Ambulance Transportation Safety: Separating Fact from Fiction

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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

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 Subcommitee TRB EMS Transport Safety, USA
- Founder of EMS Safety Foundation
- Recipient, International Society of Automotive Engineers, Women’s Leadership Award for EMS Safety

Where am I really from? ...Yes, it IS that big!

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

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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

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

The Public Health Paradigm
1. Define the problem
2. Measure its magnitude
3. Understand the key determinants:
   a. Biologic etiology: host / agent / vector
   b. Environmental & biomechanic influences
   c. Social/behavioral practices of at risk pop.
4. Develop intervention/prevention strategies
5. Set policy/priorities
6. Implement and evaluate

Some odd USA 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

Unique workplace
- In vehicles
- At roadside and other emergency scenes

The 'workplace' IS a vehicle
- EMT’s often in vulnerable positions during transport.
  - Bench seat
  - Captain’s chair
  - Standing or kneeling

The 'workplace' is also a crash scene

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….”?

Pre-admission in-hospital patient transport and at even more remote areas

Challenges and wrap-up

"Do no harm..."
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**
- More likely to crash at an intersection with traffic lights (37% vs 18% $p=0.001$) & more people & injuries/crash than similar sized vehicles##
- Serious head injury in >65% of fatal occupant injuries#

*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

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
- Complex both engineering and public health issues

EMS Transport General Concerns

- 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??

EMS Safety General Concerns

- 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

Safety is Good Business

- Safety is a top priority
- EMS Transport General Concerns
- EMS Safety General Concerns

The inevitable bottom line…

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

A Simple Question....

- WINGS, WHEELS & ROTORS
- June 2007

EMSSafety

www.EMSSafety.org

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www.EMSSafety.org
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

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

Expensive….

Very Expensive

EMS CANNOT Afford to keep paying out like this….

A “Fleet” to many in Emergency Medical care means….

- Transport Medicine
- Impact Biomechanics
- Transport Ergonomics
- Fleet Safety

Transport Medicine
EMS Transport Safety

- 'patient safety'
  AND also
- 'provider' and 'public safety'

April 2010, Resuscitation – Going fast can really hurt your patient clinically!

and...

March 2010, Annals EM Golden Hour – not so hot

Golden Hour – not so hot

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. [Ann Emerg Med. 2010;55:247-248.]

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 Issues

- Mythology – That Emergency Medical Service personnel are safe
- Injury Hazards – So called
  - Chemical/Radiation
  - Physical/Mechanical trauma – THE BIG PROBLEM
- Motor Vehicle Crashes are the highest cause of death at work – EMS has 2 X the mean national rate
- An R & D and Regulatory Gap
  - Occupational Health and Safety
  - The workplace is in a vehicle – exposure data are scant
  - Ambulance design & transport safety initiatives timeline

Ambulance design & transport safety initiatives timeline

- 1960 - National Academies of Medicine – the Cadillac to the chassis and box truck, birth of Transportation conversion
- 1961 – FMVSS
- 1973 – NHTSA
- 1979 – NTSB report and birth of EVOC
- 1980 – Swedish barrier crash tests
- 1987 – JAMA paper- Paul Auerbach
- 1995 – First published text on Ambulance collisions – and by an optometrist
- 1998 – EMSC Pediatric Ambulance Transport Safety Grant
- 1999 – First ambulance rear compartment sled tests with instrumented dummies
- 2000 – First peer reviewed engineering publication on ambulance crashworthiness
- 2001 – First full vehicle ambulance crash tests
- 2003 – Mobile Medical Transport Safety Task Force (MMTS) established
- 2004 – First AMA guidelines for Ambulance Policy
- 2005 – First EMS Chiefs of Canada ambulance safety keynote
- 2006 – First NAEMSP ambulance safety keynote
- 2007 – First EMS Chiefs of Canada ambulance safety keynote
What’s missing
1. What data is collected nationally?
   - We have no denominator data
   - We have incomplete numerator data
2. Absent population-based national injury data or injury mechanisms data
3. Absent structured transportation safety engineering input
   1+ 2 +3 = resultant inability to design and evaluate efficacy of injury interventions
4. What oversight is there?
5. Which organizations would determine policy?

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 aftermarket 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 heath, 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 - ~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

Safety oversight of what and .... by whom

- Vehicle Safety
- Vehicle Design
- Transportation systems safety
- Safety Equipment Design
- Vehicle and Safety Equipment Testing
- Standard development
- Safety policies

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

Creating a Safety Culture

- Awareness
- Training
- Incentive

the EMS transport process

- communications/dispatch
- the patient
- restraining device/seat
- transporting device/journey
- 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 Ambulance Transport Safety

IS Complex AND Multidisciplinary

- Epidemiological Data Collection
- Risk Management
- Public Safety
- Transport Safety
- Driver Training
- Fleet Safety Program
- Regulations and Standards
- Safety Technology
- Communications technology
- Software/Chain Research
- Biomechanical Automotive Safety
- Ergonomic Research
What is a survivable impact?

- 12 mph (20 km/hr)?

A survivable impact?

E = ½ mv^2, \ v^2 = 2as

- ~ 30 mph - survivable

What is a survivable impact?

E = ½ mv^2

~ 60 mph - not survivable

Thursday July 5th 2007......

Paramedic Allan Parson's killed

"...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

July 21, 2007 06:20 AM EDT

The National Highway Traffic Safety Administration (NHTSA) is investigating the scene of a fatal crash involving an ambulance and a semi-truck on Friday morning near Macon, Missouri. The crash resulted in the deaths of five paramedics from the Mid-Missouri Ambulance District. The crash occurred on Route 24, west of Macon, at around 6:30 a.m. The ambulance was carrying three paramedics and two patients when it was involved in a collision with a semi-truck, according to the Missouri State Highway Patrol. The NHTSA says the crash is being investigated to determine the cause of the accident and whether there were any safety violations. The scene remains active as emergency medical personnel work to clear the area and provide care for those involved. The crash is the worst ambulance crash in US history.
January 10, 2008

This is not a crashworthy environment

Jan 28th, 2008

April 14th, 2008

April 20, 2008..??

June 17th 2008

In this vehicle...
October 31, 2008 - Kentucky

February 11, 2009 – North Carolina

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

Monday November 30, 2009 Smithfield
Is there an acceptable rate of morbidity and mortality for pre-hospital transport systems??

USA Emergency Vehicles
Minimum Annual Fatalities 1995-2007
FARS – A National Data Set?
Small numbers – but NO data captured from 20% of the nation in 10 years

USA EMS transport safety data estimates
- ~ 50,000 vehicles
- ~ 9,000 crashes a year
- ~ One fatality each week
- ~ 25 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

and what is an EMS crash?
- Definition of an EMS crash
- Definition of Emergency Response Mode

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

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

** Kahn CA, Pirrallo RG, Kuhn EM, Prehosp Emerg Care 2001 Jul-Sep;5(3):261-9
# NIOSH, 2003
## Ray AM, Kupas DF, Prehosp Emerg Care 2005 Dec; 9:412-415

USA transport safety problem…
Balance of concerns and risk during transport

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

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

Safety is a tool to save

- Lives
- Time
- Money
  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

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
New Information/Technical Developments Jan 2006 - Jan 2010

- SAFETEA-LU, 2006 – EMS identified as one of the 4 E's
- International Ergonomics Association (IEA) – publication June 2006
- Enhanced Safety of Vehicles (ESV) - publications June 2007, 2009
- American Society Safety Engineers (ASSE) - publications June 2006, 2007
- National Academies TRB - Inaugural EMS Safety address, Jan 2007
- NEMSAC established – April 2007
- AMD Engineering Public Comments, July 2007
- KKK-F, August 2007
- OSHA September 11, 2007 EMS safety in Federal Register
- State Strategic Highway Safety Plans, October 2007
- EMS Safety Foundation established – Dec 2007
- National Academies TRB – Inaugural EMS Safety Subcommittee meeting Jan 2008
- Transportation Safety Advancement Group (TSAG) – Feb 2008
- Society for Automotive Engineers (SAE) – publications Oct 2007, 2008, 2009
- Worker visibility Act - Nov 2008
- SAE Ambulance Standards development – April 2009
- NFPA Ambulance Standards Committee – June 2009

Ambulance Safety Research: A New Field

- EMS Safety – 40 papers – on ambulance safety
  - 2 papers - on ambulance ergonomics
  - 1 paper – on stretcher ergonomics
- Computer Workstations
  - 30,000 papers – on ergonomics of computer work stations
- Erectile Dysfunction
  - 100,000 papers – on Erectile Dysfunction

Ambulance Safety Research: A New Field

- Funding??

Priorities...... Research papers in the past 30 years

- EMS Safety
  - 40 papers – on ambulance safety
  - 2 papers - on ambulance ergonomics
  - 1 paper – on stretcher ergonomics
- Computer Workstations
  - 30,000 papers – on ergonomics of computer work stations
- Erectile Dysfunction
  - 100,000 papers – on Erectile Dysfunction

Moose crash data….? – not EMS crash data

We should use the best safety practices demonstrated in engineering

...in automotive safety engineering
Range of reach. This is a well defined technical science

‘Workplace’ Hazards

Creating a Safety Culture

- Awareness
- Training
- Incentive
USA EMS in 1917

1960 to 2009

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

and who's life was he racing to save?

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

‘Real world' head-on post crash

Anchorage Daily News

Paramedic injured in crash is recovering

EMSafety

EMSafety
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 2006-2010

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 –

- 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?

Patient Safety- A routine concept...

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.

**Benefit of Safety**

- This IS a Transportation and Automotive Safety issue
- 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**

**An Aviation Safety Plan**

**Air Safety Approach**

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

Duke Risk Assessment Approach

Integrating Risk Assessment and Operational Practice!!

- Green
- Blue
- Yellow
- Red

EMS Best Practice, Sept 2006

What are the solutions?

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

Goals

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

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

Vehicle Crashworthiness testing

USA - 2000 research

Europe - 2003 to meet CEN

Preparation of test vehicles

2000 Full Vehicle Crash Testing
Pre-impact CTD positioning

Full Vehicle Crash Tests

Test 1 - Right side impact

Test 2 - Frontal

Foldable

Choose the Best Option

Immobilization board

Immobilization board

Pre-impact CTD positioning

Test 1 – Right side impact

Target vehicle, Type I ambulance

Bullet vehicle, Type II ambulance

Closing speed 44 mph

Test 2 - Frontal

1 – Bullet vehicle, Type III ambulance

2 – Target vehicle, Type II ambulance

Closing speed 34 mph
And this all takes place in 60 millisecs – the blink of an eye

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 side-facing 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.

Airbags in the back….??
Absent safety testing standards, any meaningful crash or injury mechanism data or effective occupant positioning – rear compartment airbags are likely to be hazardous.

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 v 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/FAA
• [Fleet vehicles - ASSE/ANSI Z15 ]
• USA Other
  – Purchase Specification: KKK
  – “Standards” – NTEA – AMD, ASTM F 20
  – Guideline: EMSIC Dos and Don’ts, and (ASTMA, CAAS and CAMTS)

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

NTSB 1979... and still the same problem

October 2008 JEMS Article “Rig Safety – 911”

USA Ambulances: FMVSS Exempt

USA KKK ambulance purchase specifications

USA Ambulance Manufacturing Division (AMD)

Occupant protection......??

KKK/AMD – static ‘safety testing’

• 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

• Specifications for the purchase of a Star of Life Ambulance
• Static Pull test
• 2200 Lbs. static stretcher test in longitudinal, lateral & vertical
• No dynamic test for vehicle, occupants or equipment
• No automotive test manikin

• 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

• 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.

What KKK-A-1822F, AMD and FMVSS state and don’t state...

What KKK-A-1822F, AMD and FMVSS state and don’t state...

What KKK-A-1822F, AMD and FMVSS state and don’t state...
KKK Specification and AMD Standards both default to the FMVSS for safety – however:
- 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

No ‘a’... then NO ‘F’ !!!!!
- F = ma

where  
F – force
m – mass
a – acceleration

Current 2010 USA ambulance ‘safety testing’ !?!? – Is NOT consistent with accepted automotive safety practice...

FMVSS exempt......

Visibility and lighting issues

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???

Standards Development Update
- NFPA – Meetings March 2010
- 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 systems
  – Recent update meeting in Canada

Yes a “nationally recognized testing lab” – BUT - NOT an automotive/occupant safety crash test lab!!
It isn't like this outside of the USA

News we don't want to see

Caught On Video: EMT Struck By Car

Policy and practice ignorant of existing technical safety data

Worker visibility Act: November 24th 2008

Day visibility

Night visibility

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

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

In vehicle 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 “job”
- 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

MEMS MONTHLY OVER SPEED VIOLATION TREND 2003/2004

<table>
<thead>
<tr>
<th>Series</th>
<th>Month</th>
<th>Number of Violations</th>
</tr>
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<tbody>
<tr>
<td>I</td>
<td>March</td>
<td>179,721</td>
</tr>
<tr>
<td>II</td>
<td>April</td>
<td>207,450</td>
</tr>
<tr>
<td>III</td>
<td>May</td>
<td>216,922</td>
</tr>
</tbody>
</table>

MEMS ABC Miles Per Month

- Series I – blind data, no growls
- Series II – growls & tones ON, unidentified data capture
- Series III – identified data
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

A key to safe ambulance transport
### 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 youtube??

### Remote Data Capture
- Example scorecard of comparative driver performance from the 'ggdrive' business application...
- The scorecard is created using telematics data from dedicated on-board smartphone telematics device and is presented in traffic light format against benchmark and set targets.

### New innovations: Smartphone Data Capture & Scorecards
- Reports & Scorecards
- Remote Data Capture Report
- PDF report of comparative vehicle performance from the 'ggdrive' Telematicus business application...
- This report is automatically created using telematics data from dedicated on-board telematics device and can be scheduled for production and email distribution.

### Resource availability and allocation technologies
- The jury is out on
  - Opticon
  - Simulators
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 – October 29, 2009

- 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!

October 29, 2009

- This is where the technical experts were, operational EMS providers and the government agencies too

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

- The realm of burden and benefit
  - measuring the safety of the system
  - determining the economic, ethical and risk benefit challenges
- 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
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
  - Fire / EMS
  - Volunteer EMS
- Industry partners
  - EMS Equipment
    - Vehicles, both OEM and aftermarket
- Academics

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

TRB 2009 Summit – addressed the key and interdisciplinary issues, in one day – please seek that information out.

TRB 2009, 2008, 2009 and both with vehicle engineering and transportation systems technical expertise

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

International approaches

- The state of the art non-USA vehicles have NO squad bench nor the after market 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

The EMS Safety Foundation
November 2009 Webinar for Public Access
www.EMSSafetyFoundation.org and www.objectivesafety.net

The 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

**EMS Safety Foundation**

Ambulance Vehicle & Ergonomics Workshop, October 2009

- Automotive engineers addressing EMS Safety Foundation Workshop
- 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
Flexibility to manage two patients

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

Patient Transferring Slides

Ergonomic layout and equipment
Manitoba’s new fleet

Technical Collaboration is key
- We are NOT the experts in this science
- We cannot afford to play the silo game here, it is costing lives, time and money
- We MUST have a meaningful evidenced based approach to operations and policy
- We must be outcomes driven
- We MUST cease to be a fiefdom in a discipline we have no technical background or expertise in

We must be outcomes driven

We are NOT the experts in this science

STOP being philistines and be the scientists we are trained to be and at least seek a scientific approach

Reach out to the appropriate experts – they sure do want to help us

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

Is this acceptable...?
- There are ambulances rolling out of the show room on a daily basis – as we speak – being designed by health care 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

This vehicle is safety crash tested by automotive experts

Unlike this vehicle

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

“Ripoff and Duplicate”
- Avoid reinventing the wheel at all costs
- Where are the best practices that we need to transfer knowledge from
Transportation Research Board is an excellent resource… we should be using it!!

Tips for Emergency Vehicle Operations

USFA Emergency Vehicle Safety Initiative

Traffic Incident Management Systems (TIMS)
- Released April 2008
- FEMA, USFA, IFSTA
- Covers setting up safe roadway incident work areas and using unified command at these incidents

August 2009 – Visibility review

Fleet Mix?

Were we safer in the Cadillac???

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