Enhanced Safety of the EMS Vehicle

Firstly!

- An accident?
- or a predictable and preventable event

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?

EMS Transport Safety

- 'patient safety'
- AND also
- 'provider' and 'public safety'

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......

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

Thursday July 5th 2007..... Paramedic Allan Parson’s killed

http://www.objectivesafety.net
“...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 06:20 AM EDT

Two victims killed by the impact in the crash, including two pregnant women. Another two patients were also injured. The crash occurred near the intersection of Route 40 and Route 78 in eastern Pennsylvania.

In this vehicle...

Charged with Vehicular Homicide
November 5, 2007 - PA

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

An interhospital transport... "Do no harm..."

April 14th, 2008
An emergency response vehicle was hit by a pickup truck on the same day.

June 17th, 2008
A paramedic and a patient killed in this vehicle...
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

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

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......

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

People are passengers and NOT packages or parcels
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 (e.g., 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

Safety oversight of what and .... by whom

- Vehicle Safety
- Vehicle Design
- Transportation systems safety
- Safety Equipment Design
- Vehicle and Safety Equipment Testing and Standard development
- Safety policies

There are more safety standards for moving cattle than for moving patients

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

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
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
  - ~ 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

‘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


“Ambulance transport has a death toll...”
Carl Craigle EMT-P, Chief Plate Valley Ambulance
Colorado Springs, April 2007
Clinical Care? Occupational Health and Safety.....?

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

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

June 2007

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**

- EMSC PED-SAFE-T Levick et al
- Best, Zivkovic, Ryan

**Transport Canada, Ministry of Health**

- Bull, Talty et al
- Sweden

**Turbell et al, Sweden**

- Ergonomic
- Highnett

**NHTSA/NTSB/EVOC**

- Epidemiology
- Biggers, Zachariah, Pepe

**FEMA**

- Saunders, Pirrallo, Swor

- Auerbach et al

- FEMA

- Kahn, Pirrallo

- Maguire, Hunting, Smith, Levick

- Becker, Zaloshnja, Levick, Li, Miller

- Weiss, et al

- MMWR

- NIOSH, CDC

**De Graeve, Deroo, Calle et al**

- '04

**Woo, War, Fleeger et al**

- '06

**Johnson, Lindholm, Dowd et al**

- '07

**But what about head protection?**

- It does happen....

**Problems**

- No Standards
- Unique safety and hazard protection needs
- A number of less than appropriate devices out there

**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
**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**
- MEMS MONTHLY OVER SPEED VIOLATION TREND 2003/2004
- Series
  - I - blind data, no growls
  - II - growls & tones ON
  - III - identified data

**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 in-service 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

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 it’s published…


Why do we do this?

Test 1 – Right side impact

1 – Target vehicle, Type I ambulance
2 – Bullet vehicle, Type II ambulance

Closing speed 44 mph

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

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

NIOSH Ambulance Occupant Safety Crash Testing

Safety approaches being driven by manufacturers claims and sales rather than by science and data?
USA Ambulances:
FMVSS Exempt

Occupant protection......??
July 2007

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

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......?

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

FMVSS exempt.......

It's not magic... what is safe is
known and understood

A few key words about restraint
systems...
NOT new technical data...

The Ride of Your Life....

NIOSH Ambulance Occupant Safety Crash Testing

Impact Direction 25 MPH /

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

concept vehicles I & II ??

Bigger is not necessarily better......

NO automotive safety engineer
NO crashworthiness engineer
NO ergonomist
NO reference to ANY existing or relevant automotive safety or crashworthiness technical publications.... yet multiple occupant fatalities and injuries annually....
Yet another potentially lethal example marketed as a ‘safety innovation’ YET outside of automotive safety practice

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

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

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 assigned
  - 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 January 25th 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 European event for EMS innovation
Fulda, Germany May 2008
http://www.rettmobil.com/
Vehicle Occupant Safety design

Ergonomic design

27 inch loading height - Sprinter

European HiViz Markings

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

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???

Other successful models

Ergonomic layout and 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

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 -
  - Wore 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???

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

Science not, next best guess
Policy and practice ignorant of existing technical safety data

Great visibility

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

» Operating in an environment where many aspects of safety are still devoid of safety standards – requires technical knowledge and understanding
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

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

Oklahoma, where is your SHSP EMS Chapter!!

No need to reinvent the wheel...
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

March 2007 - FHWA

Tips for Emergency Vehicle Operations

USFA Emergency Vehicle Safety Initiative

Traffic Incident Management Systems (TIMS)
- Just released April 2008
- FEMA, USFA, IFSTA
- Covers setting up safe roadway incident work areas and using unified command at these incidents

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

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
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

Thank you!
Any Questions??
an electronic recording and a .pdf handout of this presentation awaits you online
www.objectivesafety.net