EMS Safety - No More Excuses
What You Can’t Afford
Not To Know

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

Last fortnight’s news…

Paramedic critically injured
November 7, 2007

http://www.objectivesafety.net

Thursday July 5th 2007 ……..

And obituary…

...I’d like to know what can be done
so this never happens again….
Friday July 20th 2007...
The worst ambulance crash in USA history

JAN 21, 2007 08:20 AM EDT

"The worst ambulance crash in USA history"...The tragic story of an ambulance crash in 2007, as reported by the Associated Press. The article discusses the accident and the emergency medical service involved.

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......

Charged with Vehicular Homicide

- Pennsylvania: An ambulance driver was charged with vehicular homicide after a crash in 2007
- "Do no harm..."?

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

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

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

- A vehicle and ambulance collided in Marshall Township, PA, resulting in 2 deaths and 3 injuries.

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

- An ambulance involved in a crash killed 2 people. The medic had been trained to "Do no harm..." but the accident occurred in an interhospital transport.
Firstly!

▶ An accident?
▶ or a predictable and preventable event

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

EMS Transport Safety
▶ 'patient safety'
▶ AND also
▶ 'provider' and 'public safety'

Key Elements to Safety
▶ Data Capture
▶ Vehicle Biomechanics and Crashworthiness
▶ Ergonomics and Biohazards
▶ Transportation Environment
▶ Safety Management – evaluation and analysis

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

The Emergency Department (ED)

An ambulance is not an ED /ICU on wheels
Ground Transport Safety IS Complex AND Multidisciplinary

Epidemiological Data Collection
Ergonomic Research
Biomechanical Automotive Safety
Biomedical/Chem Research
Communications technology

Risk Management
Public Safety
Transport Policy
PPR
Driver Safety

Transport Safety

Regulations and Standards
PPE

Fleet Safety Programs

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 are 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 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

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

1960 to 2007

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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

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

Clinical Care? Occupational Health and Safety…..?

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

‘Workplace’ Hazards

Preventable...

James Woodman
- is a paramedic who, on his first day as a paramedic, suffered a severe TBI when the ambulance he was riding in (in the back) was t-boned and rolled onto its side.
- He remains in a persistent vegetative state in an ECF in Colorado.
- It is assumed that when the ambulance rolled onto its side, the lifepack 10 stuck James in the head....
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


So does it make sense?
- Gloves and universal precautions ...
  - ... good biohazard protection BUT aren’t going to give much protection in a ambulance crash

What do ambulance crashes really cost?
- Loss of life and injury
- Negative impact on EMS system
- Collisions are the largest liability cost and exceeds malpractice or negligence
- Besides the direct financial costs of replacing a damaged ambulance and equipment, there are additional hidden costs incurred:
  - investigating the ambulance collision
  - medical/disability costs of injured EMTs
  - hiring of new employees to replace injured personnel
  - retraining and psychological counseling of personnel involved and others
  - increased insurance rates

A problem
- 2007 Insurance data –
  - 27 fold more likely to have a claim based on transport than related to medical care

June 2007

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

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??

Role of a head protective device

- 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

New EMS helmet prototypes for 2007

Hmm...

But what about head protection?

It does happen....
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

<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 (varies with age, skill, agility, alertness + vehicle type, tire pressure, road etc)

What are the solutions?

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

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

The Driver

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

New Information
- ESV
- ASSE
- OSHA best practices
- KKK-F Public Comments
- Worker visibility Act
- SAFETEA-LU
- (Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users)
- State, Strategic Highway Safety Plans
- State EMS Council Policies

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

Safety is Good Business

Active Projects, July 2007
- Commercial Motor Vehicle Driver Training Curricula and Delivery Methods and Their Effectiveness
- Commercial Motor Vehicle Carrier Safety Management Certification
- The Role of Safety Culture in Preventing Commercial Vehicle Crashes
- The Impact of Behavior-Based Safety Techniques on Commercial Motor Vehicle Drivers
- Health and Wellness Programs for Commercial Motor Vehicle Drivers

July 2007

UPS: The ‘Big Brown’
- No left turns – instead make three rights
- Don’t back up
- Don’t employ any drivers under 25 years of age
- Don’t employ anyone with a history of driving convictions
Valuable information from the transportation industry

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

No need to reinvent the wheel...

USFA Emergency Vehicle Safety Initiative

The Effects of Sleep Deprivation on the Fighters and EMS Responders

Guidelines for Employees in Emergency Vehicle Operations

March 2007 - FHWA

FMCSA - Hours of Service Regulations

Tips for Emergency Vehicle Operations
And this all takes place in 60 milliseconds – the blink of an eye

NIOSH Ambulance Occupant Safety Crash Testing

And keep focus on ‘All hazards’ in addition to crashworthiness

- Driver age?
- Driving history?
- Patient condition?
- Dispatch?
- Vehicle stability?
- Driver feedback technologies?

What’s new

- New expertise and collaborations
- New automotive and transportation safety technologies
- New Information
- New events

Safety oversight of what and by whom

- Vehicle Safety
- Vehicle Design
- Safety Equipment Design
- Vehicle and Safety Equipment Testing and Standard development
- Safety policies

A Simple Question….
Risk/Hazards

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

EMS Best Practice, Sept 2006

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

Z15 Incident Rates

- Incident rate based on number of vehicles operated:
  \[ \text{Incident rate} = \frac{\text{Number of incidents}}{\text{Number of vehicles}} \]

- Incident rate based on vehicle mileage:
  \[ \text{Incident rate} = \frac{\text{Number of incidents}}{1,000,000 \times \text{Vehicle mileage}} \]

- Injury incident rate based on vehicle mileage:
  \[ \text{Injury incident rate} = \frac{\text{Number of incidents with injury}}{1,000,000 \times \text{Vehicle mileage}} \]

- Incident rates based on service activity:
  \[ \text{Incidents per 10,000 transports} = \frac{\text{Number of incidents}}{10,000} \]

- Vehicle injury rates based on work hours:
  \[ \text{Vehicle incidents per 200,000 hours} = \frac{\text{Number of incidents}}{200,000} \]

Systems Safety Engineering - Z.15.....

www.ASSE.org
http://www.objectivesafety.net/TransActions%20Z.15.pdf

Use proven safety tools

NAEMT July 2006 Position statement

Policy makes a difference...
Patients must be in the over the shoulder harness, medics restrained in seat belts, equipment secured

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

WEMSA Leadership

WEMSA – October 2007
1. Emergency Vehicle Operations Policy
2. Vehicle operations training and evaluation
3. A program of graduated driver responsibility
4. Drivers only age 25 and over
5. Complete stop at an intersection
6. Restricted use of Red Lights and Sirens
7. Monitoring of emergency vehicle operations

WEMSA covered some key and important policies and procedures
But…

What about hours of service?
What about visibility at the scene? For providers and the vehicles…?
What about protective equipment?
What about ambulance design safety?
What about reporting of adverse events?

What about changing driver behavior in the real world??

Demonstrated Effectiveness

Change driver behavior
Carrot not stick
Vehicle maintenance improvement
Decreased administrative burden
Insurance benefits

The “Feedback Box” - A transportation safety monitoring and feedback device
This technology is conceptually like a vehicle safety “pulse oximeter” – that with auditory feedback – can save your life, your coworkers life, your patients life, and others on the road

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

Demonstrated Effectiveness

And when a rare crash happens….

Unit 302 Accident

Extensive Indirect cost savings
- Fewer out of service vehicles
- Improved transport times
- Decreased administrative lost in managing unsafe behaviors
- Decreased legal burden
- Automatic system wide data
- Insurance benefits

Demonstrated clearly
- Driver risk behavior can be substantially modified and improved with monitoring device, with real time auditory feedback.

A key to safe transport

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

The jury is out on
- Opticon
- Simulators
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.
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Key Issues

- Mythology
  - The Emergency Medical Service personnel are safe.
- Injury Hazards
  - Radiation
  - Chemical
- Physical/Mechanical issues – THE BIG PROBLEM
- Motor Vehicle Crashes are the highest cause of death at work – EMS has > 2X the mean national rate.
- An R & D and Regulatory Gap
  - Occupational Health and Safety
    - the workplace is a vehicle – exposure data are scant
  - Automotive Safety
    - - vehicle in the work place – exempt from automotive research and testing

News we don’t want to see

Caught On Video: EMT Struck By Car

September 11, 2007

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

There are grants to assist you..

Science not, next best guess

Distances of Nighttime Visibility

Worries While in Red Light
Visibility and Conspicuity ...?

We've known for 10 years that red fire trucks are twice as likely as lime yellow trucks to crash at an intersection.

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

Not rocket science...
Day visibility

Night visibility

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

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

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

USA Ambulances: FMVSS Exempt
- 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.

Propaganda that kills…

USA ambulance purchase specifications
- Static Pull test
- 2200 Lbs. (8G’s) in Longitudinal and Lateral
- No dynamic test
- No definition to manikin mass
- No restraint for equipment
- Voluntary

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No 'a'... then NO 'F' !!!

\[ F = ma \]

where

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

KKK/AMD

- Ignorant of basic automotive safety principles
- Makes no reference to dynamic testing and YET makes reference to this standard providing protection in the setting of vehicle crash forces
- The complete ABSENCE of any real world injury data applied to the determination of these test protocols

KKK certified and FMVSS exempt...

FMVSS exempt.....

Background: USA Problems

- No reporting system or database specifically for identifying ambulance crash related injury
- No occupational and health safety standards to protect providers from injury
- Rear passenger compartment, > 60cm behind driver - exempt from Federal Motor Vehicle Safety Standards (FMVSS)
A few key words about restraint systems...

NOT new technical data...

And in the absence of standards.... NASCAR inspired ????. How ridiculous.

Being seated IN an automotive seat is what will protect you

Increasing awareness ...

Vehicle design and safety

Rash of “Safety Concept” vehicles..... Devoid of substantive automotive safety engineering input or testing

An admirable goal – BUT... implementing interventions that have not in anyway been demonstrated to be effective let alone safe is a very serious problem
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…

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

Vehicle Occupant Safety design

2007 European design
Safety technology is a key focus

Ergonomic design

NSW Australian vehicles

Flexibility to manage two patients
Securing 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?

Technical information available

- Host: Vehicle Safety
- Host: Medical Services
- Host: Transportation
- Host: Equipment

Automotive Injury Triangle and Safety Development

Host: Medical Services
Vehicle: Transportation

Protective devices/concepts

To prevent a crash:
- Driver feedback
- Driver monitoring
- Driver testing
- Vehicle Intelligent Transportation System (ITS) technologies
- Trained dispatch
- Appropriate policies

In the event of a crash:
- Vehicle crashworthiness
- Seatbelt systems
- Equipment lock downs
- Padding
- Head protection

Intelligent Transport Safety Systems
Back up Camera... Shouldn't all vehicles have one of these?

Breaking News!!
National Academies
TRB EMS/Medical Transport Safety Subcommittee – Jan 16, 2008

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

1. Awareness
2. Training
3. Incentive

Some simple and available solutions out there now
- Intersection Policy
- PPE
- Black 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 needs to happen NOW?
- Implement a Fleet Safety Program
- Correct the basic policies and procedures regarding:
  - Intersections
  - Use of occupant restraints
  - Securing equipment
  - Driver performance
  - Visibility and conspicuity
- Data:
  - Epidemiology
  - Ergonomic
- Safety oversight

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