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

A tragic emergency health care intervention outcome

To 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 system’s response capacity……

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 offer 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?

Outline

I. Review of data on ambulance crashes and safety standards and guidelines that exist for the ground EMS
II. Identification of ground EMS transport safety issues, hazards and areas of risk to patients, providers and public
III. Highlight unacceptable mythology and challenges to advancing EMS transport safety

EMS Transport Safety

‘patient safety’
AND also
‘provider’ and ‘public safety’
Firstly!

▶ An accident?
▶ or a predictable and preventable event

In a nutshell

▶ Am here to try to save you
▶ Lives
▶ Time and
▶ Money

Thursday July 5th 2007…… Paramedic Allan Parson’s killed

Fatalities and funerals
Funeral Services Held For Marble Falls Paramedic
Funeral services for Paramedic Allan Parson, who died in a crash in July 2007, were held on Thursday. The services were attended by family, friends, and fellow paramedics. Allan Parson had been a member of the local ambulance service for several years and was well-respected by those who knew him.

Charged with Vehicular Homicide

2 weeks later… Friday July 20th 2007 The worst ambulance crash in USA history

Five Killed in Crash of Ambulance and Semi

The highway patrol says two men died in a crash between an ambulance and a semi-truck on a rural highway in the United States. The paramedics were on their way to a hospital when the accident occurred. The crash killed five people and injured three others. The cause of the accident is under investigation.
2 killed, 3 injured…. September 23, 2007 - PA

[Image of ambulance]

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

[Image of ambulance]

An interhospital transport? “Do no harm…”?

[Image of ambulance]

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

Unique workplace

- In vehicles
- At roadside and other emergency scenes

Absence of standards and oversight

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

Challenges to Optimizing EMS Transport Safety

- Disparate and fragmented safety infrastructure
- Lack of a centralized EMS Safety oversight or data
- A large number of small groups of end users, with a mix of volunteers and professionals
- Ambulances are hybrid non-standard vehicles, a truck chassis and an after market box or a modified van
- EMS vehicle safety is not integrated as a part of the transport safety industry

1960 to 2007

[Images of ambulances]

Some recent adverse outcomes

[Images of traffic accidents]
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 is 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.

Ground Transport Safety IS Complex AND Multidisciplinary:
- Epidemiological Data Collection
- Ergonomic Research
- Biomechanical Automotive Safety
- Driver Training
- Safety Technology
- Regulations and Standards
- Fleet Safety Program
- Risk Management
- Public Safety
- Transport Policy
- Driver Training
- Communications Technology
- Safety Equipment Design
- Vehicle and Safety Equipment Testing and Standard Development
- Safety Policies

EMS Transport 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.

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 harness 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.

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

There are more safety standards for moving cattle than for moving patients.
A Simple Question….

The Emergency Department (ED)

An ambulance is not an ED /ICU on wheels

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 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

Is It your service’s tragic year?
- ~ 50 fatalities a year
- 15,000 EMS services
- Each year one in 300 services experiences a fatality

Predictable risks
- Fatal crashes more often at intersections, & with another vehicle (p < 0.001*)
- 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)**
- 82% 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##

*Kahn CA, Pirrallo RG, Kuhn EM, Prehosp Emerg Care 2001 Jul-Sep;5(3):261-9
**Becker, Zaloshnja, Levick, Li, Miller, Acc Anal Prev 2003
#NIOSH, 2003
##Ray AM, Kupas DF, Prehosp Emerg Care 2005 Dec; 9:412-415
and what is killing EMS?

EMS personnel fatalities*

- 74% transportation related
  - 11% were cardiovascular
  - 9% were homicide
  - 4% needle sticks, electrocution, drowning and other


"Ambulance transport has a death toll...."


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

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

What do ambulance crashes really cost?

- Loss of life and injury
- Negative impact on EMS system
- Collisions are the largest liability cost and exceeds 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

Safety is Good Business

June 2007
A problem

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

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 ?

Balance of concerns and risk during transport
➤ Response and transport time
➤ Clinical care provision
➤ Occupant safety/protection
➤ Public Safety

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

Ambulance Safety Research: A New Field
engineering
ergonomic
epidemiology

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 travelling at ~ 40mph in the hope that this would result in a safety intervention, is at best frightening

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??
Increasing awareness ...

Risk/Hazards
- Predictable risks
- Predictable fatal injuries
- Serious occupational hazard
- Public safety hazards

EMS Best Practice, Sept 2006

IMPORTANT ADVISORY
- Due to respect for the wishes of the families of medics killed in the line of duty there is to be NO PHOTOGRAPHY of any aspect of the images in this presentation - that is NO video, NO photography, NO digital images of any type

But what about head protection?

New EMS helmet prototypes for 2008

What are the solutions?
- Training?
- Practice Policy?
- Transportation Systems Engineering?
- Automotive Engineering?
- Education of other road users???

The Driver
- Driver selection
- Driver monitoring and feedback
- Driver Impairment
- Driver training
Driver issues

Which is best, how many hours...??

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

A key to safe ambulance transport

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
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 YouTube??

The jury is out on
- Opticon
- Simulators

And very Predictable...
- Intersections are lethal environments

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 at 40 mph dry and wet

Integration and Collaboration

State Strategic Highway Safety Plans
- Required as part of the SAFETEA-LU legislation
  - (Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users)
- Effective October 1st 2007
- Focus is the 4 'E's
  - Engineering
  - Education
  - Enforcement
  - Emergency Medical Services
- EMS is a core theme

State SHSP EMS Focus*

- EMERGENCY MEDICAL SERVICES DISPATCH SERVICES
- EMERGENCY MEDICAL SERVICES PARTNERSHIPS
- Emergency Medical Services in the 4 'E's
- Transportation
- Engineering
- Education
- Enforcement
- EMS is a core theme
EMS RESPONDER CRASH PREVENTION
- Undertake a systematic review of other state actions and protocols in traffic safety for the EMS system to identify and prioritize
- Increase education and involvement of EMS providers in principles of appropriate traffic safety techniques
- Develop and implement ambulance traffic safety protocols at state, regional, and service level
- Identify methods to provide incentives for adoption by EMS services of protocols that enhance traffic safety
- Partner with organizations that provide public driver awareness and education campaigns to improve driver awareness of driver responsibility and appropriate response to approaching emergency vehicles

Vehicle Operations Position Statement

Vehicle Operations Policy
- Vehicle operations training and evaluation
- A program of graduated driver responsibility
- Drivers only age 25 and over
- Complete stop at an intersection
- Restricted use of Red Lights and Sirens
- Monitoring of emergency vehicle operations

WEMSA – October 2007

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

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:


Test 1 – Right side impact

Why do we do this?

Choose the Best Option

Foldable

Full Vehicle Crash Testing

Test 1 - Right side impact
And this all takes place in 60 millisecs – the blink of an eye

NIOSH Ambulance Occupant Safety Crash Testing

‘Safety’ approaches being driven by manufacturers claims and sales rather than by science and data

USA Ambulances: FMVSS Exempt

Propaganda that kills...

Occupant protection......??

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

KKK/AMD – ‘safety testing’

- Ignorant of automotive safety principles – and specifies that a ‘successful test’ is -
- 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!!?
No ‘a’… then NO ‘F’ ———!

\[ F = ma \]

**F** – force

\( m \) – mass

\( a \) – acceleration

It’s not magic… what is safe is known and understood

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

Safety concepts out there now

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

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

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
  - Injured Patient
  - Safety Informed
  - 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
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/

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

Australia, Melbourne

NSW Australian vehicles
Flexibility to manage two patients

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

Norway initiatives

Sweden initiatives

Other successful models

Ergonomic layout and equipment

Securing equipment

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

Use proven safety tools

NAEMT July 2006 Position statement

News we don't want to see
Caught On Video: EMT Struck By Car

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

There are grants to assist you..

Policy and practice ignorant of existing technical safety data
Day visibility

Night visibility

Visibility and Conspicuity ...?

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

This looks cool AND SAFE!

From this..... to this

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 rocket science...
But whatever color…. If you run a red light some will be killed.

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

No need to reinvent the wheel...
- No left turns – instead make three rights
- Don’t back up
- Don’t employ any drivers under 25 years of age
- Don’t employ anyone with a history of driving convictions

Make three rights

UPS: The ‘Big Brown’

March 2007 - FHWA

Tips for Emergency Vehicle Operations
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 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??

Safety Management

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

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?

Risk/Hazards

- Predictable risks
- Predictable fatal injuries
- Serious occupational hazard
- Public safety hazards

Creating a Safety Culture

Within a company must start with upper management’s commitment to safety

- Awareness
- Training
- Incentive

Some simple and available solutions out there now

- Intersection Policy
- PPE
- 'Feedback' boxes
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. 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

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

Predictable Preventable and NO ACCIDENT

Conclusion
- EMS transport has serious hazards and safety issues
- 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
- Failure to transfer knowledge from transportation and automotive safety is unacceptable and dangerous
- 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

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