New Initiatives in EMS Transport Safety: Where is the State of the Art

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2008 South Carolina Emergency Care Symposium
Myrtle Beach, SC

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……

…Nov 8th’s Fatality

Puget Cx, paramedic dies in ambulance crash

And Nov 10th’s 2007 obituary…

http://www.objectivesafety.net

Jan 28th, 2008

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

Firstly!

▶ An accident?
▶ Or a predictable and preventable event

In a nutshell

▶ Am here to try to save you Lives 
▶ Time and Money

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 safer?
▶ 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?

Thursday July 5th 2007……

Paramedic Allan Parson’s killed

“…I’d like to know what can be done so this never happens again……”

Charged with Vehicular Homicide

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 08:20 AM EDT

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July 7, 2007 RONNIE KENNEDY

"I’d like to know what can be done so this never happens again……"
So

- What's important
- What's not important

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’

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 ‘workplace’ IS a vehicle

- EMT’s often in vulnerable positions during transport.
  - Bench seat
  - Captains chair
  - Standing or kneeling

The ‘workplace’ is also a crash scene

- communications/dispatch
- the patient
- restraining device/seat
- transporting device/journey
- 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 involving epidemiological data collection, risk management, and safety. Regulatory frameworks, ergonomic research, biomechanical automotive safety, fleet safety programs, and driving training are critical.

Is there an acceptable rate of morbidity and mortality for pre-hospital transport systems?

National EMS data

In the USA:
- ~ 50,000 vehicles
- ~ 5,000 crashes a year
- ~ One fatality each week
- Approximately 300 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)
- 83% of fatally injured EMS rear occupants unrestrained
- > 74% of EMT occupational fatalities are MVC related
- > 65% of fatal occupant injuries
- More likely to crash at an intersection with traffic lights (37% vs 18% p=0.001)

Occupational transportation fatalities

- WE HAVE A BIG PROBLEM HERE

Absentence 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' - ?

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?
Clinical Care? Occupational Health and Safety…..?
- This IS a Transportation and Automotive Safety issue
- This is a Systems safety issue

So for EMS personnel...
- What's going to kill you?
- What's going to injure you?

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

'Workplace' Hazards

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

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
  - Litigation (settlement/lawsuit)
  - 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

Safety is Good Business

June 2007

* Maguire, Blount, Buck & Lavelle, Occupational Fatalities in Emergency Medical Services - A Hidden Crisis, Annals of Emergency Medicine, Dec 2002
A problem
2007 Insurance data –
► 27 fold more likely to have a claim based on transport than related to medical care

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

Ambulance Safety Research:
A New Field

Priorities……
Research papers in the past 30 years
► EMS Safety
  * 40 papers - on ambulance safety
  * 2 papers - on ambulance ergonomics
  * 1 paper – on stretcher ergonomics
► Computer Workstations
  * 30,000 papers – on ergonomics of computer work stations
► Erectile Dysfunction
  * 100,000 papers – on Erectile Dysfunction

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??

IMPORTANT ADVISORY
► Due to respect for the wishes of the families of medics killed in the line of duty there is to be NO PHOTOGRAPHY of any aspect of the images in this presentation - that is NO video, NO photography, NO digital images of any type
The Driver
- Driver selection
- Driver monitoring and feedback
- Driver impairment
- Driver training

Driver issues

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???
“The best driver safety device is a rear view mirror with a cop in it”

Dudley Moore

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
  - 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

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

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

- Stopping distance at 60mph is 260 ft
- A driver will first see a pedestrian wearing retro reflective material safely at 500 ft

Policy and practice ignorant of existing technical safety data

Day visibility

Night visibility

Visibility and Conspicuity…?

Well this is a good color…

Hmmm…
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

Smart approach...

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

Air EMS is a role model for safety initiatives and focus
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

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

IAFC June 2007

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

State SHSP EMS Focus*

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<th>AREA OF EMS FOCUS</th>
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<td>Alabama</td>
<td>1. Identify and Analyze Performance Data</td>
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<td>3. Identify Crash Location</td>
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<td>4. Statewide assessment and Plan</td>
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<td>5. Improve EMS Rural Access</td>
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| Arizona    | 1. Establish EMS Legislation and Regulation |
| 2. Provide EMS Funding |
| 3. Enhance Capabilities for Medical Response to Disaster |
| 4. Expand EMS Human Resources |
| 5. Enhance EMS Education System |
| 6. Expand EMS Services |
| 7. Facilitate EMS Communications |
| 8. Conduct EMS Public Education and Information Programs |
| 9. Conduct Injury Prevention Public Awareness Efforts |
| 10. Enhance Medical Direction |
| 11. Provide Enhanced Trauma System and Facilities |
| 12. Establish an EMS Information System |
| 13. Evaluate and Monitor EMS Programs |

Integration and Collaboration


No need to reinvent the wheel...

March 2007 - FHWA

Tips for Emergency Vehicle Operations
USFA Emergency Vehicle Safety Initiative

An excellent model

Coming Soon!
Traffic Incident Management Systems (TIMS)

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

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

Intrusion

Deceleration

If we know this – and its published...

Why do we do this?

Full Vehicle Crash Testing
Test 1 – Right side impact

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

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

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

Policy makes a difference...

Vehicle Operations Position Statement

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?

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

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???

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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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

Propaganda that kills...

Occupant protection......??

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/AMD – ‘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.
No ‘a’… then NO ‘F’ !!!!!

\[ F = ma \]

where

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

FMVSS exempt......

Most trucks, SUVs do poorly in whiplash tests in crash testing, despite official declarations to the contrary.

A few key words about restraint systems...

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

NOT new technical data...

The Ride of Your Life....

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 sidefacing occupants are potentially lethal – and in NO WAY SUPPORTED BY ANY DATA OR AUTOMOTIVE SAFETY EXPERTISE

Increasing awareness ...

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

Safety concepts out there now

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

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.

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

NSW Australian vehicles
Flexibility to manage two patients

Other successful models

Ergonomic layout and equipment

Securing equipment

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
  - Ergonomics
  - Safety oversight

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???

Risk/Hazards
- Predictable risks
- Predictable fatal injuries
- Serious occupational hazard
- Public safety hazards
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 (e.g., 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

Be ready for..

- New Infrastructure
- New information
- New collaborations
- New events
- Innovation in safety technologies, strategies and policy
- Knowledge transfer
- Unacceptable mythology
- Challenges to advancing EMS transport safety

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