STEP EMS Mission

- STEP – Study of Trauma and Emergencies Project
- STEP’s mission is to inform and educate the Emergency Medical Services (EMS) community and promote opportunities for the improvement of the EMS system.
- STEP began these activities in 1967

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

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?

Emergency Medical Service Transport

- What are the transport safety issues that pertain to this important public service and public safety industry?
- What do we know of the risks and hazards and how can we measure these?
- How can the safety of this transport system be optimized?

EMS - A Key part of a system of safety

- EMS Safety Foundation
  - National EMS Resources
  - Safety and Knowledge Transfer
- Live from RETTmobil
- Emergency Medical Services
- Live from RETTmobil
- Live from RETTmobil
Your Interactive Handout awaits you online at...

- www.objectivesafety.net

This WILL be FAST!!
No need to take any notes – all text slides will be awaiting you in your online Handout

Firstly!

- An accident?
- or a predictable and preventable event

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......

Ambulance Transport Safety

- Emergency care, public heath, public safety, and patient transportation.
- Important Principle: Ambulance transport safety is part of a system, the overall balance of risk involves the safety of all occupants and the public
- All get home safely

In a nutshell

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

October 2008 JEMS Article “Rig Safety – 911”

2008 - Air EMS on the NTSB’s “Most Wanted List“, where is ground EMS??
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 in the USA.

The EMS transport process:
- Communications/Dispatch
- The patient
- Restraining devices/seat
- Transporting device/gurney
- Paramedics/transport nurses, doctors & family
- Patient monitoring equipment
- Clinical care & interventions
- Protective equipment
- The vehicle
- The driving skill
- Other road users
- The road

USA EMS data:
In the USA:
- ~50,000 vehicles
- ~5,000 crashes a year
- ~1 fatality each week
  - 25 pedestrians or occupants of other car
  - Approximately 3 to 4 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

Creating a Safety Culture:
within a company must start with upper management’s commitment to safety
- Awareness
- Training
- Incentive

Safety - Why now?
- Operating optimally in a transportation environment that is largely devoid of specific safety standards for the hazards and risks present
- Bridge the gap between what technical information exists and what is accessible and applied to EMS

EMS Safety:
- ‘Patient safety’
- AND also
- ‘Provider’ and ‘Public safety’

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
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

Emergency personnel brought the rig to a boil and removed the bodies. "This one was just a horrific accident," said Paul E. Swain, director of the Washington County Emergency Management Agency in Marshall Township. "We had people who were shocked and in tears."

A 45-year-old Pennsylvania man was killed in a collision with a semi-trailer truck in a rural township, authorities said. The man died at the scene of the crash, which occurred on Route 221 near the intersection of Route 62, about 10 miles north of Point Pleasant, according to the Washington County Sheriff's Office.

The driver of the ambulance, 29-year-old Paramedic Allan Parsons, was also killed in the crash. Parsons was driving the ambulance from the hospital to a nearby nursing home when the accident occurred.

Emergency personnel immediately arrived at the scene to provide medical assistance. The Pennsylvania State Police and the Washington County Sheriff's Office were at the scene to investigate the incident.

The cause of the crash is under investigation, and the Pennsylvania State Police are looking into the possibility of mechanical failure of the ambulance.

Fatality and funerals

2 weeks later... Thursday July 5th 2007
Paramedic Allan Parson's killed

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

November 5, 2007 - PA
Fatalities and funerals

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

An interhospital transport? "Do no harm..."?
This IS a Transportation and Automotive Safety issue

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.

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.

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.

Testing the real world

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?
So

- What's important
- What's not important

- What's going to save your life
- What might take your life

- What's going to hurt you
- What's going to protect you

- What is factual
- What is garbage

- What is new
- What is not new

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:

1960 to 2009

A passenger vehicle - sure

A 'laundry or mail truck' - ??

A passenger vehicle - no
“Ambulance transport has a death toll….”

Carl Craigle, EMT-P, Chief Platte Valley Ambulance

So for EMS personnel...

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

Ground Transport Safety IS Complex AND Multidisciplinary

- Epidemiological Data Collection
- Risk Management
- Public Safety
- Transport Policy
- PPE
- Driver Training
- Communications technology
- Safety Technology
- Regulations and Standards
- Fleet Safety Program

Occupational Health and Safety.....?

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

What is a survivable impact?

- $E = \frac{1}{2}mv^2$
- $v^2 = 2as$

37 mph (60 km/h) - survivable

62 mph (100 km/h) – not survivable
It does happen….

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

New EMS helmet prototypes for 2007-2009

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

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

Goals
- Standards for safety
- Policy based on Science
- Databases to demonstrate outcome

Ambulance Safety Research: A New Field

EMS Best Practice, Sept 2006
**What are the solutions?**

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

**Hmm...**

- 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???

**So why is it...**

It isn't like this outside of the USA

**Ambulance Standards??**

- Australasia
- Europe
- USA
  - KKK?
  - AMD?
  - FMVSS?
  - NFPA?

**USA KKK ambulance purchase specifications**


- Specifications for the purchase of a Star of Life Ambulance
- Static Pull test
- 2200 Lbs, static stretcher test in longitudinal, lateral & vertical
- No dynamic test for vehicle, occupants or equipment
- No automotive test manikin
- Voluntary

**USA Ambulance Manufacturing Division (AMD) Ambulance Standards – August 2007**

- No dynamic or impact test
- No automotive test manikin
- Mandates NO ‘crumple zone’
- No impact tested anchorages for occupant restraint or equipment
- Internal, not independent

**KKK/AMD**

- Ignorant of basic automotive safety principles -
  - Makes no reference to dynamic testing and YET makes reference to this standard providing protection in the setting of vehicle crash forces
  - The complete ABSENCE of any real world injury data applied to the determination of these test protocols
AMD 2007 - 025 'occupant safety testing'
- Compared with - Accepted automotive safety occupant testing

AMD – static ‘safety testing’
- Inconsistent with 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

USA Ambulances: FMVSS Exemption

FMVSS exempt……

Occupant protection……??

July 2007

FMVSS exempt……

NFPA Ambulance Standard Development

- NFPA Ambulance Standard Development underway
- Scope for integrating appropriate technical expertise

Balance of concerns and risk during transport

- Response and transport time
- Clinical care provision
- Occupant safety/protection
- Public Safety

Benefit of Safety

- Safe practices save lives, time and money
What do we know now??

- Intersection crashes are the most lethal
- There are documented hazards, some of 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

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

- Perception + Reaction time + Vehicle Braking time (dry) 40 mph
- Stop distance:
  - Perceived time
  - Reaction time
  - Vehicle braking time

Intrusion vs Deceleration

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

Dynamic Safety Testing

- Requires sophisticated, expensive equipment
- Measurably demonstrates forces generated during collision
- Accepted international standard for vehicle restraint systems

If we know this – and its published....
Why do we do this?

Foldable

What is actually happening during an ambulance crash

1. Target vehicle, Type I ambulance
2. Bullet vehicle, Type II ambulance
3. Closing speed 44 mph
4. And this all takes place in 60 millisecs – the blink of an eye

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
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

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

An admirable goal – BUT... implementing interventions that have not in anyway been demonstrated to be effective let alone safe is a very serious problem
There is NO vehicle safety without real world injury data and automotive safety expertise

- With what authority has ground EMS squandered $3,000,000 on these concept vehicle shams??
- We NEED meaningful injury data to better understand the mechanism of injury and fatality
- A crash test program without automotive safety expertise and real world representative injury data is irresponsible
- Without real world injury data it is not possible to effectively measure the burden of the hazard NO!! the effectiveness of any interventions

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

JEMS and EMS Responder ARE NOT automotive safety journals

- And the reviews in them are completely inappropriate, misleading and outside of what is known in automotive safety
- We should NOT TOLERATE this as it is both completely irresponsible and very dangerous …..

Innovation

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

Safety concepts out there now

National Academies TRB EMS/Medical Transport Safety Summit – November 7, 2008

Ambulance Safety Finally Gains National Attention
Important...

- Ergonomics and automotive safety issues are interrelated.
- Crashworthiness priorities override ergonomic issues.

What about changing driver behavior in the real world?

- Enhance Safety
- Improve Driver Performance
- Save Maintenance Dollars
- Aid Accident / Incident Investigation

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.

Over speed - accelerating

- Listen for growl – 15 sec warning.
- Growl frequency increases near end of warning.
- Tone on – penalty points awarded.
- Slow down – tone stops.
- Accelerate again – growl on – slow down – growl stops - no points.

Demonstrated Effectiveness

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A key to safe ambulance transport

- 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.

Monitoring and feedback devices

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

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.
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

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.

RETTmobil – ‘Mobile Rescue’
Major European event for EMS innovation
Fulda, Germany May 2008
http://www.rettmobil.com/
Vehicle Occupant Safety design

2008 European design
Safety technology is a key focus

Ergonomic design

Ergonomic layout and equipment

NSW Australian vehicles

Flexibility to manage two patients

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

Awkward tasks? Develop solutions!

Visibility and lighting issues
Worker visibility Act: November 24th 2008

Day visibility

Night visibility

Policy and practice ignorant of existing technical safety data

This addresses some very real risks, very creatively – and currently ONLY available in London Ontario!

Summit County EMS - Colorado

Old vehicle

New yellow vehicle markings

Staff use lime-green vests & jackets

Increasing safety with a 30% cost saving

Queensland Ambulance Australia

“...The multicolored (patterned) ambulance whilst distinctive, may suffer decreased conspicuity because of the effects of camouflage” De Lorenzo & Eilers Annals EM 1991
Color-blindness affects 10% of the population

As seen with normal vision

As seen with color blind vision

Emergency Vehicles – Viewer Awareness

For a timely, appropriate and safe response

- Location
- Size
- Shape
- Speed
- Intended path

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

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???

Fleet Mix?

“Ripoff and Duplicate”

- Avoid reinventing the wheel at all costs
- Where are the best practices that we need to transfer knowledge from
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

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

Tips for Emergency Vehicle Operations

An excellent model

USFA Emergency Vehicle Safety Initiative

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

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

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 (ie. 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

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

Predictable Preventable and NO ACCIDENT

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