Ambulance Safety: Moving Sick Kids Safely - Optimizing Transport Safety

A tragic emergency health care intervention outcome

It does happen….

Outline
I. Review data on ambulance transport safety
II. Highlight important predictable and preventable occupant risks and hazards during neonatal and pediatric transport
III. Demonstrate what happens during an ambulance crash
IV. Review of guidelines, standards and innovation
V. Outline practices and strategies to enhance occupant safety and reduce risks of crash-related injury

http://www.objectivesafety.net

The National Transportation Safety Board (NTSB)

Key Issues
- Mythology: That Emergency Medical Service personnel are safe
- Injury Hazards
  - 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 a vehicle – exposure data are scant
    - “technology on the work place” – “transplant” from automotive research and regulations
- Safety oversight of what and by … whome
  - Vehicle Safety
  - Vehicle Design
  - Safety Equipment Design
  - Vehicle and Safety Equipment Testing and Standard development
  - Safety policies
Goals
- Standards for safety
- Policy based on Science
- Databases to demonstrate outcome

Safety in Pediatric/Neonatal Ambulance Transport
- Is part of a SYSTEM

Perinatal Transport Safety is Complex AND Multidisciplinary
- Epidemiological Data Collection
- Risk Management
- EMS Policy
- Transport Safety
- Ergonomic Research
- Retraining
- Public Safety
- Fleet Safety Program

the Peds EMS/transport process
- communications/dispach
- policies and procedures
- the pediatric patient
- restraining device/seats
- transporting device/gurney
- paramedics/transport nurses, doctors & family
- patient monitoring equipment
- clinical care & interventions
- the vehicle
- the driver/driving skill
- the road

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

This is not acceptable
- One fatality each week
- ~ 1/3 pedestrians or occupants of other car
- ~ 4 child fatalities per year (~2X airbags 2004-2005)
- ~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
- engineering
- ergonomic
- epidemiology

Peds Transport
- Collisions/crashes among pediatric transport teams are unusual
- Team resulted in deaths, injuries, and disability
- Appears to be caused by actions of a team member (higher risk of data loss)
- Collision policies for pediatric transport teams to specific policies of the team and/or the vehicle owner or vendor
- Specific safety policies on the part of the team (either vehicle owner or provider) may prevent or decrease collisions/crashes

Towards safer transfer: the importance of critical incident reporting and review can reduce the number of adverse events during the transfer of critically ill infants.

Neonatal Transport
- The continuous process of critical incident reporting and review can reduce the number of adverse events during the transfer of critically ill infants.

* Towards safer transfer: the importance of critical incident reporting and review can reduce the number of adverse events during the transfer of critically ill infants. - Woodward GA, Fleeger EW - Pediatr Emerg Care, 2002
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 2.1 vs restrained)
- 82% of fatally injured EMS rear occupants unrestrained**
- 74% of EMS occupational fatalities are MVC related**
- Seatbelt injury in 48% of fatal occupant injuries
- 70% of fatal crashes EMS crashes during Emergency Use
- More likely to crash at intersections with turned signals (31% vs 16% p=0.001) & more people & injuries/crash than similar sized vehicles

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

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

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 amongst providers 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

We should use the best safety practices demonstrated

- We HAVE A BIG PROBLEM HERE

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What are the risks?

- Lack of tiered dispatch systems
- Frequent use of high speed
- Issues of adherence to road laws
- High use of L & S.
- Rear cabin
  - not subject to any automotive safety regulation
  - minimal structural crashworthiness features
  - inadequate and poorly studied occupant and equipment restraint
- The only design standards that are written specifically for ambulance vehicles (KKK specs) are purchase specifications, not performance specifications
USA Ambulances: FMVSS Exempt

Identifying predictable and preventable transport related risks and hazards

- Systems approach
  - Communications
  - Personnel
  - Transport
  - Equipment
  - Environment

Protective devices/concepts

- In the event of a crash
  - Vehicle crashworthiness
  - Seatbelt systems
  - Equipment lock downs
  - Padding
  - Head protection

To prevent a crash

- Driver feedback
- Driver monitoring
- Driver training
- Vehicle and other technologies
- Tiered dispatch
- Appropriate policies

Intelligent Transport Safety Systems

“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.....

Global EMS Vehicle Safety Standards v Specifications and Guidelines

- EMS Safety and Performance Standards
  - Australia & New Zealand 4105
  - Common European Community (CEC) EN1789
- Non EMS Specific USA Standards
  - (Aviation - FAA/CAA/AIA)
  - (New ASSE/ANSI Z15 - fleet vehicles)
- USA Other
  - Purchase Specification: KKK & NTEA – AMD
  - Guideline: EMSC Dos and Don'ts, and (CAAS and CAMTS)

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

Z15 Incident Rates
- Incidence rate based on number of vehicles operated:
  \[ \text{Incidence rate} = \frac{\text{Number of incidents}}{\text{Number of vehicles}} \]
- Injury incidence rate based on vehicle mileage:
  \[ \text{Injury incidence rate} = \frac{\text{Number of incidents with injury}}{\text{Vehicle mileage}} \times 1,000,000 \]
- Incident rates based on service activity:
  \[ \text{Incidents per 10,000 transports} = \frac{\text{Number of incidents}}{\text{Number of transports}} \times 10,000 \]
- Vehicle injury rates based on work hours:
  \[ \text{Vehicle incidents per 200,000 hours} = \frac{\text{Number of incidents}}{\text{Number of hours worked}} \times 200,000 \]

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

Risk to who?
- Health care interventions that are a risk to:
  - Patients (their families?)
  - Providers
  - Public

USA EMS Risk/Hazards
- Predictable risks
- Serious occupational hazard
- Predictable fatal injuries

The ‘workplace’
- Transport provider's often in vulnerable positions during transport:
  - Bench seat
  - Captains chair
  - Standing or kneeling

Air EMS is a role model for safety initiatives and focus

It does happen….
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

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

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

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

Identifying predictable and preventable transport related risks and hazards
- Systems approach
  - Communications
  - Personnel
  - Transport
  - Equipment
  - Environment

Preliminary Study: Attitudes to Head Protection in EMS

Crash Test Results:

- Target vehicle, Type I ambulance
- Bullet vehicle, Type II ambulance
- Closing speed 44 mph

- Target vehicle, Type II ambulance
- Bullet vehicle, Type III ambulance
- Closing speed 34 mph
New concepts out there now

- Black Boxes
- Tiered dispatch
- Helmets
- Enhanced ambulance vehicle design
- Intelligent Transport Technologies - ITS
- New Safety Standards

The “Black Box”
Driver behavior monitoring and feedback device

Demonstrated Effectiveness

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

Important Principles!
1. Ambulances are NOT standard passenger vehicles

Important Principles!
2. Pediatric patients in ambulances have needs which differ from children in passenger cars

Important Principles!
3. Design, performance and practice policy should be based on properly conducted 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
Very 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

PREDICTABLE PREVENTABLE and NO ‘ACCIDENT’

Future

- Goals
- New vehicles
- New technologies
- Futuristic vehicles
- New policies
- New practices
- New Standards

Conclusions

- Prevention is key - the transport environment includes predictable and preventable risks.
- Every member of a transport program must play a role to actively manage risk and to avoid taking unnecessary risk.
- Focus on safety of ALL aspects of the transport environment.
- New technologies for vehicle design, occupant PPE, and equipment restraint and driver performance are now available; be ready to integrate them into your practice.
- There is a need for a defined pathway for translation of problem identification to resolution and policy implementation.

Conclusions

- Major advances in EMS transport safety research, infrastructure and practice over the past 5 years BUT patient transport safety is still way behind the state of the art in vehicle safety and occupant protection.
- Development of substantive safety standards is a necessity and a reality.
- The absence of any national infrastructure for safety oversight in patient transport is not an acceptable situation.
- And WE NEED DATA.

And…

- It is no longer acceptable for patient transport to be functioning outside of automotive safety and PPE safety standards for prevention of and protection of EMS/transport providers and the public from injury or death.

Electronic Info:

www.objectivesafety.net

- Electronic Handout of today’s presentation
- “Ambulance Safety: Where is the State of the Art?” Webinar - Recorded online - Free access via the internet
- Comprehensive Reference List on EMS Safety