To quote Steve “Sid” Caesar –
Director IHS ES
“We want everyone to get home safely each day”

Outline

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

Your Interactive Handout awaits you online at...
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

Nadine Levick MD, MPH

- Emergency Medicine Physician and Public Health Academic, (USA & Australia)
- Founder of EMS Safety Foundation
- Chair, National Academies Subcommittee TRB EMS Transport Safety, USA
- Recipient, International Society of Automotive Engineers, Women’s Leadership Award for EMS Safety

- Japan
- Poland
- Italy
- Columbia
- Australia
- Canada
- Palestine
- Saudi Arabia
- Netherlands
- USA
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
► BUT an EMS crash can kill all involved AND wipe out an EMS systems 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?

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

October 2008 JEMS Article “Rig Safety – 911”

Is there an acceptable rate of morbidity and mortality for pre-hospital transport systems??
USA Emergency Vehicles (ground)

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 data
In the USA*

- ~50,000 vehicles
- ~5,000 crashes a year
- ~1 fatality each week
- ~25 pedestrians or occupants of other car
- ~4 child fatalities per year
- ~15 serious injuries each day
- Cost estimates > $500 million annually
- USA crash fatality rate/capita 35x higher than in Australia

*FARS/BTS 2005-6

USA crash fatality rate/capita 35x higher than in Australia

Is it your service’s tragic year?

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

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

- Awareness
- Training
- Incentive

the EMS transport process

- communications/dispatch
- the patient
- restraining device/seat
- transporting device/sheet
- paramedics/transport nurses, doctors & family
- patient monitoring equipment
- clinical care & interventions
- protective equipment
- the vehicle
- the driver/driving skill
- other road users
- the road

A survivable impact??

Tragedy you don’t want to be involved in

Thursday July 5th 2007......
Paramedic Allan Parson’s killed
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
WASHINGTON, DC (AP) — The driver of a tractor-trailer truck was killed when the two vehicles collided on an intercity highway outside Washington, D.C., on Friday morning, the Justice Department said.

The accident was one of several involving emergency medical services this year in the area, and the latest in a long string of crashes in which ambulances have been involved.

The driver of the ambulance, which was carrying two people, was killed in the crash, which occurred on the Howard University campus near the university's main building.

Emergency personnel at the scene said the accident was not a crashworthiness environment.

January 10, 2008
In this vehicle...

January 10, 2008
This is not a crashworthy environment

Jan 28th, 2008

June 17th 2008
a paramedic and a patient killed

AMBULANCE ROLLS, INJURING 4

1 dead, others injured in Sussex crash involving ambulance

1 dead, others injured in Sussex crash involving ambulance
April 14th, 2008

Minnesota - June 20, 2009

February 11, 2009 – North Carolina

October 31, 2008 - Kentucky

April 20, 2008...

October 22, 2009, TN

Patient and Provider killed, Attendant Critical

An interhospital transport

? “Do no harm…”?
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

**National Academies Transportation Research Board’s Ambulance Transport Safety Summit October 29, 2009**

http://www.objectivesafety.net/TRBSummit2009.htm

**October 2009, TRB Ambulance Transport Safety Summit Agenda**

- Session 1: Burden/Benefit - Safety Data
  - Economic
  - Health
  - Safety
  - Risk/Benefit
- Session 2: Transport System Management
  - Fleet/vehicle Operators Safety Operational Management
- Session 3: Vehicle Safety - Assessment and design
  - Vehicles
  - Special Populations
- Session 4: Information Sharing and Policy
  - Knowledge Transfer/Diagrammation
  - Standards/Specifications/Policy
- Session 5: Panel and Research Priorities

**2009 TRB Summit**

http://www.objectivesafety.net/TRBSummit2009.htm

- Brought together a spectrum of diverse expertise and representation:
- 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)
- Teamsters
- EMS State Directors
- EMS Services
  - private and municipal from across North America
  - Fire/EMS
  - Volunteer EMS
- EMS Physicians
- Industry partners
  - EMS Equipment
  - Vehicles, both OEM and aftermarket
- Academics
- Technical experts
  - Automotive safety engineering, occupant protection
  - Ergonomics and human factors.

**The EMS Safety Foundation**

www.EMSSafetyFoundation.org

brings this presentation to you
Italy is a leader

70% of accidents are due to human behaviour (owing to its performances)

FLIGHT SECURITY RULES APPLIED TO AMBULANCE

Ambulance Safety Research: A New Field

We should use the best safety practices demonstrated in engineering

...in automotive safety engineering

2 most recent publications

October SAE – October 2009
and in ergonomics

Range of reach... This is a well defined technical science

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

- EMS Safety
  - 40 papers - on ambulance safety
  - 3 papers - on ambulance ergonomics
  - 1 paper - on stretcher ergonomics

- Computer Workstations
  - 30,000 papers – on ergonomics of computer workstations

- Erectile Dysfunction
  - 100,000 papers – on Erectile Dysfunction

Ambulance Safety Research: A New Field

Funding??

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 standards and oversight

- Challenges in identifying best practice
- Myriad of unregulated commercial products
- No safety performance standards
- Absent national safety oversight
What we need to consider, where is the 'bang for buck' in ambulance transport safety:

Canada - Corporate Manslaughter Corporate Homicide Act: 8th April, 2008

1960 to 2009

A passenger vehicle - sure

A laundry or mail truck?

A passenger vehicle – yes!

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

It does happen....

Paramedic injured in crash is recovering

But what about head protection?

New EMS helmet prototypes for 2008-2009
Ground Transport Safety is complex and multidisciplinary. Epidemiological data collection, ergonomic research, public safety, transport policy, PPE, driver training, and fleet safety program are all components of transport safety.

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

Goals

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

Ambulance Vehicle Standards??
- KKK?
- AMD?
- FMVSS?
- NFPA?
- SAE...?
- International
  - ASA
  - CEN

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

USA KKK ambulance purchase specifications


- 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
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

2009 USA ambulance ‘safety testing’ ??!
- Not consistent with accepted automotive safety practice...

USA Ambulances: FMVSS Exemption

Australia & New Zealand Ambulance restraint standard AS/NZS 4535:1999
- "Restraint systems shall apply to all equipment and people carried in an ambulance…"
- Dynamic Testing - 50th & 95th percentile manikins
- 24G in Forward and Rearward
- 10G in Transverse

- "Without exception, all persons, medical devices, equipment, and objects normally carried on the road ambulance shall be maintained to prevent them from becoming a projectile when subject to a force…"
- 50th percentile manikins - 10 G in Forward, Rearward, Transverse, & Vertical directions
- Certified by Notified Body and Ambulance Mfg.

EMS Best Practice, Sept 2006

Safe Practices for Fleet Motor Vehicle Operations
- Patients must be in the over the shoulder harness, medics restrained in seat belts, equipment secured

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

Balance of concerns and risk during transport
- Response and transport time
- Clinical care provision
- Occupant safety/protection
- Public Safety

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

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

Testing the real world

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

..(varies with age, skill, agility, alertness + vehicle type, tire pressure, road etc)
The Crash Event - Crash Testing

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

Intrusion vs Deceleration

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

Dynamic Safety Testing

- requires sophisticated, expensive equipment
- measurably demonstrates forces generated during collision
- accepted international standard for vehicle restraint systems

Dynamic Sled Testing of Ambulance Pediatric Restraints

If we know this – and it’s published...


Why do we do this?

Test 1 – Right side impact

What is actually happening during an ambulance crash

[Images of ambulance crash testing]
And this all takes place in 60 millisecs – the blink of an eye

And now for some MYTH BUSTING

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

A few key words about restraint systems...

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

NOT new technical data...


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

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 for side-facing occupants are potentially lethal – and is in NO WAY SUPPORTED BY ANY DATA OR AUTOMOTIVE SAFETY EXPERTISE

Rash of “Safety Concept” vehicles.....

Devoid of substantive automotive safety engineering input or testing

- 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

Yes, the ride of your life....

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

Airbags ....??

Absent safety testing standards, any meaningful crash or injury mechanism data or effective occupant positioning – rear compartment airbags are likely to be hazardous

Increasing awareness ...

What do we know now??

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

Innovation

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

Safety concepts out there now
What about changing driver behavior in the real world?

The “Feedback Box” - A transportation safety monitoring and feedback device

Purpose of ‘Feedback Box’ Program

How the Device Works

Video Demonstration

Demonstrated Effectiveness

A key to safe ambulance transport

Extensive Indirect cost savings
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??

The jury is out on
- Opticon
- Simulators

Resource availability and allocation technologies

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???

It isn’t like this outside of the USA
News we don’t want to see

Caught On Video: EMT Struck By Car

News Media

© 2011 EMTM. The car hit the rear of the EMT’s vehicle on the night shift. The EMT was hit by a car on the night shift. The EMT was hit by a car on the night shift. The EMT was hit by a car on the night shift. The EMT was hit by a car on the night shift. The EMT was hit by a car on the night shift. The EMT was hit by a car on the night shift. The EMT was hit by a car on the night shift. The EMT was hit by a car on the night shift. The EMT was hit by a car on the night shift. The EMT was hit by a car on the night shift. The EMT was hit by a car on the night shift. The EMT was hit by a car on the night shift. The EMT was hit by a car on the night shift. The EMT was hit by a car on the night shift. The EMT was hit by a car on the night shift. The EMT was hit by a car on the night shift. The EMT was hit by a car on the night shift. The EMT was hit by a car on the night shift. The EMT was hit by a car on the night shift. The EMT was hit by a car on the night shift. The EMT was hit by a car on the night shift. The EMT was hit by a car on the night shift. The EMT was hit by a car on the night shift. The EMT was hit by a car on the night shift. The EMT was hit by a car on the night shift. The EMT was hit by a car on the night shift. The EMT was hit by a car on the night shift. The EMT was hit by a car on the night shift. The EMT was hit by a car on the night shift. The EMT was hit by a car on the night shift. The EMT was hit by a car on the night shift.
The multicolored (patterned) ambulance, while distinctive, may suffer decreased conspicuity because of the effects of camouflage.

De Lorenzo & Eilers, Annals EM 1991

Color-blindness affects 10% of the population.

As seen with normal vision

As seen with color blind vision

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.

Summit County EMS - Colorado

Old vehicle

New yellow vehicle markings

Staff use lime-green vests & jackets

Muskoka EMS - Canada

Old design

New design

Muskoka EMS - Canada

Old design

New design

Muskoka EMS - Canada

Old design

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

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.

EMS Safety Foundation Delegation bringing Rettmobil to you

Wayne Zygowicz, Advisory Board, Littleton Fire/EMS, Colorado & JEMS


Vehicle Occupant Safety design

Safe and Ergonomic design
Ergonomic layout and equipment

Awkward tasks? Develop solutions!

Flexibility to manage two patients

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

Sprinter Features Summary
Market Exclusives

- Available left side sliding door
- Premium CDI turbo Diesel engine with SCR technology to meet the EPA / CARB 2010 emission standards
- Best in class cargo capacity
- Best in class wall-to-wall turning diameter
- Best in class available payload capability
- Superior safety standard with ABS, ASR, BAS, ESP and 3-point seat belts on all passenger seats
- Most versatile commercial van on the market

Safety first - Passive Safety

Sprinter v Ford Transit crash test

Operating in an environment where many aspects of safety are still devoid of safety standards – requires technical knowledge and understanding
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?

Were we safer in the Cadillac???

Fleet Mix?

“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

National Academies TRB
Ambulance Transport Safety Summit
October 29, 2009

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

What do we know works...
- Vehicle Operations Safety Policies
- Squad bench lap seat belts
- Patient over the shoulder belts
- Securing equipment
- Forward and rear facing seating
- Some electronic technical devices
- Safety awareness
- Cultural change

Important Principles!
1. A culture of safety
2. Drive cautiously
3. Wear your belts & restrain all occupants
4. Secure all equipment
5. Integrate scientific data into your policies and procedures
   - Unrestrained occupants and equipment are a potential injury risk to all occupants

Very Important Principle
Ambulance transport safety is part of a SYSTEM, the overall balance of risk involves the safety of all occupants and the public

Conclusion
- EMS transport has serious hazards and safety issues
- Major advances in EMS safety research, infrastructure and practice over the past 5 years
- New technologies for vehicle design, occupant PPE and equipment restraint and driver performance are now available
- Development of substantive EMS safety standards is a necessity and a reality
- 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 safety and occupant protection

And....
- It is no longer acceptable for EMS to be functioning outside of automotive safety and PPE safety standards for prevention of and protection of EMS providers and the public from injury and death

PREDICTABLE PREVENTABLE and NO ACCIDENT
Thank you!

Any Questions??

Electronic handout available online

http://www.objectivesafety.net