Ambulance Transport Safety: What you need to know

Outline

I. Review of data on ambulance crashes and ground transport safety
II. Review of safety standards and guidelines that exist for the ground EMS and patient transport environment and update of latest safety developments
III. Identification of ground transport safety issues, hazards and areas of risk patients and EMS providers and profile new safety technologies.
IV. Strategies to enhance safety and reduce risks of injury during ground EMS and patient transport

Objectives

1. Educate on the risks to patients, transport and emergency medical service providers and the public from ambulance crashes.
2. Explore factors related to ambulance crashes and identify potential mechanisms of injury to patients and transport providers
3. Explain new transport safety technologies and innovations and describe the new concepts that are under development.
4. Instruct providers on strategies for enhancing transport safety and reducing risk of injury to patients and providers during transport

Some recent adverse outcomes

http://www.objectivesafety.net

Firstly!

An accident —?

or a predictable and preventable event

So….

On their way TO the hospital
With a patient who was not in cardiac arrest or in a life threatening situation
All 5 in the ambulance critically injured
EMS Best Practice, Sept 2006

Ambulance Safety Research: A New Field

We should use the best safety practices demonstrated in engineering and in ergonomics.

and in ergonomics

Risk Exposure Rates

and what is killing EMS?

EMS personnel fatalities*

- 74% transportation related
  - 1/5 of ground transport fatalities were struck by moving vehicles
  - 11% were cardiovascular
  - 9% were homicide
  - 4% needle sticks, electrocution, drowning and other


Predictable risks

- 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

So does it make sense?

- Gloves and universal precautions?... ... good biohazard protection BUT aren’t going to give much protection in an ambulance crash

A word about occupational transportation fatalities...

- WE HAVE A BIG PROBLEM HERE


Kahn CA, Pirrallo RG, Kuhn EM, Prehosp Emerg Care 2001 Jul-Sep; 5(3):261-9

Becker, Zaloshnja, Levick, Li, Miller, Acc Anal Prev 2003


NIOSH, 2003

Ray AM, Kupas DF, Prehosp Emerg Care 2005 Dec; 9:412-415

NHTSA, 49 CFR Parts 571, 572 & 589 Docket no. 92-28; notice 7

De Graeve, Deroo, Calle et al
Calle, et al

2001-2005

Highnett et al

Ray

Johnson, Lindholm, Dowd

Risk Exposure Rates

405 386 212
849
3,200

0
500
1000
1500
2000
2500
3000
3500

Automobile
Light Truck
Large Truck
Motorcycle
Urban Ambulance (Biggers et al. 1994)

FARS 2003 DATA & Biggers et al 1994

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EMS Injuries*
- Higher than the injury rate for any private industry published by DOL
- 34.6 injuries/100 full-time workers per year
- 1.5 x that of fire fighters
- 5.8 x that of health services personnel
- 7 x the national average


And the injury events...

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 - ~50 million
  (to Emergency Deps ~ 50%, < 1/3 emergent)
- Cost - ~$8 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

A Simple Question....

- EMERGENCY MEDICAL SERVICES DISPATCH SERVICES
  - Increase the participation and role of Regional EMS Councils in local and regional highway traffic safety efforts and organizations
- PRE-HOSPITAL TRAINING PROGRAMS
  - Increase the participation and role of Regional EMS Councils in local and regional highway traffic safety efforts and organizations
  - Increase education and involvement of EMS providers in the development and implementation of safety protocols and educational materials
  - Provide funds and/or support to certified EMS Course Sponsors to train EMS providers in the use of these protocols and collaborate with Regional EMS Councils and/or Regional Emergency Medical Advisory Committees (REMAC) on the development and implementation of training programs
- ROAD CONDITION AND INCIDENT RESPONSE
  - Provide a question for regional and/or county EMS representatives in the development of emergency management plan development and implementation

- EMS RESPONDER CRASH PREVENTION
  - Undertake a systematic review of other state actions and protocols for reducing injuries to the emergency vehicle crew system
  - Identify and prioritize those areas and protocols that may contribute to injuries resulting from the impact of emergency vehicles
  - Develop and implement ambulance traffic safety protocols at state, regional and service level
  - Increase education and involvement of EMS providers in the development and implementation of safety protocols and educational materials
  - Provide funds and/or support to certified EMS Course Sponsors to train EMS providers in the use of these protocols and collaborate with Regional EMS Councils and/or Regional Emergency Medical Advisory Committees (REMAC) on the development and implementation of training programs
  - Identify methods to provide incentives for adoption by EMS services of protocols that enhance traffic safety
  - Increase education and involvement of EMS providers in the development and implementation of safety protocols and educational materials

Is any of this a surprise?
- It shouldn’t be....
- Its all published and in the peer reviewed literature

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- Vehicle Design
- Safety Equipment Design
- Vehicle and Safety Equipment Testing and Standard development
- Safety policies
Unique workplace

- In vehicles
- At roadside and other emergency scenes

The EMS transport process

- Communications/dispatch
- The patient
- Restraining 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

The Emergency Department (ED)

EMS Transport Safety IS Complex AND Multidisciplinary

- Epidemiological Data Collection
- Ergonomic Research
- Biomechanical Automotive Safety
- Fleet Safety Program
- Risk Management
- Public Safety

EMS Safety

- EMS Policy
- EMS Practice
- Regulations and Standards
- Fleet Safety Program

This is not acceptable

In the USA:
- ~ 5,000 crashes a year
- ~ One fatality each week
- ~2/3 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

An ambulance is not an ED/ICU on wheels

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Haddon/Baker/Runyan Phase Factor Matrix as applied to EMS Safety:*
Balance of concerns and risk during transport

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

Benefits 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

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?

NAEMT July 2006 Position Statement

Tips for Emergency Vehicle Operations

The truck and bus industry is on the right track.... Where is EMS??

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

EMS Transport General 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: USA Problems

- No reporting system or database specifically for identifying ambulance crash related injury
- No occupational and health safety standards to protect providers from injury
- Rear passenger compartment, > 60cm behind driver - exempt from Federal Motor Vehicle Safety Standards (FMVSS)
USA Ambulances: FMVSS Exempt

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

Stop
car

40 mph

Perception + Reaction time

Vehicle Braking time (dry)

Stopped at 176 feet

Perception + Reaction time

Vehicle Braking time (wet)

Stopped at 220 feet

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??

No need to reinvent the wheel...

Paramedic injured in crash is recovering

Guidelines for Employees in Ambulance Service Siting

Archaeology Daily News

FMVSS Exempt
At the time of the accident...

- There were three personnel in the back of the ambulance plus the patient.
- The patient being treated had a self inflicted laceration with an arterial bleed to an upper extremity.
- The ambulance was traveling lights and sirens and moving slowly through an intersection when they were involved in a T-bone collision.
- They were struck on the passenger side of the vehicle near the rear of the box.
- A paramedic, with the serious head injury was seated and unrestrained on the bench seat over the rear wheel well on the impact side of the vehicle.
- At the time of impact, the paramedic with the head injury had just finished starting an IV and was discarding his needle in a wall mounted sharps container.
- A second Paramedic was standing at the head of the patient involved in an unknown activity. An EMT was standing near the front of the bench seat, holding direct pressure and elevating the patient's arm.
- The second paramedic and the EMT received minor soft tissue injuries only. The paramedic with the head injury was intubated for a short time and then extubated later that same evening.
- He is back to work after a couple of months off the job. He is not working as a paramedic yet, but he is back on the line as a chiefs aid until his doctor gives him permission to return to active duty status. He has been dealing with memory problems and the need to sleep for longer hours than normal.

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

Preliminary Study: Attitudes to Head Protection in EMS

- 16% Yes
- 84% No

Hmm...

- New EMS helmet prototypes for 2006-2007

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

eg: Scandinavia Innovation in Vehicles, and Equipment

This looks cool AND SAFE!

Not rocket science...

Global EMS Vehicle Safety Standards

- EMS Safety and Performance Standards
- Australia & New Zealand 4558
- Common European Community (CEN) EN1789
- Non EMS Specific USA Standards
  - (Aviation - FAA/CAA/JAA)
  - Z15 – Fleet vehicles safety management
- USA EMS Specification & Guidelines
- Purchase Specification: KKK & NTEA – AMD
- Guideline: EMSC Dos and Don'ts
- ASTM, CAAS and CAMTS

USA ambulance purchase specifications

- Static Pull test
  - 2200 lbs. (6G’s) in Longitudinal and Lateral
- No dynamic test
- No definition to manikin mass
- No restraint for equipment
- Voluntary

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
Automotive Injury Triangle and Safety Development

Host

Vehicle

Environment

Technology, investment, development

Scholarly Research

Driver feedback

Driver monitoring

Driver training

Vehicle Intelligent Transportation System (ITS) technologies

Tiered dispatch

Appropriate policies

To prevent a crash

In the event of a crash

Seat/seat belt systems

Equipment lock downs

Padding

Head protection

Protective devices/concepts

Tiered Dispatch

Back up Camera... Shouldn’t all vehicles have one of these?
The "Black Box"
Driver behavior monitoring and feedback device

Purpose of 'Black box' Program
- Enhance Safety
- Improve Driver Performance
- Save Maintenance Dollars
- Aid Accident / Incident Investigation

This technology is conceptually like a vehicle safety 'pulse oximeter' – that with auditory feedback - can save your life, your coworkers life, your patients life, and others on the road.

Monitoring and feedback devices
- 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 inservice or retraining after the initial introduction period.

Demonstrated Effectiveness

A key to safe ambulance transport

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

The jury is out on
- Opticon
- Simulators

Active Projects
(all due early 2007)
- Commercial Motor Vehicle Driver Training Curricula and Delivery Methods and Their Effectiveness
- Commercial Motor Vehicle Carrier Safety Management Certification
- The Role of Safety Culture in Preventing Commercial Vehicle Crashes
- The Impact of Behavior-Based Safety Techniques on Commercial Motor Vehicle Drivers
- Health and Wellness Programs for Commercial Motor Vehicle Drivers
Dynamic Safety Testing

- requires sophisticated, expensive equipment
- measurably demonstrates forces generated during collision
- accepted international standard for vehicle restraint systems

in a collision at 35 mph (60 km/hr), an unrestrained 15 kg child is exposed to the same forces* as in falling from a 4th story window

*550 kg/force in 0.03 sec

Choose the Best Option

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

Foldable

Full Vehicle Crash Tests

Test 1 - Right side impact

Test 2 - Frontal

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
Were we safer in the Cadillac??

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

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

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

An excellent model

16 Firefighter Life Safety Initiatives
www.EveryoneGoesHome.com
- Define and eliminate the need for a cultural change relating to safety, including workplace, at home, and community.
- Enhance the awareness and accountability surrounding the need for safety.
- Promote the public’s role in the prevention of management and safety.
- Provide dedicated resources for the management and safety.
- Ensure all employees are trained, equipped, and performing appropriately.
- Develop and implement policies and procedures for training, qualifications, and certification.
- Develop and implement national performance-related medical and physical fitness guidelines.
- Establish a national research and data collection system.
- Utilize available technology to produce higher levels of health and safety.
- Thoroughly investigate all fatalities, injuries, and near misses.
- Grant programs support the implementation of safe practices and mandate safe practices as an eligibility requirement.
- Develop national standards for emergency response policies and procedures.
- Develop national protocols for standardizing in national programs.
- Provide for the enforcement of codes and laws and the installation of home fire sprinklers.
- Safety must be a primary consideration in the design of equipment and necessary.

USA design initiatives
New Australian vehicles

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

UK Ambulance vehicles

Clear safety message

Sweden initiatives

Norway initiatives

Other successful models

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?

Safety Enhancements Being Implemented

- EVOC
- Tiered dispatch
- Monitoring & Feedback devices
- Helmets
- Optimized ambulance vehicle design
- New Policies and Standards
Future
- Meaningful Goals
- New policies
- New practices
- New standards
- New vehicles
- New technologies

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

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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
- 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 and death

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