S.P.E.A.R. —
Seminars for Professional Emergency Area Responders
Cleveland Clinic Regional Hospitals, Ohio, May 21st, 2008

EMS Safety and Wellness
Ambulance Transport Safety — The Essentials

35th Annual EMS Week
May 18-24, 2008 —
EMS: Your Life is Our Mission

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

A tragic emergency health care intervention outcome

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……

And Nov 10th’s 2007 obituary….

http://www.objectivesafety.net

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 safest?
► 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?
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

Firstly!

→ An accident?
→ or a predictable and preventable event

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

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 09:20 AM EDT

Charged with Vehicular Homicide

2 killed, 3 injured....

September 23, 2007 - PA
2 counts of vehicular homicide... November 5, 2007 - PA

2 crashes, 2 deaths of people who were not vehicle occupants were責任ed... 2 drivers were killed in a crash. The other 2 drivers were killed in a crash. The other 2 drivers were killed in a crash.

Benefit of Safety

Any cost of addressing these issues is dwarfed in contrast to the huge burden of not doing so - in financial costs let alone the personal, societal, ethical and litigation costs

Unique workplace

In vehicles

At roadside and other emergency scenes

Absence of standards and oversight

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

What we need to consider, where is the ‘bang for buck’ in ambulance transport safety:

New paradigm - Integration of EMS

Public health departments
Social service agencies
Community outreach
Hospitals
Health care networks / Insurers
Industry

Key 5 Safety Priority areas of focus

Here is what you sent in: n = 155

Relative Priority Issues

Priority Number one
Vehicle ops - 29%
Ambulance design - 27%

Priority Number two
Ambulance design - 35%
Vehicle ops - 29%

Challenges to Optimizing EMS Transport Safety

Disparate and fragmented safety infrastructure
Lack of a centralized EMS Safety oversight or data
A large number of small groups of end users, with a mix of volunteers and professionals
Ambulances are hybrid non-standard vehicles, a truck chassis and an after market box or a modified van
EMS vehicle safety is not integrated as a part of the transport safety industry
1960 to 2007

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

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

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 environment/still
- other road users
- the road

The Emergency Department (ED)

An ambulance is not an ED/ICU on wheels
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 cars
  - 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 serious & fatal injuries occurred in rear (OR 2.7 vs front) & to improperly restrained occupants (OR 5.4 vs restrained)**
- 60% 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

Occupational transportation fatalities

- WE HAVE A BIG PROBLEM HERE

So for EMS personnel...

- What’s going to kill you?
- What’s going to injure you?

‘Workplace’ Hazards

- 74% transportation related
- 11% were cardiovascular
- 9% were homicide
- 4% needle sticks, electrocution, drowning and other

and what is killing EMS?


Serious head injury in >65% of fatal occupant injuries

>74% of EMT occupational fatalities are MVC related

More likely to crash at an intersection with traffic lights (37% vs 18% p=0.001) & more people & injuries/crash than similar sized vehicles


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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
  - Legal legal settlement
  - Medical disability costs of injured EMTs
  - Hiring new employees to replace injured personnel
  - Re-training and psychological counseling of personnel involved and others
  - Increased insurance rates

Safety is Good Business

June 2007

A problem

2007 Insurance data –

- 27 fold more likely to have a claim based on transport than related to medical care

"Ambulance transport has a death toll..."

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

'Real world' head-on post crash

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*

Integration and Collaboration


Integration and Collaboration


- EMERGENCY MEDICAL SERVICES DISPATCH SERVICES
  - Ensure the availability and accessibility of emergency medical services in local and regional hospitals
  - Establish protocols for the effective dispatch of ambulances

- EMERGENCY MEDICAL SERVICES PARTNERSHIPS
  - Increase the participation and role of Regional EMS Councils in local and regional highway traffic safety boards and/or organizations

- PRE-HOSPITAL TRAINING PROGRAMS
  - Develop training programs for EMS providers to familiarize them with the new medical protocols
  - Provide funds and/or other support to certified EMS Course Sponsors to train EMS providers in the use of these protocols
  - Collaborate with Regional EMS Councils and/or Regional Emergency Medical Advisory Committees (REMAC) on the development and implementation of training programs

- ROAD CONDITION AND INCIDENT RESPONSE
  - Develop and implement protocols for the safe and efficient transport of emergency patients
  - Review traffic safety measures and protocols to identify those that contribute to injuries resulting from ambulance crashes
  - Identify methods to provide incentives for adoption by EMS services of protocols that enhance traffic safety
  - Partner with organizations that provide public driver awareness and education campaigns to improve driver awareness of the importance of regular maintenance of vehicles and appropriate response to approaching emergency vehicles

EMS RESPONDER CRASH PREVENTION

- Undertake a systematic review of other state actions and protocols on ambulance traffic safety measures to identify and prioritize those appropriate for the New York State pre-hospital system
- Develop and implement protocols at state, regional and service levels
- Collaborate with Regional EMS Councils and/or REMAC on the development and implementation of training programs

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

Pennsylvania Code

Vehicle Operations Position Statement

WEMSA covered some key and important policies and procedures...
Safety saves time, lives AND money.
Canada, Nova Scotia

- Since 2000 working towards a goal of zero loss ratio with insurance provider
- 10 million kilometers per year
- 150 emergency response ambulance units
- Collision claim history measured in dollars per 100,000 kilometers traveled:
  - 2000/2001 $1725.00
  - 2001/2002 $1049.00
  - 2002/2003 $751.00
  - 2003/2004 $416.00
  - 2004/2005 $229.00

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

- Engineering
- Epidemiology
- Ergonomics

Increasing awareness ...

Risk/Hazards

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

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

New EMS helmet prototypes for 2008

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

Driver issues

Which is best, how many hours...??

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

And when a rare crash happens....

Unit 302 Accident

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 you tube??

The jury is out on
- Opticon
- Simulators

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

Dynamic vs. Static Safety Testing

Dynamic Safety Testing
- requires sophisticated, expensive equipment
- measurably demonstrates forces generated during collision
- accepted international standard for vehicle restraint systems

The Crash Event - Crash Testing
- An introduction
- What one needs to know
- What do the tests really mean
- And, what tests are meaningful

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

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

Why do we do this?

Choose the Best Option

* Stopping distance: Perception time + Reaction time + Vehicle braking time
  - Depends on age, skill, agility, alertness + vehicle type, tire pressure, road etc.
Foldable

Full Vehicle Crash Testing
Test 1 – Right side impact

Test 2 – Left side impact

USA Ambulances: FMVSS Exempt

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

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

Propaganda that kills...

Occupant protection......??

Johns Hopkins University

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

Closing speed 44 mph

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

July 2007

Medic Survivors

Medic Fatality

USA Ambulances: FMVSS Exempt

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July 2007

Medic Survivors

Medic Fatality
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.

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

No ‘a’... then NO ‘F’  !!!!!

- $F = ma$

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

KKK certified and FMVSS exempt...?

FMVSS exempt.....

Its not magic... what is safe is known and understood

A few key words about restraint systems...

NOT new technical data...

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

Yes, the ride of your life….  

- Sure... these vehicles all parade around the EMS and Fire shows BUT...
- NOT ONE of these vehicles has been to the automotive safety shows or scrutinized by the automotive safety industry.

Innovation

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

Safety concepts out there now

The EMS Safety Foundation
Intro and Logistics Webinars from December 11th 2007 & Jan 9th 2008 EMS Safety Foundation tab at www.objectivesafety.net

Ambulance Transport Safety Task Force (ATS) and the National Transportation safety Board (NTSB)

National Academies Transportation Research Board’s (TRB) And Your New EMS Transport Safety Subcommittee
TRB EMS Safety Update

- Brought together NHTSA, FHWA, TRB, National Academies, DOT, CAMTS & EMS
- 3 presentations
  - TRB and EMS
  - Safety air/ground
  - Ground Ambulance Safety Issues and Directions
- Recorded presentations and handouts available at www.objectivesafety.net
- Potential for EMS safety research funding
- Next TRB meeting January 11-15, 2009 – all are welcome

Ambulance Transportation Safety Task Force

- TRB Jan. 16th 2008

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.

RETTmobil – ‘Mobile Rescue’

Major event for EMS innovation
Fulda, Germany
http://www.rettmobil.com/

Australia, Melbourne

NSW Australian vehicles
Flexibility to manage two patients

High speed crash, rolled and the occupants (patient and medics) had only minor scratches

Norway initiatives

Sweden initiatives

Other successful models

Ergonomic layout and equipment

Securing equipment

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
- 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???

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

Worker visibility Act:
Help is on the way!! November 24th 2008
There are grants to assist you...

Science not, next best guess

Policy and practice ignorant of existing technical safety data

Day visibility

Night visibility

Visibility and Conspicuity ...?

Under Way...
Emergency Vehicle Visibility and Conspicuity Study

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

This looks cool AND SAFE!

- Having access to that technical knowledge supports changes to improve safety practice
Another excellent example - From this to … this!

- 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

Integration and Collaboration


No need to reinvent the wheel...
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

What do we know now??
- Intersection crashes are the most lethal
- There are documented hazards, some which can be avoided
- Occupant and equipment restraint with standard belts is effective. (Over the shoulder harnesses for patients should be used, with the gurney in the upright position where medically feasible)
- Some vehicle design features are beneficial - automotive grade padding in head strike areas, seats that can slide toward the patient
- Electronic Driver monitoring/feedback systems appear to be highly effective
- Head protection??

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

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?

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.