The Ride of your life?
Ambulance Transport Safety Essentials

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CEO, Objective Safety, New York, USA
Chair, TRB, EMS Subcommittee, National Academies

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

This lecture is sponsored by the -

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
Who am I?

- Nadine Levick MD, MPH
- Emergency Medicine Physician and Public Health Academic, USA-Hopkins, Columbia SUNY & Australia – Royal Melbourne, Royal Childrens Hospital, 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

Science behind Policy

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

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

Science behind Policy

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  Richard P. Feynman 1988

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

Balance of concerns and risk during transport

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

- Provider
- Public
- Patient

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)

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

It does happen….

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

So

- What’s important
- What’s not important

Letter to Abe Lincoln – 1864 re: safety of ambulance design

1864 Ambulance Design Patent and diagrams
Almost 150 years ago
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?

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

Who writes vehicle and occupant safety standards??

- FMVSS
- SAE
- CEN
- FDA
- ASI
- SAE
- ISO
- MKK – only ambulances
- FMVSS – only ambulances
- ASTM – only ambulances
- NFPA – for fire trucks and now ambulances
- Health Care providers – MARYN report

As well as epidemiological injury data
August, 2011


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ESV July 2009

USA AMBULANCE CRASH REHAB REAR IMPACT TESTING

NHTSA/NTSB/EVOC

Kahn, Pirrallo, Maguire, Hunting, Smith, Levick, Becker, Zaloshnja, Levick, Li, Miller, Weiss, et al

MMWR
NIOSH, CDC

De Graeve, Deroo, Calle, et al

Ray

Kupas

Woodward, Fleeger et al

Johnson, Lindholm, Dowd

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Johnson, Lindholm, Dowd
Opening Address: A.J. Heightman
Safety Developments Update – N. Levick
Research needs assessment forms explained – E. Frazer
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

The 2012 TRB EMS Safety Summit
print this page & your smart phone will play the 8 sessions from the eTags! (even in B&W)

4: New systems safety technology solutions & telematics
5: Fleet management strategies
6: Innovative Vehicle Design
7: Operationalizing Safety
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Wrap-up – from Prof. Art Cooper

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

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

The science of Stretcher lifting & loading

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

http://www.emssafetyfoundation.org/2012TRBSummitAgendawithLinks.pdf
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/Ferno
- FleetEyes – Intermedix
- Zoll rescuenet and road safety fleet management systems
- Marvits
- 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

USA Ambulance Standards & Testing

- KKK A 1822F: Purchasing Guideline
  - “Minimum Specification and performance parameters”
- AMD-001-025: Manufacturing Guideline
- ASTM F2020-02a: Standard Practice

Ambulance Standards and Testing

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

March 2012 EMSSF TRB Synopsis Webinar
http://www.emssafetyfoundation.org/Recorded2012March19ICTEPPreWebinarlogininfo.htm

Click here www.youtube.com/watch?v=avFjl06bYcY or scan this eTag to see it on You Tube

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Ambulance Standards and Testing

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- Self certified
International Ambulance Design
Safety and Occupant Protection Standards
In existence since 1999
- Australia – ASA
- Europe - CEN

USA KKK ambulance purchase specifications
to retire October 2013
- Specifications for purchase of 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
- Voluntary

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
- Internal, not independent & not a standardizing body

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

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

NFPA 1917, August 2012
(based on KKK, AMD)
NFPA 1917 - Test Methods

- 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

NFPA 1917 Testing Criteria

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

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 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

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

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
- ~ One fatality each week
- ~ 23 pedestrians or occupants of other car
- ~10 serious injuries each day
- Cost estimates > $500 million annually

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)**
- 42% 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##

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

Design of interventions to mitigate injury is predicated on a valid testing model

Complex both engineering and public health issues

USA Occupational transportation fatalities...

WE HAVE A BIG PROBLEM HERE


FMVSS exempt.......

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

August 2009 – Impaired...
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

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

Golden Hour – not so hot
- March 2010
  Annals EM
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.]

Golden Hour Summary

- Going fast can hurt your patient clinically!

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

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 survivable impact?

- IRMRC
  - What is a survivable impact?
  - $E = \frac{1}{2} mv^2$
  - $v^2 = 2ax$

E = ½ mv²

- 12 mph (20 km/hr) - survivable
- ~ 30 mph - survivable
- ~ 60 mph – not survivable

What is a survivable impact?
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

During impact

CTD dynamics

It does happen...

But what about head protection?

New EMS helmet prototypes

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

Systems safety failure AND dangerous

NOT new technical data...

Beware some provider restraint systems are dangerous

Being seated IN an automotive seat is what will protect you

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
Safety is Good Business

Are you self insured???

Very Scary insurance data – the $10 million dollar EMT

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Workers Compensation Rate increased by 27%

Expensive…..

Very Expensive

EMS CANNOT Afford to keep paying out like this….

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

Dry Stopped at 176 feet
Wet Stopped at 220 feet

Perception time + Reaction time + Vehicle braking time

* Stopping distance: Perception time + Reaction time + Vehicle braking time

Key elements to safety
- 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

Rules/Policies Addressing Known Hazards
- Federal Motor Carrier Safety Administration (FMCSA)
  – Cell phone use – November 2011
  – Hours of Service – December 2011
Federal Motor Carrier Safety Administration - FMCSA
* http://www.fmcsa.dot.gov/

Nov 2011, Hand Held Cell Phone Ban

Dec 2011, New FMCSA Hours of Service

Safe Practices for Motor Vehicle Operations
ASSE/ANSI Z15.1 2012

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

New Safety Data
- TRB 2012
- 2011 National EMS Assessment
- 2011 NFPA
- TZD EMS
- NCHRP 17-51
- FARS/MMUCC
- NEMSIS
- BLS

National EMS Assessment

Increasing focus
- TRB - ANB10(5)
- RITA/ITS/DOT
- Traffic Records Forum
- DHS/NIST/NIOSH
- TIMS
- ASSE
- SAE
- EMS Safety Foundation

A lot is now possible and for less!
- Driver behavior
- Vehicle behavior
- Roadside ITS
- Fuel consumption/Economics
- Resource modeling
Fleet Management technologies
- Zoll rescueNet and roadsafety fleet management systems
- ACETech/Ferno
- FleetEyes – Intermedix
- Marvis
- Telematicus
- Priority Dispatch
- Optima
- Northrop Grumman

Transport performance
- Driver training?
- Real time safety performance outcomes?

What about changing driver behavior in the real world??

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

Human Interface approaches -
- Hardware fitted to the vehicle
- Non hardware App Driven cellular technology

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

Zoll Online – RescueNet Road Safety

ZOLL systems

Fleet Safety Solutions
Ferno Acetech

ACETECH. Web
- Mapping, reports, alerts, hotspots, vehicle data

Niagara EMS
Decrease in Speeding Infractions

Fleet eyes

Telematicus
- GPS and GPRS status
- A smart phone App that is a safety tool
- Driver and vehicle ids

Fleet Management capability
- Vehicle database
- Individual vehicle data
- Fleet mileage collection/Checklists
- Link to other systems (ERP, Fleet)

Maintenance & Service Plans
- Repair history & scheduling
- Action planning

Reporting
- Export to Excel for manipulation
- Scorecard views, Crystal Reports
- Direct feedback

Optima
 Demand/Resource analysis and modeling and base location planning

Northrop Grumman
**Operationally Demonstrated**

These technologies:
- Realized dramatic sustainable change in drivers’ attitude toward safety
- Provide evidence-based data to use for individual driver training and refresher courses
- Able to identify drivers that fail to align themselves with our mission of safety

**Marvlis**

- The dashboard calculates:
  - Current percent of demand coverage
  - Three closest vehicle recommendations for recent incidents
  - Realistic travel time estimates for each possible responder

**Priority Dispatch**

**Creating a Safety Culture**

- Within a company, safety must have leadership and support of upper management
  - Awareness
  - Training
  - Incentive

**Key elements to transport safety policies**

- Vehicle/Fleet Safety
- Occupant protection
- Driver performance monitoring and feedback
- Hours of service
- Driver/provider wellness and fitness
-Driver/provider impairment
- Public safety

**What MUST we do?**

- We MUST stop pretending that this is not an automotive safety occupant protection impact engineering issue
- We MUST stop writing ‘consensus’ policies on disciplines we are not trained in
- We MUST reach out to the technical experts in this field
- We MUST engage the existing technical and safety transport arenas with EMS transport
Which of these two vehicles would you want?

Sprinter v Ford Transit crash test
http://www.youtube.com/watch?v=C3kN6WF5eAA&feature=related

Safety concepts out there now

- Driver feedback technologies
- Tiered dispatch
- Enhanced ambulance vehicle design
- Intelligent Transport Technologies – ITS
- New platforms for interdisciplinary exchange
- New Safety Standards

The newest Oslo Ambulance
Safety

- Vehicle
  - All electronic safety systems:
    - A-ESP, ABS, etc.
  - Crashworthiness:
    - Original chassis
    - Seat belt tensioner
  - Internal passive safety
    - Impact zones
    - No sharp edges
    - Securing equipment

User friendly

- All necessary equipment should be reach from the seats without losing the seat belt

Based on technically sound scientific principles

- The stretcher platform can be moved into 3 different positions

User friendly

- All necessary equipment should be reach from the seats without losing the seat belt
Ergonomic layout and equipment

Flexibility to manage two patients

Podcasts - with Kyle Bates in ‘First Few Moments’
- Latest Podcast - Chris Fitzgerald, our EMS Safety Foundation’s Director of Human Factors and Ergonomics shares some key points on lifting and moving patients and equipment - http://firstfewmoments.com/?p=742
the result of the frequency analysis, green dots mark equipment used every time the ambulance is driven, orange is used every day, red every week and so on.

ESC – Does your ambulance have it??
- ESC helps drivers stay in control when they need to swerve or brake suddenly to avoid an obstacle or turn corners on slippery roads.
- Vehicles equipped with ESC are involved in fewer severe collisions caused by loss of control, resulting in significantly fewer deaths and injuries.

Vehicles equipped with ESC are involved in fewer severe collisions caused by loss of control, resulting in significantly fewer deaths and injuries.

NAEMSP 2012 Safety and Operational Innovation: Integrating Global Best Practice and Interdisciplinary Technical Expertise into Ambulance Design

The Motorcycle Medic

Ambulance Sparing
- In almost ¼ (23.5%) of all motorcycle missions ambulance use was avoided!


The ambulance response vehicle of the future?
Areas of need

- Improvement in use of occupant restraint systems
- Improvement in use of equipment restraint systems
- Policies to minimize transport risks

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

Policy makes a difference...

DOH NYS, 2012
Advisory on patient care in a moving ambulance
www.EMSSafetyFoundation.org/2012-04_NYSAdvisory_on_Patient_Care_in_a_Moving_Ambulance.pdf

Interdisciplinary Innovation Consortium

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

R & D “Ripoff and Duplicate”
- Avoid reinventing the wheel at all costs
- Where are the best practices that we need to transfer knowledge from
Live from Rettmobil 2012
Public Access – www.EMSSafetyFoundation.org

EMS Safety Foundation Live @Rettmobil 2012 on YouTube!!
Click here http://www.youtube.com/watch?v=pR_iZ7ZUanI or scan the eTag below with your mobile device to see Live @Rettmobil 2012 Webinar on YouTube.

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, 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
• Head protection??
• Electronic Driver monitoring/feedback systems appear to be highly effective

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

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
- road and road design
- integrated traffic safety technologies
- scene safety and visibility
- safety data capture
- safety oversight

Emergency Vehicles – Viewer Awareness
For a timely, appropriate and safe response
- Location
- Size
- Shape
- Speed
- Intended path

Policy and practice ignorant of existing technical safety data

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

Figure 1. The sample vehicle used was chosen to avoid any features of color. However, vehicle illumination, road illumination and timing of signals are important (Institute of Transportation Engineers, 1999 & 2004).
June 17th 2008
a paramedic and a patient killed

In this vehicle...

April 30, 2009 - Tennessee

Caution!!!

- Just because it has been 'Tested' does not necessarily mean it has been crash tested – nor that it is crashworthy and/or going to protect you
- Even if it has been 'Crash tested' – it depends upon to which standard, whether or not it is actually safe under real world crash conditions
- Appropriate technical expertise is key!!

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 design, operations and policy
- We must be outcomes driven

this vehicle is safety crash tested by automotive experts

Unlike this vehicle

So….

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

What do we know works...
- Tiered dispatch
- Vehicle Operations Safety Policies
- Ideally, forward and rear facing seating
- If not, use squad bench lap seat belts
- Patient over the shoulder belts
- Securing equipment
- Fleet management electronic technical devices
- Safety awareness
- Cultural change

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

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

Safety Management
- A Safety Culture
- Protective Policies
- Protective Devices
  - To prevent a crash
  - In the event of 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 directions
- Meaningful Goals
- New policies
- New practices
- New standards
- New vehicles
- New technologies

Key future focus
- Data and Recent Initiatives
- Transport Technical science
- Human Factors
- Bridging Diverse Disciplines
- Testing and Standards
- New systems safety technology solutions
- Fleet management strategies
- Innovative Vehicle Design
- Operationalizing Safety

- Innovation
- Collaboration
- Knowledge transfer
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**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.

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**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.

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**Thank you!**

**Any Questions??**

Electronic handout and resources available online: http://www.objectivesafety.net