


National Association of EMS Physicians
2006 Annual Conference, Tucson Arizona

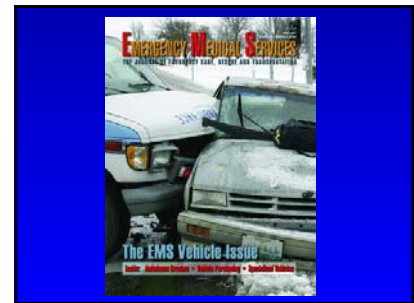
New initiatives in EMS Transport Safety: Where is the State-of-the-Art?

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This morning's Scope

- ▶ **Key Issues**
 - Crash and Safety Data
 - Oversight
- ▶ **Guidelines – standards**
 - Existing plus Draft '21'
- ▶ **Transport safety management**
 - Protective devices/programs
 - In the event of a crash
 - To prevent a crash
 - Safety Culture
- ▶ **Future**
 - Goals
 - New Safety Seminar
 - New vehicles
 - New technologies
 - Futuristic vehicles
 - New policies
 - New practices
 - New Standards



A tragic emergency health care intervention outcome

Emergency crew find one of their own killed in crash



Rollover Crash Kills Medical Technician
Ambulance Crew Off-High and Side-Over Again: Two Engineers and a Patient

It does happen....

Key Issues

- ▶ **Mythology**
 - That Emergency Medical Service personnel are safe
- ▶ **Injury Hazards**
 - Biohazard
 - Chemical/Radiation
 - 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**
 - Occupational Health and Safety
 - the workplace is in a vehicle – exposure data are scant
 - Automotive Safety
 - a vehicle is the work place – 'exempt' from automotive research and regulation

USA EMS

- ▶ **EMS Systems** - >15,000
- ▶ **Personnel** - ~1 million
(~30% F/T professional & 70% volunteer)
- ▶ **Vehicles** - ~50,000
(Type I, Type II, Type III, Freightliners, ?motorcycles)
- ▶ **Transports** - ~30 million patients
- ▶ **Cost** - ~\$5 Billion annually
- ▶ **Safety Oversight** - ? Disparate

Safety oversight of what and by whom

- ▶ **Vehicle Safety**
- ▶ **Vehicle Design**
- ▶ **Safety Equipment Design**
- ▶ **Vehicle and Safety Equipment Testing and Standard development**
- ▶ **Safety policies**

Ideally Who, What and Where ?

- ▶ **Occupational Health and Safety**
 - Epidemiology, Bio/Chem Hazards and Ergonomics
 - Regulation and Research
- ▶ **Automotive Safety**
 - Epidemiology, Engineering and Impact Biomechanics
 - Regulation and Research
- ▶ **EMS Industry**
 - Occ. Health, Automotive, Technical, Clinical & Fiscal data
 - Practice Policy, Risk Management and Fleet Safety
- ▶ **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**

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??

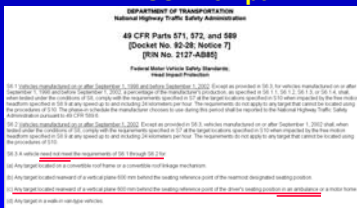
Concerns

- ▶ 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

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



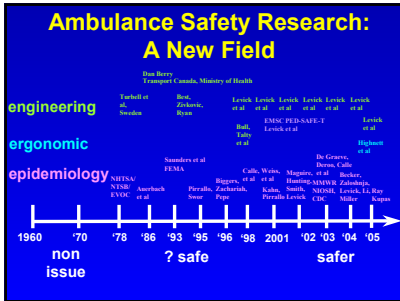
Predictable risks

- ▶ ~ One fatality each week!
- ▶ ~ 23 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)*
- ▶ 82% 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

*Nolan CA, Pivato RG, Kuhn EM. *Prehosp Emerg Care* 2001; Jul-Sep;5(3):361-9
 **Baker, Zarabing, Levin, Li, Miller, *Acc Anal Prev* 2003
 ***Bogner, Hartwig, Smith, Linnik, *Am J Emerg Med* Dec 2000
 ##GSH 2003
 ##Bogner AM, Richards DF. *Prehosp Emerg Care* 2005; Dec; 9:412-416
 ##NHTSA, 49 CFR Parts 571, 572 & 589 Docket no. 99-338, notice 7



- ### 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



- ### 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 were 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)
- *Comparison of Crashes Involving Ambulances with those of similar sized vehicles - Adam Ray, Douglas Kupas, PEC Dec 2005;9:412-415

- ### 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.....



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.



JEAS.com News
Date last updated: Wednesday, January 18, 9:28 PM

HANOVER | [First Article](#) | [Email Article to a Friend](#)

Pa. crew member thrown from ambulance in crash

HANOVER TOWNSHIP, Pa. — Ambulance crew member Dan Rescitti, of Wilkes-Barre, was thrown from the vehicle when it crashed at 4:55 a.m. on Interstate 81 near mile post 142.5, according to state police.

The Spelman ambulance, driven by Mike Belavicz, of Hanover Township, was northbound on I-81 when the vehicle veered on west lanes for approximately 200 feet, then traveled across the northbound lanes, struck a guardrail and rolled over before coming to rest on its wheels facing south.

Rescitti and Belavicz were transported to the Community Medical Center in Scranton.

Additional information about Rescitti's injuries was not immediately available.

Neither was wearing a seat belt. No patient was on board.

Daily American Republic

Ambulance driver in fatal crash is charged

KENNESAW, Mo. (AP) — An ambulance driver from the Missouri Bootheel was charged Friday with two counts of involuntary manslaughter for an accident that killed a patient in the ambulance and the driver of the other vehicle.

The accident happened Sunday on Missouri 164 near Kennett in Dhabbs County.

Patrick White, 23, of Poplar Bluff, was driving an ambulance for Poplar Bluff Regional Medical Center. The Missouri State Highway Patrol said White failed to stop at a stop sign and struck a 1993 Buick driven by Timothy Winstead, 64, of Honesville.

The ambulance's siren and emergency lights were not on, the patrol report said.

Winstead and a patient in the ambulance, William Irwin, 66, of Wagnonville, were killed.

White suffered minor injuries. He is co-worker in the ambulance, James Simpson, 41, of Proctorville, Ark., was taken to a hospital in Memphis, Tenn., with serious injuries.

Bond for White was set at \$10,000.

Spring 1997

Those Lights & Sirens Don't Save Lives...

• Alexander Kuhl, MD, MPH, FACS

While the ambulance siren and emergency lights are on, the patrol report said.

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a policy dictating routine "flair" transport and light-and-siren use must save on what lot of lives to justify the unnecessary death of a medic/paramedic

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

SAE Presents...

MILITARY AND EMERGENCY VEHICLES SAFETY

International Military and Emergency Vehicle Symposium (IMEVS) 2001

September 11-12, 2001
Phoenix, Arizona, USA

Melbourne April 8th 2003

SAE Presents...

MILITARY AND EMERGENCY VEHICLES SAFETY

International Military and Emergency Vehicle Symposium (IMEVS) 2003

April 8-10, 2003
Melbourne, Australia

Protective devices/concepts

In the event of a crash

- ▶ Vehicle crashworthiness
- ▶ Seatseat belt systems
- ▶ Equipment lock downs
- ▶ Padding
- ▶ Head protection

To prevent a crash

- ▶ Driver feedback
- ▶ Driver monitoring
- ▶ Driver training
- ▶ Vehicle technologies
- ▶ Tiered 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....

Is a license enough for ambulance drivers?

Extent of EMT training questioned by witnesses

By DAVID BOGUE
Miami Herald Staff Writer

Monday Herald Staff Writer, Sun. Aug. 7, 2005

Gregg Theune

Gregg Theune, a crash victim's husband, on Tuesday.

64 It's no different than someone who drives pizzas.

Gregg Theunes Appeal to his Senator, December 29, 2005

Failure in EMS Response Procedures Contributes to Deaths

QUESTIONS

- 1. How many ambulances in the state are not equipped with the necessary medical equipment?
- 2. How many ambulances in the state are not equipped with the necessary medical equipment?
- 3. How many ambulances in the state are not equipped with the necessary medical equipment?
- 4. How many ambulances in the state are not equipped with the necessary medical equipment?
- 5. How many ambulances in the state are not equipped with the necessary medical equipment?

ANSWERS

- 1. 100%
- 2. 100%
- 3. 100%
- 4. 100%
- 5. 100%

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
 - Captains chair
 - Standing or kneeling

View of Ambulance interior from Rear

Hazards



It does happen....



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

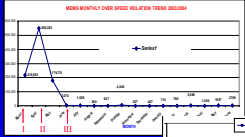
Crash Prevention

- ▶ EVOC
- ▶ Tiered Dispatch
- ▶ The "Black Box"
- ▶ Intelligent vehicle design
- ▶ Appropriate policy

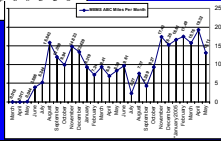
The "Black Box"

Driver behavior monitoring and feedback device

Demonstrated Effectiveness



I – blind data, no grows
 II – grows & tones ON
 unidentified data capture
 III – identified data



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

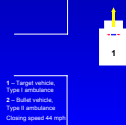
- ▶ An introduction
- ▶ What one needs to know
- ▶ What do the tests really mean
- ▶ And, what tests are meaningful

The right test for the desired outcome

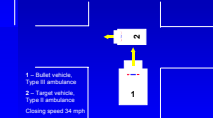
- ▶ Protecting the vehicle alone may not protect the occupants
- ▶ Crash tests using crash test pulses not specific to ambulance vehicles may give misleading results
- ▶ Crash tests of restraint or other equipment using crash dummies not designed for that purpose, may give misleading results, or worse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

Full Vehicle Crash Tests - 2000

Test 1 - Right side impact



Test 2 - Frontal



Updated: Wednesday, Mar 14 - 2:10 PM
 Florida - News - News

Florida Ambulance Hit Head-on

HEATHER CASEY
 Firehouse.Com News

Two Florida paramedics were seriously injured and another person is dead after an early morning crash between an ambulance and a Nissan car.

Just before 2:30 a.m. Wednesday, a car heading east on I-4 crossed the median and struck a Highlands County EMS ambulance head-on, according to Highlands County PIO Lisa Burley.

Courtesy: Orange County Fire Department



Computer Simulation



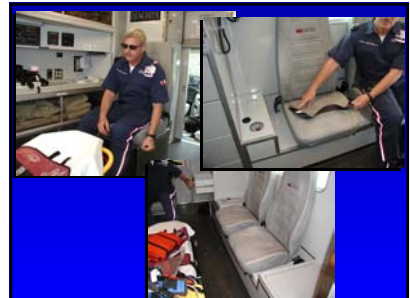
Safety Enhancements Being Implemented

- ▶ EVOC
- ▶ Tiered dispatch
- ▶ Monitoring & Feedback devices
- ▶ Helmets
- ▶ Optimized ambulance vehicle design
- ▶ New Standards

New Industry Initiatives

- ▶ Development of an industry based task force –
 - MMTS, Mobile Medical Transportation Safety Task Force, established January 2003.
 - 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



EMS Transport Safety

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



Acknowledgements

- ▶ EMSC funding -Targeted Issues Grant, PED-SAFE-T
- ▶ The late Capt. Garry Criddle - ExNHTSA/EMSC
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