Ambulance Transport Safety: Everything You Really Need to Know

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

Who am I?
Emergency medicine physician
- USA – Johns Hopkins to Harlem
- Australia – Royal Melbourne to the Outback
Public Health - Injury Research
Ambulance Transport Safety
Chair National Academies Transportation Research Board, EMS Safety Committee
Recipient of International Society of Automotive Engineers, Women’s Leadership Award

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?

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

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......

Ambulance Transport Safety
- Emergency care, public heath, public safety, and patient transportation.
- Important Principle: Ambulance transport safety is part of a system, the overall balance of risk involves the safety of all occupants and the public
- All get home safely

http://www.objectivesafety.net
In a nutshell

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

October 2008 JEMS Article

“Rig Safety – 911”

“Rig Safety 9-1-1”

Breaking News!!
National Academies
TRB EMS/Medical Transport Safety Summit – November 7, 2008

Transportation Research Board is an excellent resource… we should be using it!!

2008 - Air EMS on the NTSB’s “Most Wanted List”, where is ground EMS??

A Simple Question….

Creating a Safety Culture

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

- Awareness
- Training
- Incentive

Safety - Why now?

- Operating optimally in a transportation environment that is largely devoid of specific safety standards for the hazards and risks present
- Bridge the gap between what technical information exists and what is accessible and applied to EMS
EMS Safety

- 'patient safety'
- AND also
- 'provider' and 'public safety'

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

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

"...I'd like to know what can be done so this never happens again...."

2 weeks later... Friday July 20th 2007

The worst ambulance crash in USA history

Five Killed in Crash of Ambulance and Semi

January 10, 2008

This is not a crashworthy environment
Jan 28th, 2008

Emergency services sawed off the right side of the ambulance in which two paramedics were trapped after the accident, killing one and injuring the other.

April 14th, 2008

An emergency services worker said the two paramedics were trapped in an ambulance when the vehicle overturned on the New Haven section of the Connecticut Turnpike.

April 20, 2008..??

In this vehicle...

June 17th 2008

a paramedic and a patient killed

In this vehicle...

October 31, 2008, Kentucky

Fatalities and funerals

November 5, 2007 - PA

2 counts of vehicular homicide...
An interhospital transport? "Do no harm..."?

So
- What's important
- What's not important
- What's going to save your life
- What might take your life
- What's going to hurt you
- What's going to protect you
- What is factual
- What is garbage
- What is new
- What is not new

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
What we need to consider, where is the ‘bang for buck’ in ambulance transport safety:

- 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

EMS Transport General Concerns

- Consistently higher speed than passenger vehicles
- Greater potential for collision
- Injuries to patients and crew
- Higher potential for road trauma

1960 to 2007

- A passenger vehicle - sure
- A 'laundry or mail truck'? A passenger vehicle

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

There are more safety standards for moving cattle than for moving patients

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

- Communications/dispatch
- The patient
- Restraining device/seat
- Transporting device/gurney
- Paramedics/transport nurses, doctors & family
- Patient monitoring equipment
- Clinical care & interventions
- Protective equipment
- The vehicle
- The driver/driving skill
- Other road users
- The road

Ground Transport Safety IS Complex AND Multidisciplinary

- Epidemiology & Data Collection
- Risk Management
- Public Safety
- Transport Policy
- PPE
- Driver Training
- Safety Technology
- Regulations & Standards
- Fleet Safety Program
- Human Factors
- Transport Safety
- Policy
The Emergency Department (ED)

An ambulance is not an ED / ICU on wheels

USA EMS data

In the USA:
- ~ 50,000 vehicles
- ~ 5,000 crashes a year
- One fatality each week
  - 25 pedestrians or occupants of other car
  - Approximately 4,000 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

So for EMS personnel...
- What’s going to kill you?
- What’s going to injure you?

This is not how you want to see your partner during a transport

‘Workplace’ Hazards
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


“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

Safety is Good Business

June 2007

Safety saves time, lives AND money Canada, Nova Scotia

- Since 2000 working towards a goal of zero loss ratio with insurance provider
- 10 million kilometers per year
- 150 emergency response ambulance units
- Collision claim history measured in dollars per 100,000 kilometers traveled:
  - 2003/2004 $ 218.00
  - 2004/2005 $ 210.00
  - 2005/2006 $ 1049.00
  - 2006/2007 $ 731.00
  - 2007/2008 $ 416.00
  - 2008/2009 $ 229.00
A problem

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

Very Expensive

A number of potential interventions to enhance safety have been identified:
- Safety Policy
- Safety performance standards
- Vehicle crashworthiness
- Vehicle interior ergonomics
- Personal Protective Equipment design
- Driver selection, training and simulation
- Safety and risk awareness modification
- Risk behavior modification
- Intelligent Transportation Systems (ITS)

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

EMS Best Practice, Sept 2006
It does happen…

But what about head protection?

New EMS helmet prototypes for 2008

Problems
- No Standards
- Unique safety and hazard protection needs
- A number of less than appropriate devices out there

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

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 …


Why do we do this?

Test 1 – Right side impact

Full Vehicle Crash Testing

1. Target vehicle, Type I ambulance
2. Bullet vehicle, Type II ambulance

Closing speed 44 mph

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

NIOSH Ambulance Occupant Safety Crash Testing

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

**Ambulance Standards??**
- KKK?
- AMD?
- FMVSS?
- NFPA?

**USA KKK ambulance purchase specifications**
- Specifications for the purchase of a Star of Life Ambulance
- Static Pull test
- 2200 Lbs. static stretcher test in longitudinal, lateral & vertical
- No dynamic test for vehicle, occupants or equipment
- No automotive test manikin
- Voluntary

**USA Ambulance Manufacturing Division (AMD) Ambulance Standards – August 2007**
- No dynamic or impact test
- No automotive test manikin
- Mandates NO 'crumple zone'
- No impact tested anchorages for occupant restraint or equipment
- Internal, not independent

**AMD – static ‘safety testing’**
- Inconsistent with 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.

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

**AMC 2007 - 025 ‘occupant safety testing’**
- Compared with -
  - Accepted automotive safety occupant testing

**No ‘a’... then NO ‘F’ !!!!!**
- \[ F = ma \]
  - where \( F \) = force
  - \( m \) = mass
  - \( a \) = acceleration

**Unacceptable, and non-automotive AMD/KKK-F ‘safety testing’ practices and standards !??**
- A M A R C H T E S T R E C K B R O K E R
- T H A T W A S T H E N
- 36,000 lbs.
- Shuffled industry records for testing and testing in the industry by more than double the KKK 55% test weight Federal Standard. In addition, this test adhered to both side tests that had never been seen before.

The Public Comment period for the development of the new NFPA Ambulance Standard is open until October 15, 2008. 

http://www.emssafetyfoundation.org/NFPA_Ambulance0001.pdf

- **Protective devices/concepts**
  - To prevent a crash:
    - Driver feedback
    - Driver monitoring
    - Driver training
    - Vehicle intelligent Transportation System (ITS) technologies
    - Tethered devices
    - Appropriate policies
  - In the event of a crash:
    - Vehicle crashworthiness
    - Seat/seat belt systems
    - Equipment lock downs
    - Padding
    - Head protection

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

- **A few key words about restraint systems**

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

- **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
Innovation

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

WEMSA – October 2007
1. Emergency Vehicle Operations Policy
2. Vehicle operations training and evaluation
3. A program of graduated driver responsibility
4. Drivers only age 25 and over
5. Complete stop at an intersection
6. Restricted use of Red Lights and Sirens
7. Monitoring of emergency vehicle operations

WEMSA covered some key and important policies and procedures
But…
- What about hours of service?
- What about visibility at the scene? For providers and the vehicles…?
- What about protective equipment?
- What about ambulance design safety?
- What about reporting of adverse events?

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

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

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

Over speed - accelerating
- Listen for growl – 15 sec warning begins
- Growl frequency increases near end of warning
- Tone on – penalty points awarded
- Slow down – tone stops
- Accelerate again - growl on – slow down – growl stops - no points

Demonstrated Effectiveness

And when a rare crash happens….

Unit 302 Accident

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.

Extensive Indirect cost savings
- Fewer out of service vehicles
- Improved transport times
- Decreased administrative lost in managing unsafe behaviors
- Decreased legal burden
- Automatic system wide data
- Insurance benefits

Feedback box Summary
- The system works
- Objectively improved performance
- No increase in response times
- At fault accidents reduced
- Accepted into the culture

However:
- The system requires monitoring
- Must be reinforced by management
- Must be incentives for good performance
- Must be consequences for poor performance

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

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 European event for EMS innovation
Fulda, Germany May 2008
http://www.rettmobil.com/
One patient or Two patients and you can reach both AND your equipment...

a fleet based initiative

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

Ergonomic layout and equipment

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?
Were we safer in the Cadillac???

Other successful models

Hmm...

So why is it...

- That the EMS providers...
  - Wore 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???

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

Policy and practice ignorant of existing technical safety data

Visibility and Conspicuity ...

Visibility and lighting issues
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

Visibility heading in the right direction!

This looks cool AND SAFE!

This is AWESOME – and addresses some very real risks, very creatively – and currently ONLY available in London Ontario!

- Having access to that technical knowledge supports changes to improve safety practice
- Operating in an environment where many aspects of safety are still devoid of safety standards – requires technical knowledge and understanding

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

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

Ambulance Safety Summit
November 7th, 2008
- EMS Transportation Safety Subcommittee of the National Academies Transportation Research Board (TRB)
- Onsite panel of invited technical experts, in addition to policy makers and EMS leaders:
  - Safety data capture
  - Transport fleet management, EMS vehicle operations
  - Automotive safety and occupant protection
  - Ergonomics and human factors
  - Standards
- Will be beamed live via Webinar and recorded electronically and TRB e-circular produced
- Access to live participation requires pre-registration
- Pre-registration info disseminated in early October

TRB Jan 2009 EMS Subcommittee Meeting and Seminar
- The Subcommittee on EMS Transportation Safety of the National Academies Transportation Research Board winter subcommittee meeting and seminar is in DC during the 2009 January TRB symposium
- Your input and participation (onsite or online) is valued
- You can submit your suggestions/input for the TRB EMS Subcommittee meeting online:
  - http://www.emssafetyfoundation.org/TRBpriority.htm

New NHTSA EMS info link
- There is a new Federal link to EMS info – a great resource!
- www.EMS.gov

No need to reinvent the wheel...
Traffic Incident Management Systems (TIMS)
- Released April 2008
- FEMA, USFA, IFSTA
- Covers setting up safe roadway incident work areas and using unified command at these incidents

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

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??

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

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 (i.e. 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

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