New initiatives in EMS
Transport Safety: Where is the State-of-the-Art?

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This morning’s Scope

Key Issues

- Key Issues
- Guidel"ines – standards
- Future safety management
- Future safety culture

Future

- New safety devices
- New technologies
- New practices
- New standards

A tragic emergency health care intervention outcome

It does happen....

Key Issues

- Mythology
- That Emergency Medical Service personnel are safe
- Injury Hazards
- Physical/Mechanical trauma – THE BIG PROBLEM
- Motor Vehicle Crashes are the highest cause of death at work – EMS has > 2X the mean national rate
- An R & D and Regulatory Gap
- Vehicle Safety
- Vehicle Design
- Safety Equipment Design
- Vehicle and Safety Equipment Testing and Standard development
- Safety policies

Safety oversight of what and by whom

- Vehicle Safety
- Vehicle Design
- Safety Equipment Design
- Vehicle and Safety Equipment Testing and Standard development
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Ideally Who, What and Where?

- Occupational Health and Safety
- Epidemiology, Bio/Chem Hazards and Ergonomics
- Automotive Safety
- Epidemiology, Engineering and Impact Biomechanics
- EMS Industry
- Occ. Health, Automotive, Technical, Clinical & Fiscal
- Academia
- Independent and collaborative
- R & D and evaluation of all of the above

Goals

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

USA EMS

- EMS Systems - >15,000
- Personnel - ~1 million
  (~30% F/T professional & 70% volunteer)
- Vehicles - ~50,000
  (Type I, II, III, Firefighters, ?motorcycles)
- Transports - ~30 million patients
- Cost - ~$5 Billion annually
- Safety Oversight - ? Disparate
An ambulance is not an ED/ICU on wheels.

The EMS 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

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

Consequences:
- 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

Background: Problems:
- No reporting system or database specifically for identifying ambulance crash related injury
- Rear passenger compartment, > 60cm behind driver - exempt from FMVSS
- Cost estimates > $500 million annually
- USA Crash fatality rate/capita 35x higher than in Australia

USA Ambulances: FMVSS Exempt

Predictable risks:
- ~ One fatality each week
- ~ 20 pedestrians or occupants of other car, ~10 serious injuries each day
- More often at intersections, & with another vehicle (p < 0.001)
- Most serious & fatal injuries occurred in rear (OR 2.7 vs front) & to improperly restrained occupants (OR 2.5 vs restrained)
- 62% of fatally injured EMS rear occupants unrestrained
- 74% of EMT occupational fatalities are MVC related
- Serious head injury in >65% of fatal occupant injuries
- 70% of fatal crashes EMS crashes during Emergency Use
- More likely to crash at an intersection with traffic lights (37% vs 18% p=0.001)
- More people & injuries/crash than similar sized vehicles

SO.. What is the problem and how has it been studied
- Published epidemiology research
  - Retrospective real data
  - Convincing clear evidence of risk
    - 1986 – 2004: All 30 papers have similar conclusions
- Published engineering/ergonomic research
  - Multidisciplinary real-world sled and crash testing and ergonomics
  - Convincing clear evidence of hazard and risk
  - Concurs with and enhances findings in epidemiology studies
  - 1986 – 2004: All 10 papers have similar conclusions
Ambulance Safety Research: A New Field

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??

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

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

"Are our policies killing people?"
- 1991-2000, 302,969 Emergency vehicles involved in MVCs - 1,565 involving fatalities*
- In PA 1997-2001, ambulances were more likely than similar sized vehicles to be involved in:
  - 4-way intersection crashes (43% vs 23%, p=0.001)
  - Collisions at traffic signals (37% vs 18%, p=0.001)
  - MVCs with more people injured (76% vs 61%, p=0.001)


Auerbach, JAMA 1987
- Passenger restraints for both ambulance attendants and passengers should be mandatory
- Traffic signals should be strictly heeded at intersections and speed limits in urban settings be obeyed.
- The mean delay to hospital care after an EMS crash was 9.4 minutes

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.....

We should use the best safety practices demonstrated
A peer reviewed tragedy

- Persistent disconnect between automotive safety science and EMS transport safety approach
- Pre-hospital and Emergency Care 2004
  - "EMS vehicle drivers are advised to approach the intersection, slowing to ensure that traffic has stopped and making eye contact with other drivers before entering the intersection.
- In the modern era of road safety to suggest that a strategy of "eye contact" to be made at an intersection with a driver traveling at ~40mph in the hope that this would result in a safety intervention, is at best frightening

Missouri, August 2005

- Ran a stop sign, T-Boned a car
- EMT driver ok, Medic in back critical, patient killed. Driver of other car killed.
- Ambulance driver likely to be charged.
- Medic and patient both ejected.

EMS is emerging in the vehicle safety arena

- SAE Toptec on Military and Emergency Vehicles, USA, September 2001
- Emergency Vehicle Symposium, Australia, Melbourne, May 2003
- Thomco EMS Safety Symposium, Chicago, June 2005
- Sporadic Ambulance safety research presented at peer reviewed AAAM, ITMA, SAEM, Safe America, World Injury, Asia Pacific Injury Conferences 1999-2005

Arizona, September 11th 2001

- Protective devices/concepts
  - In the event of a crash
    - Vehicle crashworthiness
    - Seatbelt belt systems
    - Equipment lock downs
    - Padding
    - Head protection
  - To prevent a crash
    - Driver feedback
    - Driver monitoring
    - Driver training
    - Vehicle technologies
    - Tared dispatch
    - Appropriate policies
This is where automotive safety is happening – where is EMS???

Enhanced Safety of Vehicles (ESV) – The Definitive Vehicle Safety Forum
Ambulance vehicle safety has only been presented at one ESV meeting, the 17th ESV in 2001

Crash Occupant Protection
- Collision speed
- Direction of impact
- Vehicle stiffness and mass
- Compartment size & projectiles
- Intelligent vehicle technology
- Passive protection
- Head protection
- Occupant restraint/belts

Global EMS Standards
- Australia & New Zealand ASA 4535
- Common European Community EN1789
- 'USA KKK & NTEA – AMD'
- [Aviation - FAA/CAA/JAA]
- CAMTS
- International Joint Commission on Medical Transport
- Draft ANSI/ASSE Z15

This is happening out there NOW....

Gregg Theunes Appeal to his Senator, December 29, 2005

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

The 'workplace' IS a vehicle
- Providers often in vulnerable positions during transport.
  - Bench seat
  - Captain's chair
  - Standing or kneeling

Hazards
- View of Ambulance interior from rear
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

Head protection developments

- Head protection is an accepted, standard and standardized aspect of PPE for all Emergency Services, except for ground EMS personnel
- In a setting of new enhancements to ambulance transport safety – and a realistic understanding of time frames for such changes to fleet vehicles – head protection is a simple and cost effective initiative
- As a result of this study a collaborative relationship has been established with International Safety Equipment Association (ISEA) to support the development of a standard for ground EMS head protection

Crash Prevention

- EVOC
- Tiered Dispatch
- The ‘Black Box’
- Intelligent vehicle design
- Appropriate policy

The “Black Box”

Driver behavior monitoring and feedback device

The difference having data makes?

We apologize for any inconvenience caused

But what about head protection?

It does happen...
**Demonstrated Effectiveness**

- Improved safety, performance and decreased costs:
  - No increase in response times
  - Pays for itself in 6 months in reduced maintenance costs alone
  - Improved safety proxies by orders of magnitude and sustained with no in-service
  - Reduced crash rate by up to 90%
  - Well accepted
  - Is it ethical NOT to have these devices in all vehicles now?

- 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

**Air EMS is a role model for safety initiatives and focus**

**Safety Management**

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

**Creating a Safety Culture**

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

**USA EMS Risk/Hazards**

- Predictable risks
- Serious occupational hazard
- Predictable fatal injuries
Multidisciplinary collaboration and the way forward

- Development of interdisciplinary teams
  - healthcare professionals
  - safety engineering expertise
  - regulatory bodies
  - manufacturers
- Safer practices save lives, time and money

Automotive Safety PPE

- Automotive restraint in the EMS environment is a specialized form of PPE
- Ergonomic or Occupational Health and Safety expertise is key to workplace safety - but is outside of expertise with a history of automotive crash safety or vehicle restraint safety testing
- The automotive safety industry is THE industry where the safety of devices that are for the protection of occupants in a moving vehicle, are best evaluated

Other Devices

- In both the military and the automotive industry being ambulant in a moving vehicle or crash, in any device, is a dangerous practice and is not supported
- Use of current ‘seated’ crash dummies to demonstrate that such ambulatory devices may be safe is a fallacy, and misleading
- Peer review at ESV (Enhanced Safety of Vehicles)!

The Crash Event - Crash Testing

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

The right test for the desired outcome

- Protecting the vehicle alone may not protect the occupants
- Crash tests using crash test pulses not specific to ambulance vehicles may give misleading results
- Crash tests of restraint or other equipment using crash dummies not designed for that purpose, may give misleading results, or worse - may suggest that a dangerous or unsafe device may be safe

Full Vehicle Crash Tests - 2000

- Test 1 - Right side impact
- Test 2 - Frontal

Preparation of test vehicles

- Pre-impact CTD positioning

Florida Ambulance Hit Head-on
New Industry Initiatives

- Development of an industry based task force –
  - First multidisciplinary symposium held in DC, November 2003.
- AMR Concept vehicle on display at EMS Expo 2004 & 2005.
- Planned AAA symposium Spring 2006.

USA design initiatives

New Swedish vehicles

New Australian vehicles

New UK London Ambulance/neonatal vehicles
Other successful models

The right vehicle for the environment?

Not a good day for golf

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?

A glimpse of the future

Policy that Reflects SCIENCE

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

PREDICTABLE PREVENTABLE and NO ACCIDENT

Future Directions
Rational use of limited resource
Avoid reinventing the wheel
Formal safety research agenda
Framework bridging key research and infrastructure
Society of Automotive Engineers
Involvement with ESV activities
EMS safety research funding
Foster evidence based initiatives
Conclusion

- Major advances in EMS transport 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 safety standards is a necessity and a reality
- Enhanced cross-disciplinary collaboration in development of safety initiatives now exist
- 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

Electronic Info:

- www.objectivesafety.net
- Electronic Handout of today's presentation
- "Ambulance Safety: Where is the State of the Art?" Webinar June 14, 2005
  Recorded online - Free access via the internet
- Comprehensive Reference List on EMS Safety

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