Protecting the Kids We Care For - EMS Transportation Safety

To quote Steve “Sid” Caesar – Director IHS ES

“We want everyone to get home safely each day”

Now, who have we here??

- Do you transport pediatric/neonatal patients?
- Are you responsible for vehicle purchases?
- Do you manage the oversight of your vehicle performance and safety?
- Do you design your vehicles?
- Do you have ergonomic, automotive safety and crashworthiness, occupant protection and fleet safety scientific and technical data background and support?
- Do you rely on health care colleagues and aftermarket retrofitters for technical vehicle safety and fleet performance advice?

Transport Medicine

EMS Transport Safety

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

A tragic emergency health care intervention outcome

A devastating tragedy…

- An ETT down the wrong hole may kill your patient and be a terrible burden for the pts family and for the medic involved
- BUT an EMS crash can kill all involved AND wipe out an EMS systems response capacity……
Objectives

- To identify the safety issues that are key regarding pediatric patient transport for the patient, the provider and the public
- To describe safety innovation and dispel safety myths
- To instruct providers on strategies for preventing crashes and for reducing risk of injury to patients, providers and the public during transport

Transport related aspects -

- dispatch of EMS/Medical transport vehicles
- transport policies and protocols
- vehicle fleets and vehicle design
- vehicle purchase standards
- Intelligent Transportation Systems (ITS) technology
- driver training
- training simulation
- driver performance monitoring
- roadways and road design
- integrated traffic safety technologies
- scene safety and visibility
- safety data capture
- safety oversight

An interhospital transport

An interhospital transport

“Do no harm…”?

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

Benefit of Safety

Preventable...

James Woodman

- is a paramedic who, on his first day as a paramedic, suffered a severe TBI when the ambulance he was riding in (in the back) was t-boned and rolled onto its side.
- He remains in a persistent vegetative state in an ECF in Colorado.
- It is assumed that when the ambulance rolled onto its side, the lifepack 10 struck James in the head.

Thursday July 5th 2007......

"...I’d like to know what can be done so this never happens again..."
Friday July 20th 2007...
The worst ambulance crash in USA history

Firstly!

- An accident?
- or a predictable and preventable event

Safety in Pediatric/Neonatal Ambulance Transport

- Is part of a SYSTEM

The Emergency Department (ED)

An ambulance is not an ED /ICU on wheels

While much is known about general Child Passenger Safety
Absence of ambulance standards and oversight

- Challenges in identifying best practice
- Myriad of unregulated commercial products
- No safety performance standards
- Absent national safety oversight

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??

Transport oversight?

- In contrast to the bus and truck industries, which have:
  - comprehensive safety oversight
  - transportation safety interventions
  - transportation safety data capture via the Federal Motor Carrier Safety Administration (FMCSA)
- EMS has been focused more as an acute health care delivery and emergency medical service and largely outside of much of the other transportation oversight infrastructure that exists

Safety oversight of what and .... by whom

- Vehicle Safety
- Vehicle Design
- Transportation systems safety
- Safety Equipment Design
- Vehicle and Safety Equipment Testing and Standard development
- Safety policies

A Simple Question.....

- This IS a Transportation and Automotive Safety issue
- This IS a Systems safety issue

Canada - Corporate Manslaughter
Corporate Homicide Act: 8th April, 2008

General Patient Transport 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

Clinical Care? Occupational Health and Safety.....?

- This IS a Transportation and Automotive Safety issue
- This IS a Systems safety issue

National EMS data

In the USA*
- ~ 50,000 vehicles
- ~ 5,000 crashes a year
  - One fatality each week
  - ~ 20 pedestrians or occupants of other car
  - Approximately 1 child fatality per year
  - ~10 serious injuries each day
- Cost estimates > $500 million annually
- USA crash fatality rate/capita 35x higher than in Australia

*FARS/BTS 2005-6
Predictable risks

- Fatal crashes more often at intersections, & with another vehicle (p < 0.001)
- 79% of fatal crashes EMS crashes during Emergency Use
- Most serious & fatal injuries occurred when CR (2.7 vs front) & to improperly restrained occupants (OR 2.5 vs restrained)
- 62% of fatally injured EMS rear occupants unrestrained
- Serious head injury in >50% of fatal occupant injuries
- 82% of fatally injured EMS rear occupants unrestrained
- >74% of EMT occupational fatalities are MVC related
- 70% of fatal crashes EMS crashes during Emergency Use
- Most serious & fatal injuries occurred in rear (OR 2.7 vs front) & to improperly restrained occupants (OR 2.5 vs restrained)
- Serious head injury in >50% of fatal occupant injuries
- >74% of EMT occupational fatalities are MVC related
- 70% of fatal crashes EMS crashes during Emergency Use
- Most serious & fatal injuries occurred in rear (OR 2.7 vs front) & to improperly restrained occupants (OR 2.5 vs restrained)
- Serious head injury in >50% of fatal occupant injuries
- >74% of EMT occupational fatalities are MVC related

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

<table>
<thead>
<tr>
<th>Condition</th>
<th>Stopping Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry</td>
<td>44 feet</td>
</tr>
<tr>
<td>Wet</td>
<td>220 feet</td>
</tr>
</tbody>
</table>

Perception + Reaction time + Vehicle Braking time

<table>
<thead>
<tr>
<th>Condition</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry</td>
<td>176 feet</td>
</tr>
<tr>
<td>Wet</td>
<td>220 feet</td>
</tr>
</tbody>
</table>

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

Knowledge, opinions and behaviors

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

Goals

- Balance of concerns and risk during transport
Key Elements to Safety

- Data Capture
- Vehicle Biomechanics and Crashworthiness
- Ergonomics and Biohazards
- Transportation Environment
- Safety Management – evaluation and analysis

1960 to 2007

A passenger vehicle – sure

"Laundry or mail truck"??

A passenger vehicle – yes!

Some odd facts

- Ambulances are generally not built by the automotive industry
- Intelligent Transportation Systems (ITS), transportation safety engineering and transport systems engineering are not generally integrated into EMS systems
- Although all EMS systems have medical direction and oversight, it is rare for there to be transportation expertise oversight

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 2007-2008

Hmm...

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Pediatric Transport Safety IS Complex AND Multidisciplinary

- Epidemiological Data Collection
- Ergonomic Research
- Biomechanical Biostatistical Safety
- Research/Crash Research
- Communications Technology
- EMS Practice
- Regulations and Standards
- Fleet Safety Programs
- Public Safety
- Oasis
- PPE
- Driver Training

New EMS helmet prototypes for 2007-2008

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???
EMS Best Practice, Sept 2006

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


So does it make sense?
- Gloves and universal precautions?...
  ... good biohazard protection BUT aren't going to give much protection in a ambulance crash

September 11, 2007

R & D
“Ripoff and Duplicate”
- Avoid reinventing the wheel at all costs
- Where are the best practices that we need to transfer knowledge from

Air EMS is a role model for safety initiatives and focus

Air and Ground EMS
- Major differences in safety culture and approach
- Dichotomy of Safety Standards
- Diverse safety oversight
- Absent ground safety regulatory control

Ambulance Safety Research: A New Field

Non issue

3 safe

1 safe

4 safer

5 safer
Dynamic Safety Testing

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

Intrusion vs Deceleration

- Intrusion
  = vehicle to vehicle or vehicle to fixed narrow object
- Deceleration
  = sudden stop – ie. sled test

Dynamic Sled Testing of Ambulance Pediatric Restraints

If we know this – and its published…

Why do we do this?

Full Vehicle Crash Testing

Test 1 – Right side impact

Pre-impact CTD positioning

TYP 3 RESTR.

Preparation of test vehicles
And this all takes place in 60 millisecs – the blink of an eye
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

USA Ambulances: FMVSS Exempt

Propaganda that kills...

Occupant protection......??
July 2007

KKK – static ‘safety testing’
- Ignorant of automotive safety principles – and specifies -
  - No structural damage to any load bearing or supporting members, i.e., bent or broken material, broken welds, popped or sheared body rivets, bolts, and/or fasteners, shall be evident during the application of the force and after the release of the force.

Unacceptable, and ridiculous current 2007 USA ambulance ‘safety testing’ practices!!??

AMBULANCE TEST RECORD COVER

INDUSTRY LEADING SAFETY INNOVATION
No ‘a’… then NO ‘F’ !!!!!

\[ F = ma \]

- \( F \) – force
- \( m \) – mass
- \( a \) – acceleration

FMVSS exempt……

NOT new technical data...

Side facing 4-point harnesses demonstrated to be lethal, even at slow ground vehicle speeds.

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 sidefacing occupants are potentially lethal – and is in NO WAY SUPPORTED BY ANY DATA OR AUTOMOTIVE SAFETY EXPERTISE

Rash of “Safety Concept” vehicles….. Devoid of substantive automotive safety engineering input or testing

- Sure… these vehicles all parade around the EMS and Fire shows
- BUT
- NOT ONE of these vehicles has been to the automotive safety shows or scrutinized by the automotive safety industry

JEMS and EMS Responder ARE NOT automotive safety journals

- And the reviews in them are completely inappropriate, misleading and outside of what is known in automotive safety
- We should NOT TOLERATE this as it is both completely irresponsible and very dangerous …..

Safety Management

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

Innovation
New concepts out there now

- Driver feedback boxes
- Tiered dispatch
- Helmets
- Enhanced ambulance vehicle design
- Intelligent Transport Technologies - ITS
- New Safety Standards

Ambulance Transport Safety Task Force (ATS) and the National Transportation safety Board (NTSB)

- TRB EMS Safety Update
  - Brought together NHTSA, FHWA, TRB, National Academies, DOT, CAMTS & EMS
  - 3 presentations
    - TRB and EMS
    - Safety Research
    - Accident Safety Issues and Directions
  - Recorded presentations and handouts available at www.objectivesafety.net
  - Potential for EMS safety research funding
  - Next TRB meeting January 11-15, 2009 – all are welcome

Ambulance Transportation Safety Task Force January 25th 2008

The EMS Safety Foundation

- Intro and Logistics Webinars from December 11th 2007 & Jan 8th 2008
- EMS Safety Foundation tab at www.objectivesafety.net

International approaches

- The state of the art non-USA vehicles have NO squad bench nor the after market structural vehicle modifications that can potentially decrease crashworthiness integrity that were seen in study vehicles.

RETTmobil – ‘Mobile Rescue’ Major event for EMS innovation

Fulda, Germany

http://www.rettmobil.com/

RETTmobil Delegation
Vehicle Occupant Safety design

2007 European design
Safety technology is a key focus

Ergonomic design

Australia, Melbourne

NSW Australian vehicles

Flexibility to manage two patients
Safety at the scene

Australia NSW

New UK London Ambulance/neonatal vehicles

Scotland neonate/peds transport

Clear safety message

Ergonomic layout and equipment

Benefit of Safety

Safe practices save lives, time and money
This is about you and your safety

- What safety practices do you use??
  - Seat belts?
  - EVOC training?
  - Equipment lock down?
  - Helmets?
  - Driver Feedback technology?
  - Tiered dispatch?

Safety concepts out there now

- Fleet Safety Management
  - Z-15
  - Driver monitoring and feedback
  - Enhanced ambulance vehicle design
  - Intelligent Transport Technologies - ITS
  - Visibility and Conspicuity
  - New Safety Standards
  - Life Safety Initiatives
  - Resources and information

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

Policy makes a difference...

NAEMT July 2006 Position statement

We are part of the problem...

Use proven safety tools

Patients must be in the over the shoulder harness, medics restrained in seat belts, equipment secured
What about changing driver behavior in the real world??

Purpose of ‘Feedback box’ Program
- Enhance Safety
- Improve Driver Performance
- Save Maintenance Dollars
- Aid Accident / Incident Investigation

Demonstrated Effectiveness

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

Science not, next best guess

Very cool – AND visible!!!
But what about those red trucks

Another excellent example - From this to … this!
Operating in an environment where many aspects of safety are still devoid of safety standards – requires technical knowledge and understanding.

NOT red at least!

Help is on the way ???
November 24th 2008

This looks cool AND SAFE!

Not rocket science..
No need to reinvent the wheel...

March 2007  - FHWA

Tips for Emergency Vehicle Operations

USFA Emergency Vehicle Safety Initiative

Traffic Incident Management Systems (TIMS)

- Just released April 2008
- FEMA, USFA, IFSTA
- Covers setting up safe roadway incident work areas and using unified command at these incidents

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Creating a Safety Culture

within a company must start with upper management's commitment to safety

- Awareness
- Training
- Incentive
Important Principles!

1. Ambulances are NOT standard passenger vehicles.

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

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

What do we know works...

Policy
Lap seat belts
Over the shoulder harnesses
Securing equipment
Forward and rear facing seating
Some electronic technical devices
Safety awareness
Cultural change

Conclusions

- Prevention is key - The pediatric ambulance transport environment includes predictable and preventable occupant risks.
- Unrestrained occupants and equipment are a potential risk to all occupants.
- Every member of a pediatric 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.
- Safer patient transport practices exist & should be used.
- 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.

Predictable Preventable
and NO ‘ACCIDENT’

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

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And....

- Flight Safety and Fleet Safety are valuable models for systems safety
- It is no longer acceptable for patient transport to be functioning outside of automotive and transportation safety and PPE safety standards for prevention of and protection of EMS/transport providers and the public from injury or death

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