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......

Thursday July 5th 2007......

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

A tragic emergency health care intervention outcome

Friday July 20th 2007...

The worst ambulance crash in USA history

Five Killed in Crash of Ambulance and Semi

http://www.objectivesafety.net

Outline

I. Review of data on ambulance crashes and ground transport safety
- Review of safety standards and guidelines that exist for the ground patient transport environment and update of latest safety developments

II. Identification of ground transport safety issues, hazards and areas of risk to patients, providers and public

III. Highlight unacceptable mythology and challenges to advancing ground transport safety

IV. Profile innovation, strategies and knowledge transfer to enhance safety and reduce risks of ground patient transport

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So what's new...

Nadine Levick, MD MPH
CEO, Research Director
EMS Safety Foundation
Objective Safety LLC

Air Medical Transport Conference
Tampa Convention Center
September 17-19, 2007 - Tampa, Florida

GROUND AMBULANCE TRANSPORT SAFETY
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Emergency Medical Service
Ground Transport

- What are the transport safety issues that pertain to this important public service and public safety industry?
- What do we know of the risks and hazards and how can we measure these?
- How can the safety of this transport system be optimized?

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

1960 to 2007

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

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

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

Firstly!

- An accident?
- or a predictable and preventable event

EMS Transport Safety

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

This is not acceptable

In the USA
- ~ 5,000 crashes a year
- ~ One fatality each week
- ~ 300 pedestrians and 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

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What's new

- New expertise and collaborations
- New automotive and transportation safety technologies
- New information
- New events

New expertise and collaborations

- TRB
- ASSE
- OSHA
- SAE
- UTRC
- Ergonomics
- Industrial Design

New Information

- Enhanced Safety of Vehicles (ESV), June 2007
- American Society Safety Engineers (ASSE), June 2006 & June 2007
- International Ergonomists Association (IEA), June 2006
- AMD Engineering Public Comments, July 2007
- KKK-F, August 2007
- OSHA September 11, 2007 Federal Register
- SAFETY.A.D. 2006
  - State Accountability, Flexible, Efficient Transportation Equity Act: A Legacy for America
- State Strategic Highway Safety Plans, October 2007
- State EMS Council Policies
- APHA, Nov 2007
- OSHA best practices
- Worker visibility Act, to be implemented, Nov 2008

And what's really not new...


2007 Nascar Safety Expert

- On ambulance patient compartment
  “It is a death vault”
  Tom Gideon, Head of Safety, GM Nascar

and who's life was he racing to save?
NASCAR, Car of tomorrow ready to go
USA Today – March 23rd, 2007

What happened??
- Why is it that Emergency Medical Services have developed outside the umbrella of transportation safety infrastructure??

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

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

Air EMS is a role model for safety initiatives and focus

An Aviation Safety Plan

Air Safety Approach
- Safety Program Planning
- Evaluating
- Analysis of Safety Performance
- Analysis of Safety Information and Data
- Analysis of Risk Profiles and Plans

Ground Transport Safety ?

Internationally there are standards for ground safety performance
“Without exception, all persons, medical devices, equipment, and objects normally carried on the road ambulance shall be maintained to prevent them from becoming a projectile when subject to a force…”

50th percentile manikins - 10 G in Forward, Rearward, Transverse, & Vertical directions
Certified by Notified Body and Ambulance Mfg.

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

the EMS transport process
- 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 drivers/driving skill
- other road users
- the road

An ambulance is not an ED /ICU on wheels

Ground Transport Safety IS Complex AND Multidisciplinary
- Epidemiological
- Data Collection
- Risk Management
- Public Safety
- Transport Policy
- Endo Medical
- Research
- Automotive Safety
- Occupational Health and Safety
- Communications
- Technology
- Safety Technology
- Regulations and Standards
- Fleet Safety Program

And keep focus on ‘All hazards’ in addition to crashworthiness
- Driver age?
- Driving history?
- Driver impairment?
- Patient condition?
- Dispatch?
- Vehicle stability?
- Driver feedback technologies?

Occupational Health and Safety.....?
- This IS a Transportation and Automotive Safety issue
- This is a Systems safety issue
And this all takes place in 60 millisecs – the blink of an eye

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

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

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

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

EMS Best Practice, Sept 2006

BHP - Key learnings for the organization were:
- Fatalities often have similar underlying causes
- High near miss reporting often correlates with declining injuries or fatalities
- Leadership visibility in the field is vital
- Hazard identification and risk awareness are fundamental to success.

Safety Improvement Roadmap
September 2007, It's not magic......

Valuable information from the transportation industry

These folks know what we need to know...

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

The truck and bus industry is on the right track at the TRB

Knowledge transfer

July 2007

August 2007

An excellent model

http://www.EveryoneGoesHome.com
National Academies- TRB EMS Safety Subcommittee

Major crash investigation NTSB has expertise to do this comprehensively

Who has read this information??..

Hours of service? Not new in other realms of ground transport...

July 2007 Report

…..May 21st, 2007, Seattle

…..May 25th 2007?

Help is on the way ???

November 24th 2008
This looks cool AND SAFE!

Not rocket science..

September 11, 2007

We've known for 10 years that red fire trucks are twice as likely as lime yellow trucks to crash at an intersection.

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

Wyoming Ambulance Manufacturer, August 17, 2007..

‘.... the current crop of “Safety Concept Vehicles” being built by some manufacturers are a sham and they do not address the problem but are merely used as a sales gimmick.”

Science not, next best guess

Unique workplace

In vehicles

At roadside and other emergency scenes
The 'workplace' IS a vehicle
- EMT's often in vulnerable positions during transport.
  - Bench seat
  - Captain's chair
  - Standing or kneeling

The 'workplace' is also a crash scene

EMS Provider Fatalities
- 12.7 fatalities/100,000 EMS workers
- Greater than 2 X the national average (5.0 fatalities/100,000)
- Similar to Police (14.2/100,000) and Fire Fighters (16.5/100,000)

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

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

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
  - Medical/negligence lawsuit
  - Medical/negligence costs of injured EMTs
  - Hiring of new employees to replace injured personnel
  - Retraining and psychological counseling of personnel involved and others
  - Increased insurance rates
A few weeks ago…

Indirect Costs
- Estimated to be 10X direct costs!

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:
  - 2000/2001 $1725.00
  - 2001/2002 $1049.00
  - 2002/2003 $751.00
  - 2003/2004 $416.00
  - 2004/2005 $229.00

EMS CANNOT Afford to keep paying out like this…

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

Policy makes a difference…

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

Systems Safety Engineering - Z.15….

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
**Driver issues**

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

**Some challenges**

- No accepted national safety standards for -
  - EMS fleet management or safety practice
  - Ambulance vehicle rear compartment design and performance
  - Provider occupational injury protective equipment
  - Yet convincing data for injury risk and hazard
  - No data base of ambulance crash events
  - Need for patient, provider and public safety focus

**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

**What about Federal Motor Carrier Safety Administration**

- Mission –
  - To reduce the number and severity of commercial motor vehicle (CMV) crashes and enhance the efficiency of CMV operations

**A very serious gap in data, performance and oversight**

- FMCSA Truck safety goals –
  - to decrease the fatality rate of 2.8 per 100 million truck-miles in 1996 to 1.65 by 2008
- EMS crash fatality rate estimates are –
  - 7.66 - 41.93 fatalities per 100 million ambulance-miles

**Transport related aspects of EMS**

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

**The National Transportation Safety Board (NTSB)**
NTSB 1979 Accident Report

Recommendations
• EVOC
• LICENSE RECORDS

30 Years and 1,600 Fatalities later -
• NTSB 1979 Recommendations never implemented
  - To NHTSA – Class II & III Priority Action
    • Extend Federal Motor Vehicle Safety Standards (220, 221, 301) to include ambulances and other emergency vehicles
    • Extending FMVSS re: padding and restraints
  - To GSA – Class II Priority Action
    • Maintenance of handling
    • Loading instructions
    • Body structural integrity
    • Anchorage for all equipment
    • Occupant protection
  - To National Committee on Uniform Traffic Laws
    • Modify criteria

Why AREN'T we on the NTSB's "Most Wanted List"??

A Simple Question....

Ambulance Safety Research: A New Field

Priorities...... Research papers in the past 30 years
• EMS Safety
  • 45 papers – on ambulance safety
  • 1 paper – on ambulance ergonomics
  • 1 paper – on stretcher ergonomics
• Computer Workstations
  • 30,000 papers – on ergonomics of computer work stations
• Erectile Dysfunction
  • 100,000 papers – on Erectile Dysfunction

EMS Today... ‘expert panel’ ambulance manufacturer funded and NO automotive safety engineering or other technical expertise

New automotive and safety technologies
• crashworthiness
• EVS
• ITS
• Monitoring and feedback enhancements

DOT Funding for Reptiles and Road Kill
What happened??
- Why is it that Emergency Medical Services have developed outside the umbrella of transportation safety infrastructure??

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

Intersection passenger car stopping distance:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Stopping 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>

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

A few months ago....

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 ?

How you don’t wish to see your partner transported...

Guidelines – standards
- Transport safety
- Practice protocols
- Occupational Health and Safety
USA Ambulances: FMVSS Exempt

Propaganda that kills….

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 – 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 !??

No ‘a’… then NO ‘F’ !!!!!

F = ma

where F = force
m = mass
a = acceleration

Bottom line

- The AMD should consider revising the standard comprehensively to reflect current accepted automotive safety practice, given the current vehicle crashworthiness and occupant protection knowledge and published literature.

Occupant protection…??
July 2007
30 years later, 1,600 fatalities and still the same problem

But what about head protection?

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

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

New EMS helmet prototypes for 2007

With many aspects in addition to crashworthiness
- Human factors and ITS
- Crash avoidance technologies
- Predictors of crash risk
- Policy

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
Dynamic Safety Testing

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

If we know this – and its published....

Why do we do this?

NOT new technical data...

If we know this – and its published....

PPE from the stationary environment can be highly hazardous in the automotive setting

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

Vehicle design and safety

- The principles of automotive safety involve a complex science, engineering technical skill, expertise, training and knowledge
- “Give the engineers a working list of our needs and let them tell us how it should be built to accomplish those tasks.....”

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

Devoid of substantive automotive safety engineering input or testing
Bigger is not necessarily better……

OUCH! My liver!!

OUCH! My spleen!!

NO automotive safety engineer
NO crashworthiness engineer
NO ergonomist
NO reference to ANY existing or relevant automotive safety or crashworthiness technical publications……
yet multiple occupant fatalities and injuries annually……

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?

Innovation

Tiered Dispatch

Intelligent Transport Safety Systems

Back up Camera….. Shouldn’t all vehicles have one of these?

NAEMT July 2006 Position statement
Patients must be in the over the shoulder harness, medics restrained in seat belts, equipment secured.

Use proven safety tools

Safety leadership… from the IAFC and USFA

Automotive Injury Triangle and Safety Development

- Host Vehicle
- Environment
- Field Data
- Scholarly Research
- Technology, invention & development
- Protective devices/concepts

Protective devices/concepts

- To prevent a crash
  - Driver feedback
  - Driver monitoring
  - Driver training
  - Vehicle Intelligent Transportation System (ITS) technologies
  - Tiered dispatch
  - Appropriate policies

- In the event of a crash
  - Vehicle crashworthiness
  - Seat/seat belt systems
  - Equipment lock downs
  - Padding
  - Head protection

The “Black Box”

- A transportation safety monitoring and feedback device

This technology is conceptually like a vehicle safety ‘pulse oximeter’ – that with auditory feedback - can save your life, your coworkers life, your patients life, and others on the road.

Purpose of ‘Black box’ Program

- Enhance Safety
- Improve Driver Performance
- Save Maintenance Dollars
- Aid Accident / Incident Investigation

The “Black Box” - Driver behavior monitoring and feedback device

- Safety leadership… from the IAFC and USFA

Demonstrated Effectiveness

MEMS ABC Miles Per Month
A key to safe ambulance transport

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

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???

It isn’t like this outside of the USA

Safety at the scene

The difference having data makes?
The missing E’s: Education, Engineering and Enforcement

Integration and Collaboration

Education

- Where does ambulance safety feature in EMS education programs – we do know now that it is biggest threat to a medic’s life and wellbeing.

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.

Major events for innovation sharing – but regional and often language isolation

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

Vehicle Occupant Safety design

- 2007 European design
- Safety technology is a key focus

Ergonomic design

Ergonomic layout and equipment
New Australian vehicles

UK Ambulance vehicles

Clear safety message

Sweden initiatives

Norway initiatives

Basically...

The failure to address the design of these vehicles based on accepted published and peer reviewed automotive safety literature, and in isolation of the extensive global expertise in automotive safety, human factors and ergonomics, remains a serious concern for this aspect of the EMS system.

Were we safer in the Cadillac???
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

Future
- Vehicle design
- PPE
- Practice policy
- Data/Monitoring/Oversight

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

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