Ambulance Safety
What You Can’t Afford Not To Know

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Safety Stand Down Day
- Augmenting safety practices and enhancing the safety culture in critical care ground and air medical services

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

http://www.objectivesafety.net

Thursday July 5th 2007......

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

Five Killed In Crash of Ambulance and Semi
JUL 21, 2007 02:20 AM EDT


Five people were killed when an ambulance crashed into a semi-truck after a stop sign was allegedly ignored.

The accident occurred on a rural highway near the city of San Antonio, Texas. The ambulance was carrying emergency medical technicians and paramedics who were responding to a 911 call.

Emergency personnel said the ambulance was traveling at a high speed when it collided with the semi-truck.

“People are in shock and grief,” said Dr. John S. McLaughlin, a San Antonio emergency room doctor. “It’s a tragedy that happened so quickly.”

Friday July 20th 2007...
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......

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...."?

Charged with Vehicular Homicide

Firstly!

- An accident?
- or a predictable and preventable event

What's new

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

Ground Transport Safety IS Complex AND Multidisciplinary

National EMS data

In the USA*
- ~ 50,000 vehicles
- ~ 5,000 crashes a year
- One fatality each week
- ~25 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

Predictable risks

- Fatal crashes more often at intersections, & with another vehicle (p < 0.001)
- 70% of fatal crashes EMS crashes during Emergency Use
- Most severe & fatal injuries occurred in rear (OR 3.7 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 >65% of fatal occupant injuries
- 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

Absence of standards and oversight

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

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
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

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.

Preventable…

- It is assumed that when the ambulance rolled onto its side, the lifepack 10 struck James in the head.

Ambulance Safety Research: A New Field

- non issue
- safe
- safer

and what is killing EMS ?

EMS personnel fatalities*

- 74% transportation related
- 15% 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

Occupational transportation fatalities

- WE HAVE A BIG PROBLEM HERE

What do ambulance crashes really cost ?

- Loss of life and injury
- Negative impact on EMS system
- Collisions are the largest liability cost and exceed 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
  - litigation/settlement/lawsuit
  - medical/treatment costs of injured EMTs
  - hiring of new employees to replace injured personnel
  - retraining and psychological counseling of personnel involved and others
  - increased insurance rates

June 2007

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

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??

But what about 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
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

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

* Stopping distance: Perception time + Reaction time + Vehicle braking time
  (varies with age, skill, agility, alertness + vehicle type, tire pressure, road etc)
The Driver

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

Driver issues

- Driver Impairment

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 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....

Safety is Good Business

- FMCSA Truck safety goals – to decrease the fatality rate of 2.8 per 100 million truck-miles in 1996 to 1.65 by 2008
- EMS crash fatality estimates are - 7.66 - 41.93 fatalities per 100 million ambulance-miles

A very serious gap in data, performance and oversight
And keep focus on ‘All hazards’ in addition to crashworthiness

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

Testing the real world

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

If we know this – and its published...

Why do we do this?

Intrusion vs Deceleration

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


Full Vehicle Crash Testing

Test 1 – Right side impact

- Damage to vehicle
- Intrusion
- Deceleration
- Patient condition
- Testing apparatus

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

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

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 YouTube??

News we don't want to see

Caught On Video: EMT Struck By Car

News we don't want to see

May 21st, 2007, Seattle

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

There are grants to assist you...

Science not, next best guess
Visibility and Conspicuity ...?

Being seen at the scene....
November 4, 2007

Recent Visibility Webinar
www.GlobalEMSForum.org

Car hits small vehicle, pedestrian injured at scene - Beverly Hills, California
A firefighter paramedic was hit by a car while tending an accident scene.

A firefighter paramedic was hit by a car while tending an accident on the I-405 freeway near Manchester Road, according to the Beverly Hills Fire Department.

Ride Home was returning to the scene of a traffic accident when he was hit by another car about 2:00 a.m. The car also ran over and killed the person hit and damaged several vehicles at the scene.

The California highway patrol had the car's driver in custody and was investigating.

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 – AND visible!!!
But what about those red trucks

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

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

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.

Occupant protection......??
30 years later, 1,600 fatalities and still the same problem

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

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

\[ F = ma \]

where
\begin{align*}
F & \text{ -- force} \\
m & \text{-- mass} \\
a & \text{-- acceleration}
\end{align*}

KKK certified and FMVSS exempt...?

FMVSS exempt......

Most trucks, SUVs do poorly in whiplash test

A few key words about restraint systems...

Internationally, there are standards for proper automotive crash testing for safety performance

NOT new technical data...


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

And in the absence of standards....

NASCAR inspired ????....

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

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...”

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

Increasing awareness ...

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

The dangers of ignorance...

Policy Changes

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?

State Strategic Highway Safety Plans

Integration and Collaboration

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

Ergonomic layout and equipment

NSW Australian vehicles

Flexibility to manage two patients

Australia, Melbourne

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?

Were we safer in the Cadillac???
Knowledge transfer

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

ASSE Transactions, Fall 2007

Technical information available

An excellent model

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

Its not magic……

Valuable information from the transportation industry
These folks know what we need to know...

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

IAFC June 2007

No need to reinvent the wheel...

USFA Emergency Vehicle Safety Initiative

March 2007 - FHWA

FMCSA - Hours of Service Regulations

Tips forEmergency Vehicle Operations
Automotive Injury Triangle and Safety Development

Host Vehicle

Environment

Technology, invention & development

Field data

Scholarly research

Voluntary initiatives

Regulatory initiatives

Countermeasure deployment

Protective devices/concepts

To prevent a crash
- Driver feedback
- Driver monitoring
- Driver training
- Vehicle Intelligent Transportation System (ITS) technologies
- Timed dispatch
- Appropriate policies

In the event of a crash
- Vehicle crashworthiness
- Seat/seat belt systems
- Equipment lock downs
- Padding
- Head protection

Intelligent Transport Safety Systems

Breaking News!!

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

Back up Camera….. Shouldn’t all vehicles have one of these?

Some simple and available solutions out there now

- Intersection Policy
- PPE
- Black boxes

Creating a Safety Culture

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

- Awareness
- Training
- Incentive

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