

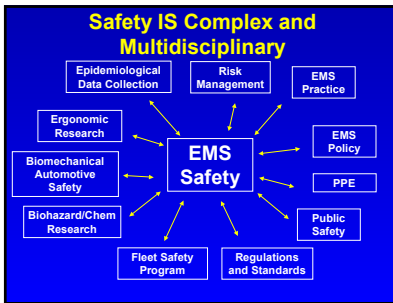


American Ambulance Association
Annual Convention and Trade Show, 2005 Las Vegas



EMS Vehicle Safety: Where is the State-of-the-Art?

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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
- ▶ **First Responder 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

Challenges to Optimizing USA 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 automotive safety industry
- ▶ Rear compartment exempt from FMVSS
- ▶ Complex automotive safety area bridging acute clinical care, public health, public safety and automotive safety
- ▶ Very recent history as a research issue
- ▶ Limited fiscal support for cross disciplinary EMS transport safety research

Then, The Opportunity

- ▶ This is vehicles, and this is vehicle safety
- ▶ Vehicle safety technology and infrastructure exists
- ▶ Ditto drivers, and driver safety technology
- ▶ Collaboration, and the multidisciplinary model
- ▶ Optimal use of very scarce resource

This morning's Scope

- ▶ **Key Issues**
 - Crash and Safety Data
 - Oversight
- ▶ **Guidelines – standards**
 - Existing plus '215'
 - In the event of a crash
 - To prevent a crash
- ▶ **Transport safety management**
 - Protective devices/programs
 - Safety Culture
- ▶ **Future**
 - Goals:
 - New vehicles
 - New technologies
 - Futuristic vehicles
 - New policies
 - New practices
 - New Standards

Key Issues

- ▶ **Mythology**
 - That Emergency Service Responders are safe
- ▶ **Injury Hazards**
 - Biohazard
 - Chemical/Radiation
 - Physical/Mechanical trauma – THE BIG PROBLEM
- ▶ **Motor Vehicle Crashes are the highest cause of death at work – first responders have > 2X that 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

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

Background: Problems

- ▶ **Predictable risks**
 - More often at intersections, and with another vehicle (p < 0.001)*
 - Most serious and fatal injuries occurred in the rear (OR 2.7 vs front) and to improperly restrained occupants (OR 2.5 vs restrained)
 - 82% of fatally injured EMS rear occupants were unrestrained**
 - EMS has > 2X the mean national occupational fatality rate
 - > 74% of all occupational fatalities for EMTs are MVC related***
 - Serious head injury involved >65% of fatal EMS occupant injuries#
- ▶ **Vehicle rear passenger compartment > 60cm behind driver - exempt from FMVSS##**
- ▶ **No reporting system or database specifically for identifying ambulance crash related injury.**

*Matta C, A. Perrotta M, Lavin E.M. Prehosp Emerg Care 2001; Jul-Sep 5(3): 302-9
**Baker J, Zaritsky L, Smith S, Miller J, et al. Acad Emerg Med 2003
***Maguire, Hastings, Smith, Lovick, Annals Emergency Medicine 2002
#Morrill 2003
##NHTSA 49 CFR Part 571, 572 & 589 December 92-26, section 7

We should use the best safety practices demonstrated

Development of an Effective Ambulance Patient Restraint

Development and Application of a Dynamic Testing Procedure for Ambulance Paediatric Patient Restraint Systems

2001-01-1173

Biomechanics of the patient compartment of ambulance vehicles under crash conditions: testing countermeasures to mitigate injury

Author: **John T. Lawrence**, **John T. Lawrence**



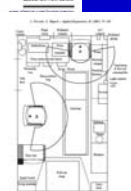
UK Ergonomic Paper 2005

Reviewing ambulance design for clinical and paramedic safety

Jonny Formis, Sue Hignett*

Abstract

This study aimed to review the layout of the patient compartment in a UK ambulance for ease of use by clinical staff. Parameters were observed and recorded during the course of the study. The study found that ambulance design is often not user centred and that there are many opportunities for improvement. The study found that ambulance design is often not user centred and that there are many opportunities for improvement. The study found that ambulance design is often not user centred and that there are many opportunities for improvement.




Background: Biomechanics

- ▶ Vehicles are hazardous
- ▶ Vehicles have poor crashworthiness
- ▶ Vehicle interiors are hazardous
- ▶ There exist simple solutions to substantially optimize the safety of this environment

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 current vehicle design features are beneficial, such as automotive grade padding in head strike areas, seats that can slide toward the patient
- ▶ Head protection??

Balance of concerns and risk during transport



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

EMS is emerging in the vehicle safety arena


- ▶ First and only presentation of ambulance safety research at ESV Congress was 2001
- ▶ 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

Abstracts by Public Report 2001-01-1173



Melbourne April 8th 2003

NATIONAL EMERGENCY SERVICES SYMPOSIUM 2003

Abstracts by Public Report 2003-01-1173



Girl, medics injured in crash

NEW HAVEN, Conn. — A 10-year-old girl was injured when the ambulance she was riding in crashed into a school bus stop sign on Monday.



Expectant Mother Loses Child In Crash On I-70
Ambulance Driver Dies, Three Others Transported To Hospitals

By **THE WASH. POST** Staff Writer
 November 17, 2008

Story by
THE WASH. POST

ELIZABETH CITY, Md. — An ambulance driver was killed and an expectant mother lost her baby after a severe crash on Interstate 70 in Ellicott City, Md., on Friday afternoon. Sixty-three people were injured, three of whom were killed, three others seriously injured.



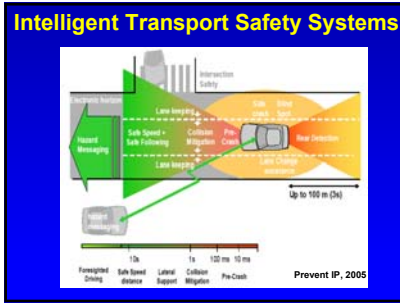
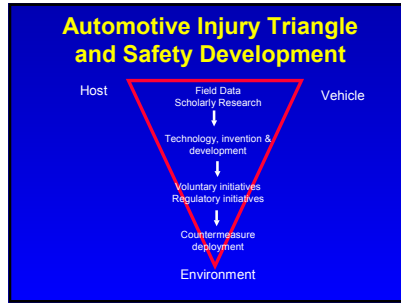
Protective devices

In the event of a crash

- ▶ Seat belts
- ▶ Equipment lock downs
- ▶ Padding
- ▶ Head protection

To prevent a crash

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



Enhanced Safety of Vehicles (ESV) Conference

ESV – The Definitive Vehicle Safety Forum

Ambulance vehicle safety has only been presented at one ESV meeting, the 17th ESV in 2001

Washington, DC USA
 10th International Technical Conference on the Enhanced Safety of Vehicles

ESV 17th Conference Search Result By: 06/17/08

The same search results that you requested for 1,000 pages, now in about 100 pages to print. Thank you.

ESV 17th Conference Search Result By: 06/17/08

ESV 17th Conference Search Result By: 06/17/08

SUV-ambulance crash injures 6

By **KERRY WILSON**
 OF The Oakland Press

AN 800-POUND SUV crashed into an ambulance on a quiet residential street in a suburb of Detroit on Friday, killing the ambulance driver and injuring six people, including several children in a passenger van who was not wearing a seat belt and was driven into a residential driveway.

The crash, which happened about 11:30 a.m. on Friday, was at 57th Avenue and 10th Street in the city of Warren. The ambulance, owned by American Medical Franchise and staffed by an employee and volunteer of the suburb, was on its way to a hospital.

The SUV, a Ford Expedition, was attempting to turn right on 57th Avenue from the north. It crossed the path of the ambulance, which was driving south on 57th Avenue. The SUV's driver, James L. James, 44, of Warren, was killed.

The ambulance driver, James L. James, 44, of Warren, was killed. The ambulance was on its way to a hospital.

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Daily American Republic

Ambulance driver in fatal crash is charged

KEENE, N.H. (AP) — An ambulance driver from the Mountain Road was charged Friday with one count 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 Route 164 near Keene in Doodle County.

James White, 33, of Foster Hill, was driving an ambulance for Foster Hill Regional Medical Center. The Mountain State Highway Patrol said White failed to stop at a stop sign and struck a 1992 Buick driven by Dorothy Ward, 64, of Horseville.

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

Ward and a patient in the ambulance, William Swales, 61, of Wappapah, were killed.

White suffered minor injuries. He co-works at the ambulance. James Depina, 43, of Picoche, Ark., was taken to a hospital in Memphis, Tenn., with minor injuries.

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

Prevention

Injury and crash prevention is better than cure

Crash Prevention

- ▶ EVOC
- ▶ Tiered Dispatch
- ▶ The “Black Box”

Crash Occupant Protection

- ▶ collision speed
- ▶ direction of impact
- ▶ vehicle stiffness and mass
- ▶ compartment size & projectiles
- ▶ passive protection
- ▶ head protection
- ▶ occupant restraint/belts

EMS Research /Data Vacuum

- ▶ ? total no. of ambulances
- ▶ ? total no. of medics
- ▶ ? total no. of runs (per age & severity)
- ▶ ? total pt. miles (per age & severity)
- ▶ ? true crash fatality rate per mile
- ▶ ? crash injury rate
- ▶ ? adverse events

The ‘workplace’ IS a vehicle

- ▶ Providers often in vulnerable positions during transport.
 - Bench seat
 - Captains chair
 - Standing or kneeling



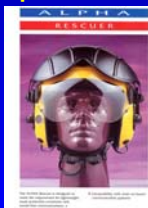
View of Ambulance interior from Rear

Hazards



It does happen....

But what about head protection?

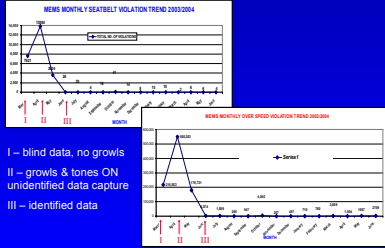


Head Protection Issues

- ▶ Absence of standards or guidelines for occupational head protection for ground EMS
- ▶ Exposure to ambulance crash head injury is high
- ▶ Dramatic increase in preparedness to wear head protection when hazards explained
- ▶ There is no PPE device specifically designed to meet the defined head injury hazards in EMS
- ▶ Head protection PPE device should include:
 - communication capacity
 - address comfort, visibility and aesthetics
 - be protective for automotive crash forces

The “Black Box”

Demonstrated Effectiveness



Two Important Questions

- ▶ Is it ethical to do any further black box studies?
- ▶ Is it ethical NOT to have these devices in all EMS vehicles, given the safety benefit and cost effectiveness?

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
- ▶ Much uncertainty as to what is safe and what is unsafe occupant protection practice
- ▶ 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

Safety for EMS Transport Goals

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

Air EMS is a role model for safety initiatives and focus



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

Global EMS Standards

- ▶ Australia & New Zealand 4535
- ▶ Common European Community (CEN) EN1789
- ▶ USA KKK & NTEA - AMD
- ▶ [Aviation - FAA/CAA/JAA]
- ▶ CAMTS
- ▶ Draft ANSI/ASSE Z15

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

Safety process

- ▶ Identify hazards
- ▶ Raise awareness of safety issues
- ▶ Create a safety attitude
- ▶ Promote Teamwork
- ▶ Provide motivation
- ▶ Accomplish established goals

This is about you and your safety

- ▶ What safety practices do you use??
 - ♦ Seat belts ?
 - ♦ EVOC training ?
 - ♦ Equipment lock down ?
 - ♦ Helmets ?
 - ♦ "Black Box" technology ?
 - ♦ Tiered dispatch ?

USA EMS Risk/Hazards

- ▶ Predictable risks
- ▶ Serious occupational hazard
- ▶ Predictable fatal injuries



Peds EMS

- ▶ ~One in ten (or about 6 million) ambulance transports involves a child
- ▶ Only ~ 1.8 million are children <5 yrs
- ▶ Ambulances ≠ standard passenger vehicles
- ▶ Pediatric patients in ambulances ≠ children in passenger cars

Kids are not little adults



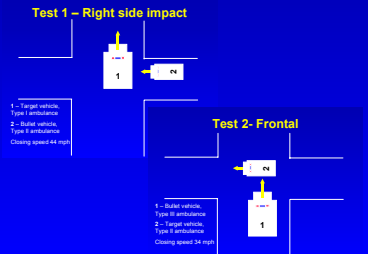
- ♦ Behavior
- ♦ Communication skills
- ♦ Fear
- ♦ Development
- ♦ Size and shape
- ♦ Biomechanics



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

Full Vehicle Crash Tests - 2000



Important Questions

1. How best to safety test EMS vehicles
2. What are the optimal safety enhancements for current vehicles
3. What is the ideal vehicle design

Concepts out there now

- ▶ Helmets
- ▶ Black Boxes
- ▶ Tiered dispatch
- ▶ Enhanced ambulance vehicle design
- ▶ Need for a cross disciplinary ambulance transport safety institute to be established

New Industry Task Force (MMTS)

- ▶ 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
- ▶ Concept vehicle on display at EMS Expo 2004 & 2005

USA design initiatives



concept vehicles I & II



Swedish Volvo ambulances



New Australian vehicles



New UK London Ambulance/neonatal vehicles



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 ?

A glimpse of the future



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

Safety Enhancements Being Implemented

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

Extremely Important Principles !

1. A culture of safety
2. Drive cautiously
3. Wear your belts & restrain all occupants (use over the shoulder harnesses for patients)
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

**PREDICTABLE
PREVENTABLE
and
NO ACCIDENT**

Conclusions

- ▶ Focus on safety of ALL aspects of the ambulance environment
- ▶ Develop a Safety Culture
- ▶ Real dangers exist in some current practices - Unrestrained occupants and equipment are a potential injury risk to all occupants
- ▶ Safer patient transport practices exist & should be used
- ▶ Prevention is key- teach EVOC
- ▶ Safety developments are underway: be ready to integrate them into your practice

Electronic Info for you all:

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
- ▶ George Gillespie & Michael Schultze – US Military NAWC
- ▶ Joe McIntire & Joe Liscina - USAARL
- ▶ Veridian/Calspan/CenTIR
- ▶ Ambulance Association of America
- ▶ The USA EMS community
- ▶ Bill Murphy - Ontario Ministry of Health
- ▶ Muttiah Jeyendra - Standards Australia
- ▶ Research assistants – Allison Better, Tony Tsai, Philip Lee and Puneet Gupta.