Ambulance Crashes – Research & Are You Safe in An Ambulance?
Bang for buck: Ambulance Safety, Standards and Survival - What do you need to know!

What are we going to cover today?
- Key principles of ambulance transport safety
- Ambulance safety research and data
- National and Regional Standards and Guidelines
- How to make your ambulance transport environment safer right now
- Future goals for Ambulance transport safety

‘Workplace’ Hazards

Bigger is not necessarily better.....

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

But what about head protection?

New EMS helmet prototypes

Head protection @ EMS Expo 2012
Seat Belt and Restraint Use:
Seat belts or restraints will be securely fastened to the following individuals when the vehicle is in motion:
1) All EMS vehicle operators
2) All patients
3) All non-EMS passengers (cab and patient compartment)
4) All EMS practitioners (when patient care allows)
5) All infants and toddlers (these children should be transported in an age appropriate child seat if their condition allows). Children should not be placed in cab passenger seat with airbag.

A. All EMS operations, including incident responses and patient transports.

These guidelines provide general information and "best practice" guidelines related to the use of lights and sirens by EMS providers and EMS vehicle operators during incident response and patient transport. EMS agencies may use these guidelines to fulfill the agency’s requirement for a policy regarding the use of lights and other warning devices as required by EMS Act regulation 28 § 1005.10 (l) or regions may use these guidelines in establishing regional treatment and transport protocols.

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1) Distracted driving is responsible for many MVCs, and EMS agencies should assure that policies reduce the risk of a distracted driving accident.
2) EMSVOs should not view pagers, phone screens, text messages, or mobile data terminals or enter data into GPS devices while an EMS vehicle is in motion.
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Safety Event reporting

And now for some Myth Busting

2017-2019 QUALITY ACHIEVEMENT GOLD STANDARD

Don't try this at home!
‘Safety’ approaches being driven by manufacturers claims and sales rather than by science and data

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

“Our design features are focused on improving the safety of the patient compartment, and side restraint protection in X ambulances helps reduce the threat of a fatal injury if a rollover occurs.”

Airbags ….??
Absent safety testing standards, any meaningful crash or injury mechanism data or effective occupant positioning – rear compartment airbags are likely to be hazardous

You turning right? or should I?

October 2008 JEMS Article “Rig Safety – 911”

Ambulance Vehicle Standards??
- KKK?
- AMD?
- FMVSS?
- CMVSS?
- NFPA?
- SAE…?
- ASTM…?
- International – ASA – CEN

Transporting kids?

The meat in the sandwich
As we have outlined

- Unique challenges to crashworthiness, safety performance analysis and oversight of ambulance vehicles
- Is an interdisciplinary field, where the science of crashworthiness and occupant protection safety engineering interacts with acute medical care delivery, clinical ergonomics and also public health, public safety, transportation safety and safety data capture.

Important to have guidelines because we ARE not auto safety engineers!!

EMS right now needs to know what works and what doesn’t:

- We have a moral and ethical responsibility to provide technically sound guidance based on the technically sound scientific and engineering information that does exist

This NHTSA/Maryn document has some useful information BUT also complications and hazards!!

Sept 2012 - NHTSA’s clear disclaimer

Declaram

This publication is a product of the Department of Transportation National Highway Traffic Safety Administration. The publication has been developed by NHTSA and the National Highway Traffic Safety Administration (NHTSA). The publication is intended to help hospital staff transport children in motor vehicles. Use of the publication is voluntary, and its use does not constitute an endorsement by the Department of Transportation or the National Highway Traffic Safety Administration (NHTSA) of the Department of Transportation or the National Highway Traffic Safety Administration (NHTSA) of any products, services or manufacturers. Certain proprietary trademarks, service marks, and/or trade names enclosed herein are used for identification purposes only, do not constitute endorsement, do not imply approval, and in no way are intended to imply that these products, services or manufacturers are endorsed, recommended, approved, or favored over others not so identified. No endorsement is intended or implied by the use of any trademark, service mark, or trade name in this publication.

And again

- Somewhat questionably a national guideline has now been created— that puts some children at risk, and is in conflict, if not ignorant of published technical science
- NOT one technical publication is referenced on the safety of ambulance transport or technical aspects of automotive safety and occupant protection as it pertains to this environment

Sadly....

Do we ask automotive safety engineers to develop cardiac arrest protocols?

- Then why are a group of health care providers, with no technical qualifications or training in automotive safety engineering and occupant protection engineering - developing technical recommendations for occupant protection of children.
And in a setting that is considered highly complex even for the most skilled technical automotive safety engineers and occupant protection engineering expertise.

Key technical publications exist in the peer reviewed literature... Maryn Report fails to reference existing Peer reviewed auto engineering refs

Basically...
- DON'T put child in the front seat
- DON'T put the child on the rear facing captains chair
- Just about anywhere else is OK!
- Use a child seat when medically appropriate and size fits, well secured

NASEMSO MRAVD initiative
http://www.nasemso.org/Projects/AgencyAndVehicleLicensure/AmbulanceVehicleDesignProject.asp

NASEMSO – MRAVD 2012

August 1, 2012
NASEMSO - Model Rules for Ambulance Vehicle Design (MRAVD)

Golden Hour – not so hot
- March 2010 Annals EM

Golden Hour Summary
- This study suggests that in our current out-of-hospital and emergency care system time may be less crucial than once thought. Routine lights-and-sirens transport for trauma patients, with its inherent risks, may not be warranted. [Ann Emerg Med. 2010;55:247-248.]

April 2010, Resuscitation – Going fast can hurt your patient clinically!
**Data Envelopment Analysis**

- EMS Stations/
  - 10,000 citizens
  - 100 km rural road length
  - 1000 km² area

- Staff/
  - # EMS Transportation Units

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**Jan 2010 - Evaluating Trauma Management Performance in Europe**

Yongjun Shen, Elke Hermans, Da Ruan, Geert Wets, Tom Brijs and Koen Vanhoof

**GAO findings**

- Transports for all Medicare fee-for-service beneficiaries grew 33% 2004 to 2010
- Transports nationwide grew most in super-rural areas (41%) relative to urban & rural areas
- 59% increase in basic life support (BLS) nonemergency transports
- BLS nonemergency transports in super-rural areas grew the most—by 82%

**GAO-13-6**

**Cost components**

**Safety is Good Business**

What are the solutions?

- Training?
- Practice Policy?
- Transportation Systems Engineering?
- Automotive Engineering?
- Education of other road users???

**Expensive...**

**Are you self insured???**

Very Scary insurance data – the $10 million dollar EMT

<table>
<thead>
<tr>
<th>Year</th>
<th>Premium</th>
<th>Incurred Medical</th>
<th>Incurred Indemnity</th>
<th>Modified Premium</th>
<th>Total Claims</th>
<th>Rate Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>14.1</td>
<td>540</td>
<td>885</td>
<td>3.08</td>
<td>9,925</td>
<td>27%</td>
</tr>
<tr>
<td>2002</td>
<td>12.5</td>
<td>447</td>
<td>266</td>
<td>2.66</td>
<td>255</td>
<td>78%</td>
</tr>
<tr>
<td>2001</td>
<td>11.3</td>
<td>454</td>
<td>88</td>
<td>2.08</td>
<td>128</td>
<td>78%</td>
</tr>
<tr>
<td>2000</td>
<td>10.6</td>
<td>420</td>
<td>93</td>
<td>1.91</td>
<td>128</td>
<td>55%</td>
</tr>
<tr>
<td>1999</td>
<td>10.1</td>
<td>405</td>
<td>115</td>
<td>1.58</td>
<td>117</td>
<td>56%</td>
</tr>
<tr>
<td>1998</td>
<td>9.6</td>
<td>411</td>
<td>13</td>
<td>1.20</td>
<td>30</td>
<td>51%</td>
</tr>
</tbody>
</table>

Workers Compensation Rate increased by 27%

**A problem**

2011 Insurance data –
- 35 fold more likely to have a claim based on transport than related to medical care
- 27 fold more likely to have a claim based on transport than related to medical care
- 10 fold more likely to have a claim based on transport than related to medical care

**The Huntsville Times**

Ambulance suit gets $3.1 million

A stringent police enquiry into the death of a 75-year-old woman in a West Midlands ambulance was 50% more likely to have a claim related to medical care

**Workers Compensation Rate increased by 27%**
Very Expensive

EMS CANNOT Afford to keep paying out like this....

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

Dry
Stopped at 176 feet

Wet
Stopped at 220 feet

* Stopping distance: Perception time + Reaction time + Vehicle braking time (varies with age, skill, agility, alertness + vehicle type, tire pressure, road etc)

Key elements to safety

- Impact Biomechanics
- Transport Ergonomics
- Fleet Safety

Impact biomechanics

- Crashworthiness
- Vehicle design
- Occupant protection

Transport Ergonomics

- Operational tasks
- Human factors analysis
- Range of reach
- Patient loading and unloading
A “Fleet” to many in Emergency Medical care means….

Fleet safety
- Operational policies – dispatch, safety
- Fleet mix
- Vehicle selection – safety, ESC, loading height
- Driver performance and monitoring
- Scene safety
- Visibility and conspicuity
- Safety measurement and management

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 over both shoulders for side-facing occupants are potentially lethal – and in NO WAY SUPPORTED BY ANY DATA OR INDEPENDENT AUTOMOTIVE SAFETY EXPERTISE

Rules/Policies Addressing Known Hazards
- Federal Motor Carrier Safety Administration (FMCSA)
  - Cell phone use – November 2011
  - Hours of Service – December 2011

Federal Motor Carrier Safety Administration - FMCSA
- http://www.fmcsa.dot.gov/

Nov 2011, Hand Held Cell Phone Ban
- http://www.fmcsa.dot.gov/index-regulations/topics/noindex.htm

Dec 2011, New FMCSA Hours of Service
- http://www.fmcsa.dot.gov/index-regulations/topics/noindex.htm
Safe Practices for Motor Vehicle Operations
ASSE/ANSI Z15.1-2012

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

Newly Revised ANSI/ASSE Z15.1-2012 Standard is now available.
• These practices are designed for use by those having the responsibility for the administration and operation of motor vehicles as a part of organizational operations.

New Safety Data
• TRB 2012
• 2011 National EMS Assessment
• 2011 NFPA
• TZD EMS
• NCHRP 17-51
• FARS/MMUCC
• NEMSIS
• BLS

National EMS Assessment

Increasing focus
• TRB - ANB10(5)
• RITA/ITS/DOT
• Traffic Records Forum
• DHS/NIST/NIOSH
• TIMS
• ASSE
• SAE
• EMS Safety Foundation

A lot is now possible and for less!
• Driver behavior
• Vehicle behavior
• Roadside ITS
• Fuel consumption/Economics
• Resource modeling

Fleet Management technologies
• Zoll rescuenet and road safety fleet management systems
• ACETech/Ferno
• FleetEyes – Intermedix
• Marvis
• Telematics
• Priority Dispatch
• Optima
• Northrop Grumman

Transport performance
• Driver training?
• Real time safety performance outcomes?
What about changing driver behavior in the real world??

Invehicle technologies to enhance transport safety

- Aftermarket in vehicle electronic e-safety devices with monitoring and feedback

Human Interface approaches

- Hardware fitted to the vehicle
- Non hardware App Driven cellular technology

Spectrum of dimensions

- CAD
- Resource allocation
- Fleet performance – Monitoring: System that gives management data of vehicle efficiency and use
  Feedback: Directly to drivers at the wheel
- Public Alerts

Zoll Online – RescueNet Road Safety

ZOLL systems

Ferno Acetech

ACETECH.. Web

- Mapping, reports, alerts, hotspots, vehicle data
Niagara EMS
Decrease in Speeding Infractions

Fleet eyes

Telematicus

GGD views
A smart phone App that is a safety tool

Telematicus
Fleet Management capability

Vehicle database
- Individual vehicle's data
- Fleet mileage collection/checklists
- Link to other systems (SAP, Fleet)

Maintenance & Service Plans
- Repair history & scheduling
- Future planning
- Reporting
- Export to Excel for manipulation
- Scorecards views, Crystal Reports

Optima
Demand/Resource analysis and modeling and base location planning

Northrop Grumman
Operationally Demonstrated

These technologies:
- Realized dramatic sustainable change in drivers' attitude toward safety
- Provide evidence-based data to use for individual driver training and refresher courses
- Able to identify drivers that fail to align themselves with our mission of safety

Marvlis

- The dashboard calculates:
  - Current percent of demand coverage
  - Three closest vehicle recommendations for recent incidents
  - Realistic travel time estimates for each possible responder

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Marvlis

• The web interface:
  • individual choice of reference maps
  • integration of AVL/ARL and other live feeds
  • native Android client
  • creation/update of spatial data directly to ArcGIS Server
  • customization options to extend functionality

Priority Dispatch

• This IS a Transportation and Automotive Safety issue

Creating a Safety Culture
within a company safety must have leadership and support
of upper management

• Awareness
• Training
• Incentive

Key elements to transport safety policies

• Vehicle/Fleet Safety
• Occupant protection
• Driver performance monitoring and feedback
• Hours of service
• Driver/provider wellness and fitness
• Driver/provider impairment
• Public safety

Oslo Norway
mass shooting
EMS response
July 2011

Oak Creek, Wisconsin
mass shooting
EMS response
July 2012

August 5th, 2012 - Mars

What MUST we do?

• We MUST stop pretending that this is not an automotive safety occupant protection impact engineering issue
• We MUST stop writing ‘consensus’ policies on disciplines we are not trained in
• We MUST reach out to the technical experts in this field
• We MUST engage the existing technical and safety transport arenas with EMS transport
Which of these two vehicles would you want?
Sprinter v Ford Transit crash test
http://www.youtube.com/watch?v=C3kN6WF5rAA

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

The newest Oslo Ambulance
Safety

- Vehicle
  - All electronic safety systems: A-ESP, ABS, etc.
  - Crashworthiness:
    - Original chassis
    - Seat belt tensioner
  - Internal passive safety
  - Impact zones
  - No sharp edges
  - Securing equipment

User friendly

- All necessary equipment should be reach from the seats without losing the seat belt

Based on technically sound scientific principles

- The stretcher platform can be moved into 3 different positions

All necessary equipment should be easily reached from the seats without losing the seat belt.
Vehicle Occupant Safety design

European design
Safety technology is a key focus

Safe and Ergonomic design
Patient Transferring Slides

Ergonomic layout and equipment

Flexibility to manage two patients
PodCasts - with Kyle Bates in ‘First Few Moments’

- Latest Podcast - Chris Fitzgerald, our EMS Safety Foundation’s Director of Human Factors and Ergonomics shares some key points on lifting and moving patients and equipment - http://firstfewmoments.com/?p=742

The result of the frequency analysis, green dots mean equipment used every time the ambulance is driven, orange every day, red every week and so on

ESC helps drivers stay in control when they need to swerve or brake suddenly to avoid an obstacle or turn corners on slippery roads.

ESC – Does your ambulance have it??

- ESC helps drivers stay in control when they need to swerve or brake suddenly to avoid an obstacle or turn corners on slippery roads.
- Vehicles equipped with ESC are involved in fewer severe collisions caused by loss of control, resulting in significantly fewer deaths and injuries

Based on technically sound scientific principles and here at Expo
Ambulance Sparing

- In almost ¼ (23.5%) of all motorcycle missions ambulance use was avoided!


Areas of need

- Improvement in use of occupant restraint systems
- Improvement in use of equipment restraint systems
- Policies to minimize transport risks

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

The ambulance response vehicle of the future?
Policy makes a difference…

DOH NYS, 2012
Advisory on patient care in a moving ambulance
www.EMSSafetyFoundation.org/2012-04_NYSAdvisory_on_Patient_Care_in_a_Moving_Ambulance.pdf

Interdisciplinary Innovation
Consortium

The EMS Safety Foundation:
A practical and functional model
Interdisciplinary and Operational and International
• Innovation
• Collaboration
• Knowledge transfer

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

Rettmobil 2012 – May 9-11th
Public Access – www.EMSSafetyFoundation.org

Live from Rettmobil 2012
Click here http://www.youtube.com/watch?v=pR_iZ7ZUanI or scan the eTag below with your mobile device to see Live @Rettmobil 2012 Webinar on You Tube
**What do we know now??**

- Intersection crashes are the most lethal
- There are documented hazards, some of which can be avoided
- Occupant restraint with standard belts is effective. (Over the shoulder belts for patients, with the gurney in the upright position where medically feasible)
- All equipment should be locked down
- Some vehicle design features are beneficial - automotive grade padding in head strike areas, seats that can slide toward the patient
- Head protection??
- Electronic Driver monitoring/feedback systems appear to be highly effective

**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.

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**Transport related aspects -**

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

**Emergency Vehicles – Viewer Awareness**

For a timely, appropriate and safe response

- Location
- Size
- Shape
- Speed
- Intended path

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**Policy and practice ignorant of existing technical safety data**

- June 17th 2008

**But whatever color …. If you run a red light someone will be killed**

- a paramedic and a patient killed

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**Click here** [http://www.youtube.com/watch?v=pR_iZ7ZUanI](http://www.youtube.com/watch?v=pR_iZ7ZUanI) **or scan the above eTag to see Webinar**
In this vehicle...

April 30, 2009 - Tennessee

Caution!!!

- Just because it has been 'Tested' does not necessarily mean it has been crash tested – nor that it is crashworthy and/or going to protect you
- Even if it has been 'Crash tested' – it depends upon to which standard, whether or not it is actually safe under real world crash conditions
- Appropriate technical expertise is key!!

Technical Collaboration is key

- We are NOT the experts in this science
- We cannot afford to play the silo game here, it is costing lives, time and money
- We MUST have a meaningful evidenced based approach to design, operations and policy
- We must be outcomes driven

this vehicle is safety crash tested by automotive experts

Unlike this vehicle

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?

Fleet Mix ?
What do we know works...
- Tiered dispatch
- Vehicle Operations Safety Policies
- Ideally, forward and rear facing seating
- If not, use squad bench lap seat belts
- Patient over the shoulder belts
- Securing equipment
- Fleet management electronic technical devices
- Safety awareness
- Cultural change

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

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

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

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

Future directions
- Meaningful Goals
- New policies
- New practices
- New standards
- New vehicles
- New technologies

Key future focus
- Data and Recent Initiatives
- Transport Technical science
- Human Factors
- Bridging Diverse Disciplines
- Testing and Standards
- New systems safety technology solutions
- Fleet management strategies
- Innovative Vehicle Design
- Operationalizing Safety

Innovation
Collaboration
Knowledge transfer
Conclusion
- EMS transport has serious hazards and safety issues
- Major advances in EMS safety research, infrastructure and practice over the past 5 years
- Development of substantive EMS safety standards is a necessity and a reality
- Multidisciplinary safety issue that EMS cannot solve internally
- 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, transportation and occupational safety

And….
- It is no longer acceptable for EMS to be functioning outside of transportation, automotive 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 and resources available online
http://www.objectivesafety.net

Your handouts etag page

for those on one r or q generation!
- if you have a smart phone
- and you have downloaded free Tag Reader
- point your phone and capture this etag to get today’s handout on your phone