Ambulance Transport Safety -
What You Can't Afford
Not To Know

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

FASNY, EMS Seminar,
Stonybook, Long Island,
February 2nd, 2008

Paramedic critically injured
November 7, 2007

And Nov 10th's 2007 obituary…

Jan 18th, 2008

Part of Intensive Care Unit after Ambulance
Crash.

Jan 23rd, 2008

1 dead, others injured in Sussex crash involving ambulance

A few weeks ago…

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

Thursday July 5th 2007......

Friday July 20th 2007...
The worst ambulance crash in USA history

Five Killed In Crash of Ambulance and Semi

July 21, 2007 06:10 AM EDT

Last updated: July 21, 2007 06:43 AM EDT

Another tragic scene unfolded on the New York State Thruway today as another ambulance crash was involved in an accident.

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

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

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

Firstly!

An accident?

or a predictable and preventable event

Testing the real world

Charged with Vehicular Homicide

As he had been trained to do...??

2 killed, 3 injured....
September 23, 2007 - PA

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

An interhospital transport? “Do no harm…”?

Outline

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

EMS Transport Safety

- ‘patient safety’
- AND also
- ‘provider’ and ‘public safety’

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

the EMS transport process

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

An ambulance is not an ED / ICU on wheels

Ground Transport Safety IS Complex AND Multidisciplinary

- Epidemiological Data Collection
- Risk Management
- Public Safety
- Transport Policy
- Driver Training
- PPE
- Safety Technology
- Regulations and Standards
- First Safety Program

Ergonomic Research

Biomechanical Automotive Safety

Research/Other Research

Safety Technology

Repetitive and Standard
National EMS data

- In the USA*
  - ~50,000 vehicles
  - ~5,000 crashes a year
  - One fatality each week
  - 2/3 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

Is it your service’s tragic year?

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

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**
- >74% of EMS occupational fatalities are MVC related***
- Serious head injury in 45% 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#

Absence of standards and oversight

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

1960 to 2007

- A passenger vehicle - sure
- A 'laundry or mail truck' - ?
- A passenger vehicle – yes!

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

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

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

and who's life was he racing to save?

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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

Clinical Care?
Occupational Health and Safety.....?

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

This is not how you want to see your partner during a transport

'Workplace' Hazards

So does it make sense?

Gloves and universal precautions?.... good biohazard protection BUT aren't going to give much protection in a ambulance crash

Benefit of Safety

Safe practices save lives, time and money

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

This is about you and your safety

- What safety practices do you use??
  - Seat belts?
  - 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

It does happen....

But what about head protection?

- 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

Role of a head protective device

New EMS helmet prototypes for 2008

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???
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

- Perception + Reaction time + Vehicle braking time

<table>
<thead>
<tr>
<th>Condition</th>
<th>Stopping Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry</td>
<td>176 feet</td>
</tr>
<tr>
<td>Wet</td>
<td>220 feet</td>
</tr>
</tbody>
</table>

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

What are the solutions?

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

The Driver

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

R & D

“Ripoff and Duplicate”

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

Air EMS is a role model for safety initiatives and focus

Transportation Research Board is an excellent resource... we should be using it!!

IAFC June 2007
Integration and Collaboration

No need to reinvent the wheel...
USFA Emergency Vehicle Safety Initiative

VFIS Summer 2006
Tips for Emergency Vehicle Operations

An excellent model
http://www.everyonergoeshome.com

Coming Soon!
Traffic Incident Management Systems (TIMS)
- USFA report to be released any day
- Research and writing by IFSTA
- Covers setting up safe roadway incident work areas and using unified command at these incidents
- Will be available in a downloadable format

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

If we know this – and its published....

Test 1 – Right side impact


Johns Hopkins University

Test 1 – Right side impact

Impact Direction
25 MPH

Full Vehicle Crash Testing

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

NIOSH Ambulance Occupant Safety Crash Testing

Fire Service Emergency Vehicle Safety Initiative – Phase II

Developed an innovative web based emergency vehicle safety educational program to support the volunteer fire service in partnership with the NVFC:
http://www.nvfc.org/evsp/index.html

Risk/Hazards

- Predictable risks
- Predictable fatal injuries
- Serious occupational hazard
- Public safety hazards

NIOSH Ambulance Occupant Safety Crash Testing

Impact Direction
25 MPH

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Risk/Hazards

- Predictable risks
- Predictable fatal injuries
- Serious occupational hazard
- Public safety hazards
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

Policy makes a difference...

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

What about changing driver behavior in the real world??

American National Standard
ANSI/ASSE Z15.1-2006
Safe Practices for Fleet Motor Vehicle Operations

EMS Best Practice, Sept 2006

Safety concepts out there now
- Fleet Safety Management
  - Z-15
  - Driver monitoring and feedback
- Enhanced ambulance vehicle design
- Intelligent Transport Technologies - ITS
- Visibility and Conspicuity
- New Safety Standards
- Life Safety Initiatives
- Resources and information

NAEMT July 2006 Position statement
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
    - including: vehicle speed and performance, driver behaviors and emergency mode
  - Auditory feedback of warning ‘growls’, and penalty tones
  - Data downloaded automatically every day

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 you tube??

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??

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

There are grants to assist you..
Recent Visibility Webinar
www_GlobalEMSForum.org

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

Policy and practice ignorant of existing technical safety data

Very cool – even high visibility hoses!!

This looks cool AND SAFE!

From this…. to this

Not rocket science..

Very cool !!!
Day visibility

Night visibility

Safety Management

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

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

USA Ambulances: FMVSS Exempt

- To prevent a crash
- In the event of a crash

Continuous Education and Evaluation

\[ \text{To prevent a crash} \]

\[ \text{In the event of a crash} \]

To prevent a crash

In the event of a crash

Occupant protection......??

July 2007

KKK – static ‘safety testing’

- Ignorant of 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.

Unacceptable, and ridiculous current 2007 USA ambulance ‘safety testing’ practices !??

Unacceptable, and ridiculous current 2007 USA ambulance ‘safety testing’ practices !??
No ‘a’… then NO ‘F’ !!!!!

\[ F = ma \]

where
- F – force
- m – mass
- a – acceleration

FMVSS exempt……

A few key words about restraint systems……

No new technical data……

NOT new technical data……

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

Increasing awareness …

Vehicle design and safety

- The principles of automotive safety involve a complex science, engineering technical skill, expertise, training and knowledge
- “Give the engineers a working list of our needs and let them tell us how it should be built to accomplish those tasks……”
  

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

Most recent - Attention to vehicle visibility... but failures of occupant protection and systems engineering

Bigger is not necessarily better......

NO automotive safety engineer
NO crashworthiness engineer
NO ergonomist
NO reference to ANY existing or relevant automotive safety or crashworthiness technical publications.... yet multiple occupant fatalities and injuries annually....

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NO ergonomist
NO reference to ANY existing or relevant automotive safety or crashworthiness technical publications....

Innovation

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

Major events for innovation sharing
- but regional and often language isolation
  http://www.rettmobil.org/

Vehicle Occupant Safety design
2007 European design
Safety technology is a key focus
Ergonomic design

Ergonomic layout and equipment

NSW Australian vehicles

Flexibility to manage two patients

Make sure that EVERYTHING is tied down!

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???

Creating a Safety Culture
within a company must start with upper management’s commitment to safety
- Awareness
- Training
- Incentive
Some simple and available solutions out there now
- Intersection Policy
- PPE
- ‘Feedback’ boxes

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

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??

an electronic recording and a .pdf handout of this presentation awaits you online

www.objectivesafety.net