Ambulance Transport Safety: Where is the State of the Art

Moving Sick Kids Safely - Optimizing Transport Safety for Crew, Neonates, and Children

Welcome
- Cincinnati Children’s
- Angel One – Arkansas Children’s Hospital
- Carolinas Medical Center
- Children’s Hospital Columbus Ohio
- Children’s National Medical Center
- Akron Children’s Hospital

Outline
I. Look at the 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

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
- Safety oversight of what and by whom
- Vehicle Safety
- Vehicle Design
- Safety Equipment Design
- Vehicle and Safety Equipment Testing and Standard development
- Safety policies

Pediatric Patient Transport Safety IS Complex AND Multidisciplinary

Ideally Who, What and Where?
- Occupational Health and Safety
  - Epidemiology, BioChem Hazards and Ergonomics Research and Research
- Automotive Safety
  - Epidemiology, Engineering and Impact Biomechanics Research and Research
- EMS Industry
  - OHS, 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

The NTSB

History and Mission

The National Transportation Safety Board (NTSB) is an independent Federal agency charged with investigating major accidents and incidents of transportation in the United States. NTSB auscults the occurrence and enforces safety standards in an effort to prevent future accidents.

- 30101 M Street, N.W.
- Washington, DC 20594-0001
-联系电话: 1-800-359-3544
- 网站: http://ptsb.gov

Safety in Pediatric Ambulance Transport

- Is part of a SYSTEM

http://www.objectivesafety.net

EMS Update

The Office of Emergency Medical Services

在2006年2月，NTSB发布了紧急医疗服务的年度报告。该报告提供了重要的信息和数据，有助于改善紧急医疗服务的安全性。报告中提到了一些重要的结论和建议，旨在提高紧急医疗服务的标准和质量。

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, PhD Dec 2005, 31417-972

http://www.objectivesafety.net
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.....

You know they must have seen you....

There is NO way humanly possible that they could stop.....

Is there an acceptable rate of morbidity and mortality for pre-hospital transport systems??

This is not acceptable

- One fatality each week#
- ~ 2/3 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

<table>
<thead>
<tr>
<th>911 Call to Hospital/ED Definitive Care Time Intervals*</th>
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<tbody>
<tr>
<td>Emergency Occurs</td>
</tr>
<tr>
<td>911 Contacted</td>
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<tr>
<td>EMS Vehicle Dispatched</td>
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<tr>
<td>EMS Arrives</td>
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<tr>
<td>EMS Leaves Scene</td>
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<tr>
<td>EMS Arrives at ED Bay</td>
</tr>
<tr>
<td>Hospital/ED Definitive Care</td>
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Vehicle related transport time

EMS response to the scene time

EMS dispatch time

ED EMS bay to hospital/ED definitive care time (Y)

This is not acceptable

Vision Zero:
An ethical approach to safety and mobility

- Claes Tingvall

Vision Zero is a philosophy of road safety that eventually no one will be killed or seriously injured within the road transport system. Vision Zero describes the view that safety cannot be traded for mobility. Sweden’s Vision Zero is aimed at eliminating all deaths or long-term health losses arising from road crashes. The mobility in the road transport system should be a function of the safety and not vice versa.

We should use the best safety practices demonstrated

- Electronic Driver monitoring/feedback systems appear to be highly effective

Predictable risks

- More often at intersections, & with another vehicle (p < 0.001)
- Most serious & fatal injuries occurred in rear (OR 2.7 vs front) & improperly restrained occupants (OR 2.5 vs restrained)
- ~12% of fatally injured EMS rear occupants unrestrained**
- ~74% of EMT occupational fatalities are MVC related***
- Head injury in 40% 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##
- Serious head injury in >65% of fatal occupant injuries#
- 70% of fatal crashes EMS crashes during Emergency Use##
- 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??

Ambulance Safety Research:
A New Field

ergonomic
epidemiology
non issue
safesafenerging

What do we know now??

- Intersection crashes are the most lethal
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911 Call to Hospital/ED Definitive Care Time Intervals*

Emergency Occurs
911 Contacted
EMS Vehicle Dispatched
EMS Arrives
EMS leaves Scene
EMS Arrives at ED Bay
Hospital/ED Definitive Care
Balance of concerns and risk during transport

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

Haddon/Baker/Runyan Phase-Factor Matrix

Response and transport time

- Clinical care provision
- Occupant safety/protection
- Public Safety

Public Safety

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

Identification of predictable and preventable transport related risks and hazards

What are the risks?

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

Multidisciplinary collaboration and the way forward

- Development of interdisciplinary teams
  - healthcare professionals
  - safety engineering experts
  - regulatory bodies
  - manufacturers
- Safer practices save lives, time and money

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

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 on the road
- Issues of adherence to road laws
- High use of L & S
- Rear cabin
- not subject to any automotive safety regulations
- minimal structural crashworthiness features
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USA Ambulances: FMVSS Exempt

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
This is happening out there NOW…. Gregg Theunes Appeal to his Senator, December 29, 2005

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

Safety for emergency transport
Policy that reflects SCIENCE

Global EMS Vehicle Safety Standards & Specifications and Guidelines
- EMS Safety and Performance Standards
  - Australia & New Zealand ANSI
  - European Community (CEN) EN1789
- Non EMS Specific USA Standards
  - [Aviation - FAA/CAA/JAA]
  - [New ASSE/ANSI Z15 – fleet vehicles]
- Other
  - [American Specification: XXV & NHTSA – AMD]
  - [Guideline: EMSC Dos and Don’ts, and (CAAS and CAMTS)]

New ANSI/ASSE Z15.1-2006

Transport Safety Guidelines EMSC/NHTSA fact sheet
http://www.ems-c.org
http://www.nhtsa.dot.gov

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
Cost?
- Loss of life and serious injury to EMS providers, patients, public
- Insurance payouts per serious crash: $10-35 million
- Estimated in excess of $500 million annually

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

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?

Air EMS is a role model for safety initiatives and focus

head protection?

Key Helmet Features

It does happen....
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

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

Test 1 – Right side impact
1 - Target vehicle, Type I ambulance
2 - Bullet vehicle, Type II ambulance
Closing speed 44 mph

Test 2- Frontal
1 - Bullet vehicle, Type III ambulance
2 - Target vehicle, Type II ambulance
Closing speed 34 mph

Johns Hopkins University

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

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?

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 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

Future

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

Conclusion

- Major advances in EMS transport safety research, infrastructure and practice over the past 5 years
- EMS is still way behind the state of the art in vehicle safety and occupant protection
- Enhanced cross disciplinary collaboration in development of safety initiatives now exist
- Focus on safety of ALL aspects of the ambulance environment - safer patient transport practices exist & should be used
- New safety developments are underway: be ready to integrate them into your practice
- And above all 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 providers and the public from death or injury...
Electronic Info:

www.objectivesafety.net

- Electronic Handout of today’s presentation
- “Ambulance Safety: Where is the State of the Art?”
  Webinar June 18, 2005
  Recorded online - Free access via the internet
- Comprehensive Reference List on EMS Safety

Acknowledgements

- EMSC funding – Targeted Issues Grant, PEDSAFE-T
- The late Capt. Garry Criddle – ENHTSA/EMSC
- George Gillespie & Michael Schultzes – US Military NAWC
- Joe McIntire & Joe Liscina - USAARL
- Allen Blatt & Bruce Donnelly – Ventian-Calpan
- Steve Horzeczak & Kurt Krumperman – 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