“Everything you always wanted to know about ambulance transport safety but were afraid to ask!”

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American Ambulance Association
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A tragic emergency health care intervention outcome

It does happen....

Review of developments addressing the safety, risks and hazards of ambulance transport

- Population based data on ambulance crashes, injuries and mortality
- Ambulance vehicle crashworthiness
- Ergonomics
- Risks and hazards
- Current and new safety intervention technologies
- Safety oversight
- Recently approved fleet safety standards
- New initiatives and guidelines underdevelopment
- Footage of crash scenes and crash tests of ambulances

What’s going wrong, Why is it so, and Who’s paying for it??????

- Where is the big picture that outlines the problems
- Why are we allowing the same tragic things to happen OVER and OVER again
- Who’s pocket is getting hit

Balance of concerns and risk during transport

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

EMS Transport Safety

- ‘patient safety’
- AND also
- ‘provider’ and ‘public safety’

Transportation is your biggest black hole

- You are 10 x more likely to be sued for the way your vehicles are operated than you are for medical malpractice
- Vehicle related issues ARE your highest risk management cost

Firstly!

- An accident?
- or a predictable and preventable event

the EMS process

- communications/dispatch
- the patient
- restraining devices/beds
- transporting device/insert
- paramedics/transport nurses, doctors & family
- patient monitoring equipment
- clinical care & interventions
- protective equipment
- the vehicle
- the drivers/driving skill
- other road users
- the road
USA EMS

- EMS Systems - >15,000
- Personnel - ~ 1 million (~30% F/T professional & 70% volunteer)
- Vehicles - ~50,000
  (Type I, Type II, Type III, Firefighters, ?motorcycles)
- Transports - ~50 million
  (to Emergency Depts ~ 50%, < 1/3 emergent)
- Cost - ~$5 Billion annually
- Safety Oversight - ? Disparate

Safety oversight of what and by ....

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

This is not acceptable

In the USA*

- ~ 5,000 crashes a year
- ~ One fatality each week
- ~33 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

Ambulance Safety Research: A New Field

We should use the best safety practices demonstrated

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***
- More likely to crash at an intersection with traffic lights (37% vs 18% p=0.001) & more people & injuries/crash than similar sized vehicles##

EMS Provider Fatalities

- 12.7 fatalities/100,000 EMS workers
- Greater than 2 X the national average (5.0 fatalities/100,000)
- Similar to Police (14.2/100,000) and Fire Fighters (16.5/100,000)

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

We have a big problem here

A word about occupational transportation fatalities


EMS Injuries*

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

* Maguire, Hunting, Guidotti & Smith, Occupational Injuries among Emergency Medical Services Personnel, Prehospital and Emergency Care Oct/Dec 2005

The NTSB

- History and Mission

- EMS Safety and Performance Standards
  - Australia & New Zealand 4535
  - 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
      - CAN and CAM18

Global EMS Vehicle Safety Standards v Specifications and Guidelines

- ASTM F 1086 - 94
  - USA ambulance purchase specifications
  - Static Pull test: 2200 Lbs. (8G’s) in Longitudinal and Lateral
  - No dynamic test
  - No definition to manikin mass
  - No restraint for equipment
  - Voluntary


- Safe Practices for Fleet Motor Vehicle Operations
- Scope of the Z15.1 Standard
  - For the safe operation of motor vehicles owned or operated by organizations, including:
    - Definitions
    - Management Leadership Administration
    - Operational Environment
    - Driver Considerations
    - Vehicle Considerations
    - Incident Reporting and Analysis
  - These practices are designed for use by those having the responsibility for the administration and operation of motor vehicles as a part of organizational operations.

Z15 Incident Rates

- Incident rate based on number of vehicles operated:
  - Incident rate = Number of incidents / Number of vehicles operated
- Incident rate based on vehicle mile age:
  - Incident rate = Number of incidents / Vehicle mileage
- Injury incident rate based on vehicle mileage:
  - Injury incident rate = Number of incidents with injury / Vehicle mileage
- Incident rates based on service activity:
  - Incident rate = Number of incidents / Number of transports
- Vehicle injury rates based on work hours:
  - Incidents per 200,000 hours = Number of incidents / Number of hours worked

Legal Perspectives on Z.15

- Carlsbad (N.M.) Fire Department (1996): As a direct result of Z15, the caseload dropped 25%.
- City of Brooklyn (NY) – 1996: 20% reduction in claims.
- San Francisco Fire Department (1996): 6% reduction in cases filed and 25% reduction in personal injury.

Some vehicles contain a seat heater, and standard equipment should be installed. The following test results from the respective tests indicate that the seat heater complies with this standard:

Static Pull Test:
- 2200 Lbs. (8G’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...
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

Leaders in focus on optimizing safety practice
- Richmond Ambulance Authority
- Cetronia Ambulance Service
- American Medical Response
- Nova Scotia Ambulance Service
- New South Wales Ambulance Service
- Melbourne Neonatal transport Service, Australia

Canada, Nova Scotia
- Since 2000 working towards a goal of zero loss ratio with insurance provider
- 10 million kilometers per year
- 150 emergency response ambulance units
- Collision claim history measured in dollars per 10,000 kilometers traveled:
  - 2000/2001 $1725.00
  - 2001/2002 $1049.00
  - 2002/2003 $ 751.00
  - 2003/2004 $ 418.00
  - 2004/2005 $ 228.00

Richmond Ambulance Authority
- Patient Care
- QUICNET/CodeStat Suite
- Road Safety Technology
- Driver Reports
- Risk & Safety Reviews
  - 100% sentinel incident review
  - Workers Compensation Incidents
- National Safety Initiative
  - Themes of the Month
  - Vehicle Maintenance
  - “A” and “B” preventative Maintenance schedules

What we know that helps:
- Have safety policies and procedures
- Secure providers and other seated occupants with existing restraints
- Secure patient with over the shoulder harness
- Secure Equipment
- Use driver and vehicle monitoring and feedback technology
- Use tiered dispatch

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

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

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

What do ambulance crashes really cost?

- Loss of life and injury
- Negative impact on EMS system
- Collisions are the largest liability cost and exceed malpractice or negligence
- Besides the direct financial costs of replacing a damaged ambulance and equipment, there are additional hidden costs incurred:
  - investigating the ambulance collision
  - litigation/settlement/lawsuit
  - medical/disability costs of injured EMTs
  - hiring of new employees to replace injured personnel
  - retraining and psychological counseling of personnel involved and others
  - increased insurance rates

What needs to happen NOW?

- Implement a Fleet Safety Program
- Correct the basic policies and procedures regarding:
  - Intersections
  - Use of occupant restraints
  - Securing equipment
  - Driver performance
- Data
- Epidemiology
- Ergonomic
- Safety oversight

NAEMT July 2006 Position Statement

Key Issues

- Mythology
  - That Emergency Medical Service personnel are safe
- Injury Hazards
  - Bioterror
  - Chemical/Medication
  - Physical/Mechanical trauma – THE BIG PROBLEM
- Motor Vehicle Crashes are the highest cause of death at work – 10-25% higher than the mean national rate
- An R & D and Regulatory Gap
  - Occupational Health and Safety
  - Exposure data are scant
  - Automotive Safety – vehicles are a workplace - exempt from automotive research
- Engineering

The ‘workplace’ IS a vehicle

- Providers often in vulnerable positions during transport.
  - Bench seat
  - Captain’s chair
  - Standing or kneeling

But what about head protection?

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

New EMS helmet prototypes for 2006-2007

Concern
- What is currently occurring as routine practice in EMS is ignoring that science, and worse there are initiatives that are automotive safety in their entirety that are occurring outside of that industry and those principles.

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)!

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 ?

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

“Are our policies killing people?”
- 1991-2000, 202,969 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=0.01)
  - MVCs with more people injured (76% vs 61%, p=0.001)


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.....
Intersection passenger car stopping distance* at 40 mph dry and wet

Perception + Reaction time Vehicle Braking time (dry)

- Stop distance
- Perception time + Reaction time + Vehicle braking time
  (varies with age, skill, agility, distance, vehicle type, tire pressure, road etc)

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 when 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??

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???
Automotive Safety World

Protective devices/concepts
To prevent a crash
- Driver feedback
- Driver monitoring
- Driver training
- Vehicle ITS technologies
- Tiered dispatch
- Appropriate policies
In the event of a crash
- Vehicle crashworthiness
- Seat/seat belt systems
- Equipment lock downs
- Padding
- Head protection

Automotive Injury Triangle and Safety Development

Intelligent Transport Safety Systems

Automotive Injury Triangle

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

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.

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

Intelligent Transport Safety Systems

The “Black Box”

Purpose of ‘Black box’ Program

Monitoring and feedback devices

Other monitoring devices
The jury is out on

Opticon
Simulators

The Crash Event - Crash Testing

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

USA design initiatives

concept vehicles I & II

New Australian vehicles

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

Flexibility to manage two patients
UK Ambulance vehicles

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 Standards

What’s missing
1. What data is collected nationally?
   - We have no denominator data
   - We have incomplete numerator data
2. Absent population based national injury data or injury mechanics data
3. Absent structured automotive safety engineering input
   - $1 + 2 + 3 = \text{resultant inability to design and evaluate efficacy of injury interventions}
4. What oversight is there
5. Which organizations would determine policy

Current fleet
- Secure all equipment
- Secure occupants
- Don’t drive through red lights
- Use properly implemented “Black Boxes”
- Monitor crash events with common denominators (i.e., per 100,000 miles and per trip)
- Have a written and implemented ‘safety program’

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

Conclusion
- 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

PREDICTABLE
PREVENTABLE
and
NO ACCIDENT

Any Questions??
Electronic handout available online
http://www.objectivesafety.net