
EMS Safety Conference
November 9&10, 2012
Ambassador Conference Center in Erie, PA

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Bang for buck: Ambulance Safety
Standards and Survival – What do you need to know!

October 28, 2012

What are we going to cover today?
• Key principles of ambulance transport safety
• Ambulance safety research and data
• National and Regional Standards and Guidelines
• How to make your ambulance transport environment safer right now
• Future goals for Ambulance transport safety

Goals and Learning Objectives
• Educate on the risks to patients, transport and emergency medical service providers and the public from ambulance transport adverse events
• Identify and explore factors related to ambulance crashes and identify potential mechanisms of injury to EMS transport providers, patients and the public and expose safety myths
• Instruct providers on strategies for enhancing transport safety and reducing risk of injury to patients and providers and the public during transport

Emergency Medical Services (EMS)
An important and unique transport system
• Public safety, public health and emergency service
• Is there to save lives

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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

Emergency Medical Service
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?
What can we learn from and share with our international colleagues

Your electronic handout/resource card

Or if you are < 30 years
Who am I?

- Nadine Levick MD, MPH
- Emergency Medicine Physician and Public Health Academic, (USA-Hopkins, Columbia SUNY & 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

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

How do you use an eTag for the first time?

Get Microsoft Tag App on your smartphone.
(there are other free Apps too, a quick Google search)
open Tag App and scan the eTag
www.objectivesafety.net/PDFHO.htm form will open directly on your phone

Your handouts etag page

for those not of the Y or Z generation!
- if you have a smart phone
- and you have downloaded free Tag Reader
- point your phone and capture this etag to get today’s handout on your phone

White House Safety Data Palooza
September 14, 2012
Interdisciplinary Innovation Consortium

Communication Technology trends

January 2012, USA
Smartphone penetration by age and income

Smartphone navigation devices

A lot is now possible and for less!
- Driver behavior
- Vehicle behavior
- Roadside ITS
- Fuel consumption/Economics
- Resource modeling

Goals
- Cheaper
- Better
- Safer

EMS Transport Safety
- ‘patient safety’
  AND also
- ‘provider’ and ‘public safety’

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

September 27, 2012
The ambulance was NOT using lights and siren.
There was a passenger in the front from the initial car accident and three EMTs in the patient compartment.
The driver of the ambulance stated to the crew that he was becoming lightheaded and dizzy and began to pull off the road, passed out and depressed the accelerator.

Two of the EMTs were not wearing a seatbelt. The third EMT was on the squad bench and was wearing a seatbelt. The third EMT was uninjured aside from some bruises, and was back at work the next day. The other two have significant though non-life threatening injuries, but have prolonged injuries.

Seat Belt and Restraint Use:
Seat belts or restraints will be securely fastened to the following individuals when the vehicle is in motion:
1) All EMS vehicle operators
2) All patients
3) All non-EMS passengers (cab and patient compartment)
4) All EMS practitioners (when patient care allows)
5) All infants and toddlers (these children should be transported in an age appropriate child seat if their condition allows). Children should not be placed in cab passenger seat with airbag.

September 4, 2012- Las Vegas

August 27, 2012 - NYC

Fatal injuries among EMTs and paramedics, 2003-2010*

- Highway incidents: 31%
- Other transportation incidents: 7%
- Aircraft incidents: 32%
- Assaults and violent acts: 9%
- Other transportation incidents: 11%

*Data for 2010 are preliminary. Percents may not add to 100 due to rounding.
Source: Bureau of Labor Statistics, Census of Fatal Occupational Injuries

Friday September 7, 2012
NYC
Funeral of Paramedic David Restuccio
Science behind Policy

“For successful technology, reality must take precedence over public relations, for Nature cannot be fooled.”
Richard P. Feynman 1988

Communicating risk

Which image of October 26th communicates better risk perception?

Balance of concerns and risk during transport

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

Safety of the...

- Provider
- Public
- Patient

the EMS transport process

- Communications/Dispatch
- the patient
- Restraining devices/seats
- Transporting devices/means
- 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
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

Ground Ambulance Transport Safety IS Complex AND Multidisciplinary

- Epidemiological Data Collection
- Ergonomic Research
- Biomechanical Research
- Transport Policy
- Environmental Safety
- Regulations and Standards
- Public Safety
- Fleet Safety Program
- Driver Training
- PPE

So

- What’s important
- What’s not important

What’s going to save your life
- What might take your life

What’s going to hurt you
- What’s going to protect you
1864 Ambulance Design Patent and diagrams
Almost 150 years ago

USA EMS in 1917

1880’s

USA 1980’s Then…

And 2012…

Equipment hard to reach
Innovation Now…

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?

- What we need to consider, where is the ‘bang for buck’ in ambulance transport safety?
- Where is the low hanging fruit?

WE DO HAVE TECHNICAL DATA!!

Ambulance Safety Research:
No longer such a New Field

We should use the best safety practices demonstrated in engineering

and in ergonomics

Range of reach. This is a well defined technical science

ESV July 2009
As well as epidemiological injury data
August, 2011

Who writes vehicle and occupant safety standards??
- FMVSS
- SAE
- CEN
- ASA
- ISO
- KIK – only ambulances
- AMD – only ambulances
- ASTM – only ambulances
- NFPA – for fire trucks and new ambulances
- Health Care providers – MARYN report

One Day event, 30 presentations
- Held in Washington DC, Keck Center
- Simulcast Live to EMS Today
- Live Webinar Access - globally
- Over 100 participants live across 3 continents
- Greater than 10,000 downloads of handouts
  within the first week!!

The 2012 TRB EMS Safety Summit
print this page & your smart phone will play the 8 sessions from the eTags! (even in B&W)
1: Data and Recent Initiatives
2: Transport, Human Factors - Bridging Diverse Disciplines
3: Testing and Standards
4: New systems safety technology solutions & telematics
5: Fleet management strategies
6: Innovative Vehicle Design
7: Operationalizing Safety
8: Panel: How to optimize the safety of your existing fleet
Wrap up – from Prof. Art Cooper
http://www.emssafetyfoundation.org/2012TRBSummitAgendawithLinks.pdf

The impaired/distracted driver
- Impairment
  - Illness
  - Exhaustion
  - Substance
  - Emotion
  - Distraction
  - CELL PHONE !!!!!! – (A MAJOR HAZARD)
  - Other technology

Talking increases crash risk 5x
Texting is COMPLETELY UNACCEPTABLE
23X increase in crash risk

The science of Stretcher lifting & loading
Stretcher Load - # 1

And what is the loading height of your ambulance??

Size matters…. Less than 27 inches will save your back!!!!

EMS SAFETY COURSE
National Association of Emergency Medical Technicians

Course Design
• One-day program
• Interactive lecture, discussion, group activities
• Case studies using real incidents
• 8 hours continuing education credit (CECBEMS)
• Presented in 8 modules

A lot is now possible and for less!
• Driver behavior
• Vehicle behavior
• Roadside ITS
• Fuel consumption/Economics
• Resource modeling

Fleet Management technologies
• ACETech/Femo
• FleetEyes – Intermedix
• Zoll rescuenet and roadsafety fleet management systems
• Marvis
• Telematicus
• Optima
• Northrop Grumman

Spectrum of dimensions
• CAD
• Resource allocation
• Fleet performance –
  – Monitoring: System that gives management data of vehicle efficiency and use
  – Feedback: Directly to drivers at the wheel
• Public Alerts

Telematics
TRB 2012 Summit – addressed the key and interdisciplinary applied solutions issues, in one day – please seek that information out. www.objectivesafety.net/TRBSummit2012.htm

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


March 2012 EMSSF TRB Synopsia Webinar

USA Ambulance Standards & Testing

- AMD-001-025: Manufacturing Guideline
- ASTM F2020-02a: Standard Practice

Ambulance Standards and Testing

- Interrelated – mostly paraphrasing each other’s requirements
- Self certified

International Ambulance Design Safety and Occupant Protection Standards

In existence since 1999
- Australia – ASA
- Europe - CEN

USA Ambulance Standards & Testing

- No dynamic or impact test
- No automotive test manikin
- Mandates NO ‘crumple zone’
- No impact tested anchorages for occupant or equipment
- Internal, not independent & not a standardizing body


USA Ambulance Manufacturing Division (AMD)

Ambulance Standards – August 2007 (being integrated into NFPA 1917)

- No dynamic or impact test
- No automotive test manikin
- Mandates NO ‘crumple zone’
- No impact tested anchorages for occupant or equipment

AMD ambulance ‘safety testing’ ? – IS NOT consistent with accepted automotive safety practice...

Yes a “nationally recognized testing lab” – BUT - NOT an automotive/occupant safety crash test lab!!
The Laws of Physics Prevail...

No ‘a’… then NO ‘F’ !!!!!

- \( F = ma \)

where 
\( F \) – force 
\( m \) – mass 
\( a \) – acceleration

No ‘a’… then NO ‘F’ !!!!!

F = ma

where F – force
m – mass
a – acceleration

AMD 2007 - 025 ‘static
occupant safety testing’ - Compared with -

Accepted automotive
safety dynamic occupant
testing

AMD 2007 - 025 ‘static
occupant safety testing’

- Compared with -

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testing

NFPA 1917, August 2012
(based on KKK, AMD)

NFPA 1917 - Test Methods

NFPA 1917 Testing Criteria

- AMD Standards incorporated
- Side load testing types I and III
- All adjustable seats must be
dynamically tested to SAE J2917
- Seat belts for side facing seats tested to
FMVSS 210

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NFPA - Key issues identified by
EMS Safety Foundation

- Key that meaningful safety data drive the
process
- Need for ambulance safety, injury and
fatality mechanism outcomes data be used
- Integration and collaboration with technical
automotive occupant protection and
crashworthiness expertise is paramount

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SAE Ambulance Equipment
mounting testing standards
Frontal Impact SAE 2917, published May 2010
Side Impact SAE 2956, published June 2011

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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

Absence of standards and oversight

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

USA EMS

- EMS Systems - >19,000
- Personnel - ~1 million (~30% F/T professional & 70% volunteer)
- Vehicles - ~80,000
  (Type I, Type II, Type III, Freightliners, motorcycles)
- Transports - ~30 million
  (to Emergency Depts ~ 50%, < 1/3 emergent)
- Cost - ~$8 Billion annually
- Safety Oversight - ? Disparate

USA EMS transport safety data estimates

- ~80,000 vehicles
- ~9,000 crashes a year
- ~1 fatality each week

USA Occupational transportation fatalities...


Predictable risks

- Fatal crashes more often at intersections, & with another vehicle (p < 0.001)
- 70% of fatal crashes EMS crashes during Emergency Use*
- Most severe & fatal injuries occurred in rear (OR 2.7 vs front & 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 injury
- More likely to crash at an intersection with traffic lights (37% vs 18% p<0.05) & more people & injuries/crash than smaller sized vehicles##

EMS Transport General Concerns

- 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

USA Occupational transportation fatalities...


Is there an acceptable rate of morbidity and mortality for pre-hospital transport systems??
and what is killing EMS?
USA 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


** 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

FMVSS exempt......

August 2009 – Impaired...

Training... effectiveness...??

September 25, 2012

Safe Systems Approach

Systems safety of:
- Getting you, your patient and equipment in and out of the vehicle
- Providing patient care inside the vehicle
- Occupant protection in crash and near miss situations
- Public safety
Occupant Safety in EMS is driven by both operational and biomechanical systems. Systems Safety integrating these two issues is key. There is interaction of occupants with the system, with each other and with available seating options and vehicle interior, equipment and operational tasks.

Safety Performance
- Measurement
- Outcomes
- Technical expertise

Some new dimensions
- Vehicles – smarter, sleeker, safer – CHEAPER!
- Operations – new technology tools
- Interdisciplinary infrastructure – new global platforms

Safety of the...
- Provider
- Public
- Patient

Safety is a tool to save
- Lives
- Time
- Money
  must be evidenced based

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

When is it safe to do what...?
- What are your policies???
  - If your patient is pink, warm and talking?
  - Are you required to notify the driver if you are out of your seat belt?
  - Are ‘routine procedures’ putting you at risk?

What is a safe speed and how do we identify that?

What is a survivable impact?
12 mph (20 km/hr)?
What is a survivable impact?

\[ E = \frac{1}{2} m v^2 \]

\[ v^2 = 2as \]

\[ \text{IRMRC} \sim 30 \text{ mph} \text{ – survivable} \]

\[ \text{IRMRC} \sim 60 \text{ mph} \text{ – not survivable} \]

A survivable impact??

A serious problem…

A few key words about restraint systems…

Dynamic Sled Testing of Ambulance Pediatric Restraints (a resident research project)

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

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

Impact residue

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

‘Workplace’ Hazards

Bigger is not necessarily better……..

NOT new technical data…

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

Beware some provider restraint systems are dangerous

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

PPE from the stationary environment can be highly hazardous in the automotive setting

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

XX

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

XX

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

575x25
High speed crash, rolled and the occupants (patient and medics) had only minor scratches

Thank you!
Any Questions??
Electronic handout available online
http://www.objectivesafety.net