To quote Steve “Sid” Caesar – Director IHS ES
“We want everyone to get home safely each day”

Would you ever give medication that had been demonstrated by clinical experts to be lethal and toxic at any dose?

Would you EVER use a piece of equipment that had been demonstrated for 10 years in the peer reviewed literature to be unsafe – let alone lethal???

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

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?

While much is known about general Child Passenger Safety
- Challenges in identifying best practice
- Myriad of unregulated commercial products
- No safety performance standards
- Absent national safety oversight

Absence of ambulance standards and oversight
When you hear the words
- “I like”
- “I believe”
- “I think”
about any product or safety device in the absence of any safety standards
Beware!!

In the absence of standards
What you want is...
- Independent data
- Independent technical experts
- Independent analysis
NOT industry generated marketing!!

The Ride of Your Life...

What works what doesn’t?
What’s safe what isn’t?
Where do you go to find out?

How do you avoid making a purchasing decision that might kill you or your colleagues??

Transport Medicine

A problem
2007 Insurance data –
- 27 fold more likely to have a claim based on transport than related to medical care

Transport Science...

Science behind Policy
- “For successful technology, reality must take precedence over public relations, for Nature cannot be fooled.”
  - Richard P. Feynman 1988
EMS Transport Safety

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

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
- Independent resources and information

http://www.objectivesafety.net

A tragic emergency health care intervention outcome

It does happen…

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……

Firstly!

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

Safety in Pediatric/Neonatal Ambulance Transport

- Is part of a SYSTEM

the Peds EMS/transport process

- communications/basket
- policies and procedures
- the pediatric patient
- restraining device/seat
- transporting device/gurney
- paramedics/transport nurses, doctors & family
- patient monitoring equipment
- clinical care & interventions
- the vehicle
- the driver/driving skill
- the road
The Emergency Department (ED)

An ambulance is not an ED / ICU on wheels

Recent adverse EMS transport outcomes

UPS and Laundry trucks have very similar design and even more stringent safety requirements to EMS vehicles BUT very different cargo...... People are passengers and NOT packages or parcels

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

Pediatric Transport Safety IS Complex AND Multidisciplinary

- Biomechanics
- Ergonomics
- Fleet safety
Real world answers to real world questions -

- What features will enhance safety of my new vehicle purchase?
- What color scheme do I want on my vehicle to make it safest?
- Do I need a helmet, and if so which one?
- What policies affect the safest system?
- How do I get my team to address safety issues?
- What data should I collect when something goes wrong, and how to analyze it?

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 fuels and vehicle design
- vehicle purchase standards
- Intelligent Transportation Systems (ITS) technology
- driver training
- training simulation
- driver performance monitoring
- road design
- integrated traffic safety technologies
- scene safety and visibility
- safety data analysis
- safety oversight

A BIG Problem

- Operating in an environment where many aspects of safety are still devoid of safety standards – requires detailed technical knowledge and understanding in technical disciplines OUTSIDE of healthcare disciplines

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

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

An interhospital transport?
"Do no harm….?"

Charged with Vehicular Homicide

2 killed, 3 injured....
September 23, 2007 - PA

2 counts of vehicular homicide...
November 5, 2007 - PA

What do we know now??

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

A Simple Question....
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 (e.g., 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.

Canada - Corporate Manslaughter
Corporation Homicide Act: 8th April, 2008
- This IS a Transportation and Automotive Safety issue
- This is a Systems safety issue

Clinical Care? Occupational Health and Safety.....?
- 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 in rear (OR 2.7 vs front) & to improperly restrained occupants (OR 2.5 vs restrained)
  - 83% of fatally injured EMS rear occupants unrestrained
  - >74% of EMT occupational fatalities are MVC related
  - Serious head injury in >65% of fatal occupant injuries
  - More likely to crash at an intersection with traffic lights (37% vs 18% p=0.001) & more people & injuries/crash than similar sized vehicles

National EMS data
- In the USA:
  - >50,000 vehicles
  - >5,000 crashes a year
  - >100 fatalities each week
  - ~250000 (ie. patients) or occupants of other car
  - 1000 (ie. patients) or occupants of other car
  - >10000 serious injuries each day
  - Cost estimates >$500 million annually
  - USA crash fatality rate/capita 35x higher than in Australia

USA crash fatality rate/capita 35x higher than in Australia

Peds Transport
- Collisions/crashes among pediatric transport teams
- are unusual
- have resulted in deaths, injuries, and disability
- appear to be caused by the actions of a team member
- Animals, weather, object...
- Control is difficult, look for their safety record to specific policies of the team and/or the vehicle owner or vendor and to luck.
- Specific safety policies on the part of the team and/or vehicle owner or provider may prevent or decrease collisions/crashes.

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
- And maybe they did...
- There is NO way humanly possible that they could stop.....
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 neonatal transfer: the importance of critical incident review: Moss SJ, D Embleton N, Fenton AC Archives of Disease In Childhood 90 (7): 729-732 JUL 2005

Neonatal Transport

Knowledge, opinions and behaviors

Goals

Standards for safety
Policy based on Science
Databases to demonstrate outcome

Balance of concerns and risk during transport

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

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 - yes!

A ‘laundry or mail truck’ - ??

A passenger vehicle - sure!

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…
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???

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

*Maguire, Hunting, Smith & Levick, Occupational Fatalities in Emergency Medicine, Arch Emerg Med, 2002

So does it make sense?

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

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

A peer reviewed tragedy

- Persistent disconnect between automotive safety science and EMS transport safety approach
- Pre-hospital and Emergency Care 2004

- EMS vehicle drivers are advised to approach the intersection, slowing to ensure that traffic has stopped and making eye contact with other drivers before entering the intersection.

- In the modern era of road safety to suggest that a strategy of “eye contact” to be made at an intersection with a driver traveling at ~ 40mph in the hope that this would result in a safety intervention, is at best frightening.

Dynamic vs. Static Safety Testing

Dynamic Safety Testing

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

The Crash Event - Crash Testing

- An introduction
- What one needs to know
- What do the tests really mean
- And, what tests are meaningful
- This is all about time – in milliseconds

Intrusion vs Deceleration

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

If we know this – and its published...

Full Vehicle Crash Testing

Test 1 – Right side impact

Pre-impact CTD positioning

Preparation of test vehicles

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

Impact residue

CTD dynamics

Post impact
Immobilization board

Foldable

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/AMD – static ‘safety testing’
- Ignorant of automotive safety principles – and specifies -
  - No structural damage to any load bearing or supporting members, i.e., torn 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 !!!!

F = ma

where F – force
  m – mass
  a – acceleration

No ‘a’... then NO ‘F’ !!!!
FMVSS exempt......

NOT new technical data...

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

Rash of “Safety Concept” vehicles.....

Devoid of substantive automotive safety engineering input or testing

Yes, the ride of your life....

- 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

Safety Management

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

Innovation

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

New concepts out there now
Ambulance Transport Safety Task Force (ATS) and the National Transportation safety Board (NTSB)

National Academies Transportation Research Board’s (TRB) And Your New EMS Transport Safety Subcommittee

TRB EMS Safety Update
- Brought together NHTSA, FHWA, TRB, National Academies, DOT, CAMTS & EMS
- 3 presentations
  - TRB and EMS
  - Ground Ambulance 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 29th 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/

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.
Vehicle Occupant Safety design
2007 European design
Safety technology is a key focus

Ergonomic design

New Australian vehicles
Flexibility to manage two patients

New UK London Ambulance/neonatal vehicles
Clear safety message

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

American National Standard
ANSI/ASSE Z15.1-2006
Safe Practices for Fleet Motor Vehicle Operations

Benefits of Safety

- Safe practices save lives, time and money
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…

Integration of clinical care with fleet management using an aviation model

NAEMT July 2006 Position statement

Use proven safety tools

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

We are part of the problem…

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
How the Device Works
- Computerized monitoring device installed on each vehicle to measure parameters
- Each driver has individual key “fob”
- Data collected every second including: vehicle speed and performance, driver behaviors and emergency mode
- Auditory feedback of warning ‘growls’, and penalty tones
- Data downloaded automatically every day

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

You want a system that works!!
- Does the system really work
- Is it going to be a major burden on your staff to implement
- What are the real costs
- Are you going to have video of your company vehicle on you tube??

The jury is out on
- Opticon
- Simulators

Visibility and Conspicuity ...?

USFA and SAE – April 2007
Under Way…
Emergency Vehicle Visibility and Conspicuity Study
- Funded by the USFA; conducted by IFSTA
- Looking at the effectiveness of reflective markings used on emergency vehicles
- Doing best practice research and working with manufacturers

Worker visibility Act:
Help is on the way!! November 24th 2008

There are grants to assist you..

This looks cool AND SAFE!

Day visibility

Night visibility

From this… to this

- Having access to that technical knowledge supports changes to improve safety practice
Very cool – AND visible!!!

But what about those red trucks

Another excellent example -
From this to ... this!

Retroreflectivity

Integration and Collaboration
EMS Transport Safety Strategies - 2006-2007 New York State
Strategic Highway Safety Plan

MO is a national leader in
road safety generally

Statewide Fatality Totals as of June 1, 2008:
+ 2008 Year to date fatalities - 347
+ 2007 Totals up to 6/01/07 - 392
+ 11% decrease for the year
+ 2007 Year End Total = 992
+ 2006 Year End Total = 1,096
+ 2005 Year End Total = 1,257

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

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??

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

What do we know works…
- Vehicle Operations Safety Policies
  - Squad bench lap seat belts
  - Patient over the shoulder harnesses
  - Securing equipment
  - Forward and rear facing seating
  - Some electronic technical devices
  - Safety awareness
  - Cultural change

What you can do now
- Have a written and implemented ‘safety program’
  - Secure all equipment
  - Secure occupants with standard belts
  - Don’t drive through red lights/stop signs
  - Use properly implemented “Feedback Boxes”
  - Monitor crash events with common denominators (ie. per 100,000 miles and per trip)

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

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

PREICTABLE 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

Conclusions

- Prevention is key - The pediatric ambulance transport environment includes predictable and preventable occupant risks.
- Unrestrained occupants and equipment are a potential injury risk to all occupants
- Every member of a pediatric transport program must play a role to actively manage risk and to avoid 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

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