are 600mm or 2 feet positioned rearward of the driver
- KKK require a 'national test lab' to conduct AMD 'tests' BUT NOT an automotive test lab!
- No dynamic impact tests AT ALL
- No crashworthiness tests

USA Ambulance Manufacturing Division (AMD)

Ambulance Standards – August 2007

- No dynamic or impact test
- No automotive test manikin
- Mandates NO 'crumple zone'
- No impact tested anchorages for occupant restraint or equipment
- Internal, not independent

Occupant protection????

July 2007

May 13, 2010.. Last month

KKK/AMD – static ‘safety testing’

- Ignorant of automotive safety principles – and specifies -
  - No structural damage to any load bearing or supporting members, i.e., torn or broken material, broken welds, popped or sheared body rivets, bolts, and/or fasteners, shall be evident during the application of the force and after the release of the force.

Ridiculous current 2009 USA ambulance ‘safety testing’!?!? – IS NOT consistent with accepted automotive safety practice...

- F = ma

where
- F = force
- m = mass
- a = acceleration
Standards Development Update
- NFPA – developing enhanced KKK
- SAE – x2 standards underdevelopment
  - General vehicle crashworthiness and occupant safety standard
  - Specific equipment and occupant restraint standard
- ISO - ISO/AWI 39001 - Road-traffic Safety management system

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

Visibility and lighting issues

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???

News we don’t want to see

Caught On Video: EMT Struck By Car

It isn’t like this outside of the USA

Worker visibility Act: November 24th 2008

FMVSS exempt…….
Day visibility

Night visibility

Here's the real world at 6 ft...

August 2009 – Visibility review

Policy and practice ignorant of existing technical safety data

This addresses some very real risks, very creatively – and currently ONLY available in London Ontario!

Color-blindness affects 10% of the population

Emergency Vehicles – Viewer Awareness

For a timely, appropriate and safe response

- Location
- Size
- Shape
- Speed
- Intended path
- Having access to that technical knowledge supports changes to improve safety practice.

But whatever color .... If you run a red light someone will be killed

Invehicle technologies to enhance transport safety
- Aftermarket in vehicle electronic e-safety devices with monitoring and feedback

What about changing driver behavior in the real world??

The “Feedback Box” - A transportation safety monitoring and feedback device
This technology is conceptually like a vehicle safety “pulse oximeter” – that with auditory feedback - can save your life, your coworkers life, your patients life, and others on the road.
Purpose of ‘Feedback box’ 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 ‘growl’, and penalty tones
- Data downloaded automatically every day

Demonstrated Effectiveness

MEMS - Seatbelt Violations per Month

MEMS - Overspeed Violations per Month

MEMS - Force Count Violations per Month

MEMS - Percent of Drivers Below Standard

And when a rare crash happens….

Unit 302 Accident
**Monitoring and feedback devices**
- Implementation well received by the providers.
- 20% cost saving in vehicle maintenance within 6 months.
- No increase in response times
- Fewer crashes and less severe crashes
- Sustained improvement in safety proxies, with no inservice or retraining after the initial introduction period.

**Feedback box Summary**
- The system works
- Objectively improved performance
- No increase in response times
- At fault accidents reduced
- Accepted into the culture

However:
- The system requires monitoring
- Must be reinforced by management
- Must be incentives for good performance
- Must be consequences for poor performance

**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

**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

**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

**Resource availability and allocation technologies**

**Do you want graphic images of the crashes your investment DID NOT HELP YOU AVOID???
EMS Transport Safety

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

Innovation

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

What’s new

Safety concepts out there now

- Driver feedback technologies
- Tiered dispatch
- Enhanced ambulance vehicle design
- Intelligent Transport Technologies - ITS
- New Safety Standards

What the independent technically expert
occupant protection and automotive
safety engineers say about our current
ambulances and ‘safety’ approaches:

- “The rear compartment Death Vault”
- “The Kitchen Design must go”
- “The Kill, Kill, Kill (KKK) spec”
- “The organ donor harness system”

Independent Technical Expertise

- The “kitchen design” is completely unacceptable and a failure in health care delivery, occupant protection and ergonomics.
- Independent technical expertise must be here and involved

National Academies Transportation Research Board
Ambulance Transport Safety Summit –

- Bridging the gap between what we do and what is known
- Enhancing ambulance transport safety through shared knowledge of technical data
- Open access, all EMS related organizations notified and invited, and beamed to EMS Expo!

What could you learn from the National Academies – right NOW and gratis

- The realm of burden and benefit
  - measuring the safety of the system
- Transport System Management
  - fleet safety and oversight technologies and policies
  - operations management - dispatch, congestion routing, deployment of resources, benchmarking
- Vehicle safety
  - occupant protection design and testing
  - vehicle performance safety
  - vehicle and personnel human factors issues
- Dissemination and Policy
  - Knowledge transfer
  - Standards, specifications and policy

October 29, 2009

- This is where the technical experts were, operational
EMS providers and the government agencies too
October 29, 2009 TRB Summit

2009 TRB Summit Participants
http://www.objectivesafety.net/TRBSummit2009.htm

- Technical experts
  - Automotive safety engineering, occupant protection
  - Automotive and EMS operational ergonomics and human factors
  - Transportation systems safety engineering
- Government agencies
  - National Highway Traffic Safety Administration (NHTSA)
  - Department of Transportation ITS (DOT)
  - National Transportation Safety Board (NTSB)
  - Federal Highways Administration (FHWA)
  - Federal Motor Carrier Safety Administration (FMCSA)
  - Bureau of Labor and Statistics (BLS),
  - Department of Homeland Security (DHS)
- EMS State Directors
- Industry partners
- Academics

Please do go and access this information, it comes from technical and operational experts and it is gratis.

There have been two TRB Summits held, 2008, 2009 and both with vehicle engineering and transportation systems technical expertise.

See www.trb.org, and for the Summit archives:
www.objectivesafety.net/TRBSummit2008.htm
www.objectivesafety.net/TRBSummit2009.htm

International approaches
• The state of the art non-USA vehicles have NO squad bench nor the aftermarket structural vehicle modifications that can potentially decrease crashworthiness integrity that were seen in study vehicles.

The EMS Safety Foundation: A practical and functional model
Interdisciplinary and Operational
• Innovation
• Collaboration
• Knowledge transfer

Its out there NOW
• TRB 2009 Summit – addressed the key and interdisciplinary issues, in one day – please seek that information out.
• There have been two TRB Summits held, 2008, 2009 and both with vehicle engineering and transportation systems technical expertise.
• See www.trb.org, and for the Summit archives:
  www.objectivesafety.net/TRBSummit2008.htm
  www.objectivesafety.net/TRBSummit2009.htm

Background:
• EMS Safety Foundation has been established to fill a gap in:
  - technical knowledge transfer
  - practical interdisciplinary R & D
  - evaluation and implementation of system safety enhancements for EMS and Medical Transport
• It is a not-for-profit institute

Mission
• This is a team of like-minded innovators across EMS Medical Transport and a number of technical disciplines, who share the common mission of enhancing the safety of EMS delivery for all involved.
In a nutshell

- EMS Safety Foundation is a not-for-profit multidisciplinary virtual think tank and test bed for safety innovation and knowledge transfer
- It is a virtual network integrating the end users and the technical experts
- A tool to enhance the safety of delivery of EMS services

R & D “Ripoff and Duplicate”

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

The EMS Safety Foundation

www.EMSSafetyFoundation.org

brings this presentation to you

Automotive engineers addressing EMS Safety Foundation Workshop

RETTmobil is -

- A major European Emergency Rescue Congress, Trade show and Symposium
- Held in Fulda, Germany
- Established in 2001
- Attended by ~20,000 attendees
- Brainchild of Prof Peter Sefrin

Day 1:

http://www.emsresponder.com/web/online/Safety/ Live-From-RETTmobil2SS13137
EMS Safety Foundation Delegation bringing International Innovation to you!

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

Safe and Ergonomic design
Collaboration and Outcomes

- Interdisciplinary Collaboration is what is key – not orthopedic folks talking to cardiologists – BUT collaboration between the health care folks appropriate automotive and occupant protection engineers and transportation system design and industry standards that make sense – and
- Meaningful measures of outcome and performance

Texas' Careflite's new vehicles

Careflite's new vehicle

Manitoba's new fleet
Science behind Policy

- “For successful technology, reality must take precedence over public relations, for Nature cannot be fooled.”
  Richard P. Feynman 1988
this vehicle is safety crash tested by automotive experts

Unlike this vehicle

Is this acceptable...?
- There are ambulances rolling out of the showroom on a daily basis – as we speak – being designed by healthcare providers and built by after-market retrofitters, who are not at all governed as are other passenger vehicle manufacturers by the standards set by the society for automotive engineers

So what do we need to do??
- Reach out to the appropriate experts – they sure do want to help us
- STOP being philistines and be the scientists we are trained to be and at least seek a scientific approach
- Get your heads out of the sand – there is plenty of valid technical information – FMCSA, TRB, SAE
- Make policy and purchase decisions on technically sound data, not a marketing brochure
- HAVE MEANINGFUL AND TRANSLATABLE OUTCOME MEASURES FOR YOUR SERVICES SAFETY PERFORMANCE

Future Directions
- Rational use of limited resource
- Avoid reinventing the wheel
- Formal safety research agenda
- Framework bridging key research and infrastructure
  - Society of Automotive Engineers
  - Involvement with ESV activities
  - EMS safety research funding
  - Foster evidence based initiatives

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

Were we safer in the Cadillac???

Creating a Safety Culture
- Awareness
- Training
- Incentive

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

Future

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

Conclusion

- EMS transport has serious hazards and safety issues
- Major advances in EMS safety research, infrastructure and practice over the past 5 years
- Development of substantive EMS safety standards is a necessity and a reality
- Multidisciplinary safety issue that EMS cannot solve internally
- Failure to transfer knowledge from transportation and automotive safety is unacceptable and dangerous
- EMS is still way behind the state of the art in vehicle, transportation and occupational safety

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

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