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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

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?

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Firstly!
- An accident?
- or a predictable and preventable event

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….
Ambulance Transport Safety

- Emergency care, public health, 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

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

October 2008 JEMS Article “Rig Safety – 911”

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

USA EMS data

In the USA*

- ~ 50,000 vehicles
- ~ 5,000 crashes a year
- ~ 1 fatality each week
- ~23 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

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

The EMS transport process

- Communications/dispatch
- The patient
- Restraint device/sheet
- Transporting device/gurney
- Paramedics/transport nurses, doctors & family
- Patient monitoring equipment
- Clinical care & interventions
- Protective equipment
- The vehicle
- Driving/operating skill
- Other road users
- The road

The Emergency Department (ED)

An ambulance is not an ED /ICU on wheels

A survivable impact??

Impact and energy transfer – its all about time - $E = \frac{1}{2}mv^2$

- Duration of a vehicle crash impact is 60-80 milliseconds – the duration of a blink

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

"...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

The accident, which occurred near Smithville, New Mexico, left four people dead and one critically injured. The ambulance was transporting a patient from a hospital to a nearby hospital.

June 17th 2008
a paramedic and a patient killed

In this vehicle...

In this vehicle...

January 10, 2008

This is not a crashworthy environment

January 10, 2008

Jan 28th, 2008

1 dead, others injured in Sussex crash involving ambulance
April 20, 2008...

October 31, 2008 - Kentucky

February 11, 2009 – North Carolina

April 30, 2009 - Tennessee

Minnesota - June 20, 2009

August 2009 – Impaired...

September 15, 2009 ...this week

An interhospital transport?

"Do no harm..."?
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.

Ambulance Safety Research: A New Field

- engineering
- ergonomic
- epidemiology

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

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

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
  - Captain’s chair
  - Standing or kneeling

View of Ambulance interior from seat
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 – yes!

“Ambulance transport has a death toll....”
Carl Craigle EMT-P, Chief Platte Valley Ambulance

But what about head protection?

New EMS helmet prototypes for 2008-2009
Ground Transport Safety IS Complex AND Multidisciplinary

Transport Safety
- Epidemiological Data Collection
- Ergonomic Research
- Biomechanical Automotive Safety
- Software/Chem. research
- Safety Technology
- Regulations and Standards
- Fast Safety Program

Air EMS is a role model for safety initiatives and focus

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

Ambulance Vehicle Standards??
- 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

2009 USA ambulance ‘safety testing’?!? Not consistent with accepted automotive safety practice...

USA Ambulances: FMVSS Exemption

EMS Best Practice, Sept 2006

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

What are the solutions?
- Training?
- Practice Policy?
- Transportation Systems Engineering?
- Automotive Engineering?
- Education of other road users???

Balance of concerns and risk during transport
- Response and transport time
- Clinical care provision
- Occupant safety/protection
- Public Safety

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

Dry
Stopped at
Perception + Reaction time Vehicle Braking  time (dry)
40 mph
176 feet

Wet
Stopped at
Perception + Reaction time Vehicle Braking  time (wet)
220 feet

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

Testing the real world

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

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

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?

What is actually happening during an ambulance crash
And this all takes place in 60 millisecs – the blink of an eye

A few key words about restraint systems...

PPE from the stationary environment can be highly hazardous in the automotive setting

NOT new technical data...

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

Increasing awareness ...
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 concepts out there now

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

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

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 YouTube??

Visibility and lighting issues

News we don’t want to see

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??

It isn’t like this outside of the USA

News we don’t want to see

Caught On Video: EMT Struck By Car

Worker visibility Act: November 24th 2008

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

The multicolored (patterned) ambulance while distinctive, may suffer decreased conspicuity because of the effects of camouflage

De Lorenzo & Eilers Annals EM 1991

Policy and practice ignorant of existing technical safety data

For a timely, appropriate and safe response

- Location
- Size
- Shape
- Speed
- Intended path
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.

EMS Safety Foundation Delegation bringing Rettmobil to you

But whatever color ... if you run a red light someone will be killed
Vehicle Occupant Safety design

European design

Safety technology is a key focus.

Safe and Ergonomic design

Ergonomic layout and equipment

Flexibility to manage two patients

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

Safety first - Passive Safety

In a frontal crash, transmission and engine will be pushed underneath front occupants. This also occurs in the event of side impact or collision with a rigid wall. A "disconnectable" front axle releases additional deformation zones in the longitudinal frame member where a particular force level is reached. The device also features sideward and upward movement, or partial overturning, of the front axle module.
Is safety crash tested by automotive experts

Unlike this vehicle

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

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

Tips for Emergency Vehicle Operations

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

National Academies TRB
Ambulance Transport Safety Summit
October 29, 2009

Risk/Hazards
- Predictable risks
- Predictable fatal injuries
- Serious occupational hazard
- Public safety hazards

http://www.objectivesafety.net/TRBSummit2009.htm

What can you 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”

What do we know works…
- Vehicle Operations Safety Policies
- Squad bench lap seat belts
- Patient over the shoulder belts
- Securing equipment
- Forward and rear facing seating
- Some electronic technical devices
- Safety awareness
- Cultural change

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??
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http://www.objectivesafety.net