Ambulance Transport Safety: Everything You Really Need to Know

To quote Steve "Sid" Caesar – Director IHS ES

“We want everyone to get home safely each day”

http://www.objectivesafety.net

Firstly!

▶ An accident?
▶ or a predictable and preventable event

A tragic emergency health care intervention outcome

Creating a Safety Culture

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

▶ Awareness
▶ Training
▶ Incentive

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……

Safety - Why now?

▶ Operating optimally in a transportation environment that is largely devoid of specific safety standards for the hazards and risks present
▶ Bridge the gap between what technical information exists and what is accessible and applied to EMS
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.

New Information 2006-2008

- Enhanced Safety of Vehicles (ESV), June 2007
- American Society Safety Engineers (ASSE), June 2006 & June 2007
- International Ergonomists Association (IEA), June 2006
- Transportation Research Board – EMS Safety address, Jan 2007
- AMD Engineering Public Comments, October 2007
- OSHA September 11, 2007 Federal Register
- OSHA EMS best practices late 2008
- OSHA EMS best practices late 2008
- OSHA Emergency Responder Round Table March 2008
- OSHA EMS best practices late 2008

Very Important Principle

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

June 17th 2008

a paramedic and a patient killed

June 17th, 2008

a paramedic and a patient killed

Thursday July 5th 2007……

Paramedic Allan Parson's killed

Friday July 20th 2007

The worst ambulance crash in USA history

In this vehicle...
2 counts of vehicular homicide... November 5, 2007 - PA

An interhospital transport? "Do no harm..."?

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.

Unique workplace

- In vehicles
- At roadside and other emergency scenes

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:

1960 to 2007

A passenger vehicle - sure

A 'laundry or mail truck' - ??

Some recent adverse outcomes

UPS and Laundry trucks have very similar design and even more stringent safety requirements to EMS vehicles BUT very different cargo......

People are passengers and NOT packages or parcels
Some odd facts
- Ambulances are generally not built by the automotive industry.
- Intelligent Transportation Systems (ITS), transportation safety engineering is not generally integrated into EMS systems.
- Although all EMS systems have medical direction and oversight, it is rare for there to be transportation expertise oversight.

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.

Ground Transport Safety IS Complex AND Multidisciplinary

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

The EMS transport process
- communications/dispatch
- the patient
- restraining device/seat
- transporting device/vehicle
- 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

USA EMS data
- In the USA*
  - ~50,000 vehicles
  - ~5,000 crashes a year
  - ~1 fatality each week
  - ~15 pedestrians or occupants of other car
  - Approximately 4 child fatalities per year
  - ~10 serious injuries each day
  - Cost estimates > $500 million annually
- USA crash fatality rate/capita 35x higher than in Australia

*FARS/BTS 2005-6
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 killing EMS?

EMS personnel fatalities:

- 74% transportation related
  - 1/3 of ground transport fatalities were struck by moving vehicles
- 11% were cardiovascular
- 9% were homicide
- 4% needle sticks, electrocution, drowning and other


"Ambulance transport has a death toll....."

Carl Craigle EMT-P, Chief Platte Valley Ambulance
Colorado Springs, April 2007

Clinical Care?

Occupational Health and Safety.....?

- This IS a Transportation and Automotive Safety issue
- This is a Systems safety issue

Safety is Good Business

June 2007

A problem

2007 Insurance data –

- 27 fold more likely to have a claim based on transport than related to medical care
EMS CANNOT Afford to keep paying out like this....

A number of potential interventions to enhance safety have been identified:
- Safety Policy
- Safety performance standards
- Vehicle crashworthiness
- Vehicle interior ergonomics
- Personal Protective Equipment design
- Driver selection, training and simulation
- Safety and risk awareness modification
- Risk behavior modification
- Intelligent Transportation Systems (ITS)

Benefit of Safety
- Safe practices save lives, time and money

This is about you and your safety
- What safety practices do you use??
  - Seat belt?
  - EVOC training?
  - Equipment lock down?
  - Helmets?
  - Driver Feedback technology?
  - Tiered dispatch?

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

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

Ambulance Safety Research: A New Field
- Engineering
- Ergonomic
- Epidemiology

Increasing awareness ...

EMS Best Practice, Sept 2006
It does happen....

But what about head protection?

New EMS helmet prototypes for 2008

Problems
- No Standards
- Unique safety and hazard protection needs
- A number of less than appropriate devices out there

EMS has unique head protection needs – not well met by a ‘truncated’ fire helmet...

Dynamic vs. Static Safety Testing

Dynamic Safety Testing
- Requires sophisticated, expensive equipment
- Measurably demonstrates forces generated during collision
- Accepted international standard for vehicle restraint systems

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 – i.e. sled test

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


Full Vehicle Crash Testing

Test 1 – Right side impact

Johns Hopkins University

- Target vehicle, Type I ambulance
- Bullet vehicle, Type II ambulance

Closing speed 44 mph

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

NIOSH Ambulance Occupant Safety Crash Testing

Impact Direction
25 MPH /

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

Ambulance Standards??
- KKK?
- AMD?
- FMVSS?
- NFPA?

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
- Voluntary

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

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

AMD – static ‘safety testing’
- Inconsistent with automotive safety principles – and specifies that a ‘successful test’ is -
  - 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.

Occupant protection......??
July 2007

KKK certified and FMVSS exempt..?
No ‘a’… then NO ‘F’ !!!!!

\[ F = ma \]

where

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

USA Ambulances:
FMVSS Exemption

NFPA Ambulance Standard Development

- NFPA Ambulance Standard Development Public Comment
- The Public Comment period for the development of the new NFPA Ambulance Standard – is open until October 15, 2008

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

A few key words about restraint systems...

NOT new technical data...

NIOSH Ambulance Occupant Safety Crash Testing

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

Side facing 4-point harnesses demonstrated to be lethal, even at slow ground vehicle speeds
Rash of "Safety Concept" vehicles...  
Devoid of substantive automotive safety engineering input or testing

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

Innovation

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

The Driver
- Driver selection  
- Driver monitoring and feedback  
- Driver Impairment  
- Driver training

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

What about changing driver behavior in the real world??

Purpose of ‘Feedback box’ Program
- Enhance Safety  
- Improve Driver Performance  
- Save Maintenance Dollars  
- Aid Accident / Incident Investigation

How the Device Works
- Computerized monitoring device installed on each vehicle to measure parameters  
- Each driver has individual key “fob”  
- Data collected every second  
- Auditory feedback of warning ‘growls’, and penalty tones  
- Data downloaded automatically every day
Demonstrated Effectiveness

MEMS MONTHLY OVER SPEED VIOLATION TREND 2003/2004

216,922
550,353
2,074 1,609
285 547
4,046
207 407 710 780
3,069
1,004 1,657 2,790

Series 1

Mar
Apr
May
June
July
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October
November
December

A key to safe ambulance transport

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.

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

The EMS Safety Foundation
Intro and Logistics Webinars from December 11th 2007 & Jan 8th 2008
EMS Safety Foundation tab at www.objectivesafety.net

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.

Vehicle Occupant Safety design
2008 European design
Safety technology is a key focus.
Ergonomic design
One patient or Two patients and you can reach both AND your equipment...
a fleet based initiative

Flexibility to manage two patients
Ergonomic layout and equipment

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???

Other successful models
American National Standard
ANSI/ASSE Z15.1-2006
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

Use proven safety tools

NAEMT July 2006 Position statement

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

News we don’t want to see
Caught On Video: EMT Struck By Car

Worker visibility Act:
Help is on the way!! November 24th 2008

Visibility and lighting issues

Policy and practice ignorant of existing technical safety data

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Under Way...
Emergency Vehicle Visibility and Conspicuity Study

- Funded by the USFA
- Conducted by IFSTA
- Looking at the effectiveness of reflective markings used on emergency vehicles
- Doing best practice research and working with manufacturers

This looks cool AND SAFE!

- Having access to that technical knowledge supports changes to improve safety practice
- Operating in an environment where many aspects of safety are still devoid of safety standards – requires technical knowledge and understanding

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

R & D
“Ripoff and Duplicate”

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

Integration and Collaboration
State Strategic Highway Safety Plans
- Required as part of the SAFETEA-LU legislation
- (Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users)
- Effective October 1st 2007
- Focus is the 4 'E's
  - Engineering
  - Education
  - Enforcement
  - Emergency Medical Services
- EMS is a core theme

Ambulance Safety Summit
November 7th, 2008
- EMS Transportation Safety Subcommittee of the National Academies Transportation Research Board (TRB)
- Onsite panel of invited technical experts, in addition to policymakers and EMS leaders.
  - Safety data capture
  - Transport fleet management, EMS vehicle operations
  - Automotive safety and occupant protection
  - Ergonomics and human factors
  - Standards
- Will be beamed live via Webinar and recorded electronically and TRB e-circular produced
- Access to live participation requires pre-registration
- Pre-registration info disseminated in early October

TRB Jan 2009 EMS Subcommittee Meeting and Seminar
- The Subcommittee on EMS Transportation Safety of the National Academies Transportation Research Board winter subcommittee meeting and seminar is in DC during the 2009 January TRB symposium
- Your input and participation (onsite or online) is valued
- You can submit your suggestions/input for the TRB EMS Subcommittee meeting online -
  - http://www.emssafetyfoundation.org/TRBpriority.htm

New NHTSA EMS info link
- There is a new Federal link to EMS info – a great resource!
  - www.EMS.gov

www.GlobalEMSForum.org
“Running Hot or Not” – Sept 27th, 9.30am EDT
Previous Visibility and Standards Webinars

October 2008 JEMS Article
“Rig Safety – 911"

No need to reinvent the wheel...

March 2007 - FHWA
Tips for Emergency Vehicle Operations
USFA Emergency Vehicle Safety Initiative

Traffic Incident Management Systems (TIMS)

Risk/Hazards

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??

Safety Management

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

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

What you can do now
- Have a written and implemented ‘safety program’
- Secure all equipment
- Secure occupants with standard belts
- Don’t drive through red lights/stop signs
- Use properly implemented “Feedback Boxes”
- Monitor crash events with common denominators (i.e. per 100,000 miles and per trip)

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
small changes can make a BIG DIFFERENCE

PREPARE – TEACH – REACH – RESPOND
- Look at your own safety record
- Teach safety and hazard awareness
- Reach out with safety information to all your EMS providers
- Respond with the best safety practices

PREDICTABLE PREVENTABLE and NO ACCIDENT

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

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