Safe Ambulance Transport of Kids – Everything You Really Need to Know

Now, who have we here??

- Do you transport patients?
- Are you responsible for vehicle purchases?
- Do you manage the oversight of your vehicle performance and safety?
- Do you design your vehicles?
- Do you have automotive safety and crashworthiness, occupant protection and fleet safety scientific and technical data background and support?
- Do you rely on health care colleagues and aftermarket retrofitters for technical vehicle safety and fleet performance advice?

How do you turn this… into this…. Safely?

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.

Things can go wrong – but when there are sound safety policies and technologies in place, and the system is well prepared, you can minimize harm.

Your Interactive Handout awaits you online at...

- www.objectivesafety.net

This WILL be FAST!!
No need to take any notes – all text slides will be awaiting you in your online Handout.

Outline

I. Identification of ground ped patient transport safety issues, hazards and areas of risk to patients, providers and public
II. Highlight unacceptable mythology and challenges to advancing ground ped patient transport safety
III. Profile innovation, new safety technologies and strategies and knowledge transfer to enhance safety and reduce risks of ground ped patient transport

http://www.objectivesafety.net
Your Handout and Additional Resources
Who am I?
- Nadine Levick MD, MPH
- Emergency Medicine Physician and Public Health Academic, (USA-Hopkins, Harlem, Maimonides, Brookdale & Australia – Royal Melbourne, Royal Childrens Hospitals, Royal Australian Flying Doctor Service)
- Chair, National Academies Subcommittee TRB EMS Transport Safety, USA
- Founder of EMS Safety Foundation
- Recipient, International Society of Automotive Engineers, Women’s Leadership Award for EMS Safety

EMS Transport Safety
- ‘patient safety’
- AND also
- ‘provider’ and ‘public safety’

Principles of Transport Safety

Task Analysis
- What is it that you need to do?
- How best should the system be designed to make it possible to do that safely
- What happens in other parts of the world??

Are we taking unnecessary risks in how we do our transports??

Ambulance transport a serious transport safety problem...
In the USA
- the most lethal vehicle on the road both per mile travelled and per vehicle
- is exempt from commercial fleet safety oversight from Federal Motor Carrier Safety Administration (FMCSA)
- 2/3 fatalities not in the ambulance
- Exempt from most FMVSS standards

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 and medical transport systems
- Although all EMS and medical transport systems have medical direction and oversight, it is rare for there to be transportation expertise oversight

Data...
- What is your transport safety record in your service?
- How can you improve if you don’t have a meaningful measure of safety performance?
- Transport safety is not guesswork, it is a science

...and
- Is your ambulance crashworthy?
- Do you have a telematics feedback system?
- Enhanced Stability Control (ESC) – Does your ambulance have it??
  - An estimated >16% decrease in vehicle crashes
- and what is your loading height??
  - ...is it less than 27 inches (68cm)??
Absence of USA standards and oversight
- Challenges in identifying best practice
- Myriad of unregulated commercial products
- No safety performance standards
- Absent national safety oversight

Already this year, Jan 8, 2011
WNEP
Rover Collides with Ambulance Transports His Daughter
By Jane Helfant
WNEP.COM, January 8, 2011

Safety of the...
- Provider
- Public
- Patient

And...
- In the vehicle
- At the scene
- During transport

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

But Patient Safety is just one part of this system

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

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Data...

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ESC – Does your ambulance have it??

- Transport Canada announced that effective August 31, 2011, automakers must install Electronic Stability Control (ESC) technology in Canadian vehicles.
- 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

Current accepted safety design and transport system technologies are being ignored, and worse...

New Information/Technical Developments Jan 2006- Jan 2011

- SAFETEA-LU, 2006 – EMS identified as one of the 4 E’s (Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users)
- International Ergonomists Association (IEA) - publication June 2006
- Enhanced Safety of Vehicles (ESV) - publications June 2007, 2009
- American Society Safety Engineers (ASSE) - publications June 2006, 2007
- National Academies TRB – Inaugural EMS Safety address, Jan 2007
- EMS Safety Foundation established – April 2007
- NEMSAC established – April 2007
- OSHA – publication July 2007
- Transportation Safety Advancement Group (TSAG) – Feb 2008
- Worker visibility Act - Nov 2008
- SAE Ambulance Standards development – May 2010
- EMS Safety Foundation established – Dec 2007
- National Academies TRB – Inaugural EMS Safety Subcommittee meeting Jan 2008
- Transportation Safety Advancement Group (TSAG) – Feb 2008
- NFPA Ambulance Standards Committee – May 2010
- EMS Safety Foundation Innovation WorkShop  - October 2010

A challenge we know now...

- …is that there is a major problem with the present approach and what is being done currently.
- and many practices are in conflict with, or not supported by, existing technical engineering science

And...

This is in a setting where

- transport safety is the major and most costly adverse event in EMS
- And there have been all sorts of major technical and informational developments since Jan 2006

Some new dimensions

- Vehicles – smarter, sleeker, safer – CHEAPER!
- Operations – new technology tools
- Interdisciplinary infrastructure – new global platforms

Systems safety of:

- Getting you, your patient and equipment in and out of the vehicle
- Providing patient care inside the vehicle
- Occupant protection in crash and near miss situations

Safety Performance

- Measurement
- Outcomes
- Technical expertise
When is it safe to do what...?

- What are your policies???
  - If your patient is pink, warm and talking?
  - Are you required to notify the driver if you are out of your seat belt?
  - Are ‘routine procedures’ putting you at risk?

What is a safe speed and how do we identify that?

A serious problem...

Transport related aspects -
- dispatch of EMS/Medical transport vehicles
- transport policies and protocols
- vehicle fleet 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

Transport Medicine

- Impact Biomechanics
- Transport Ergonomics
- Fleet Safety

A “Fleet” to many in Emergency Medical care means....

Impact biomechanics
- Crashworthiness
- Vehicle design
- Occupant protection

Transport Ergonomics
- Operational tasks
- Human factors analysis
- Range of reach
- Patient loading and unloading
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

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

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

Creating a Safety Culture
within a company 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

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)**
- 62% 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

ED nurse recounting event

Preventable...
- James Woodman
  - is a paramedic who, on his first day as a paramedic, suffered a severe TBI when the ambulance he was riding in (in the back) was t-boned and rolled onto its side.
  - He remains in a persistent vegetative state in an ECF in Colorado.
  - It is assumed that when the ambulance rolled onto its side, the lifepack 10 struck James in the head......
**Patient 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 and patient transport care
- Other high speed vehicles (e.g., racing cars) have a different safety paradigm
- Design of interventions to mitigate injury is predicated on a valid testing model
- Complex both engineering and public health issues

**Science behind Policy**
- "For successful technology, reality must take precedence over public relations, for Nature cannot be fooled."
  Richard P. Feynman 1988

**Ground Ambulance Transport Safety IS Complex AND Multidisciplinary**

**The Emergency Department (ED)**
- An ambulance is not an ED/ICU on wheels
- The laws of physics prevail...
  - and they don’t care what your job title is or if you are a patient, a provider or a member of the public

**A tragic emergency health care intervention outcome**
- Do we ask vehicle builders to write cardiac arrest protocols...?
  Vehicle design and safety is not what we are trained to do!!!
June 17th 2008
a paramedic and a patient killed

This is in a setting where
• transport safety is the major and most
costly adverse event in EMS
• And there have been all sorts of major
technical and informational developments
since Jan 2006

We should use the best safety
practices demonstrated in engineering

...in automotive safety
engineering
Range of reach.. This is a well defined technical science

‘Workplace’ Hazards

Important…
- Ergonomics and automotive safety issues are interrelated
- Crashworthiness priorities override the ergonomic issues

Duke Risk Assessment Approach
Integrating Risk Assessment and Operational Practice!!
- Green
- Blue
- Yellow
- Red

Goals
- Standards for safety
- Policy based on Science
- Databases to demonstrate outcome
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
Dynamic Sled Testing of Ambulance Pediatric Restraints


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

Why do we do this?

Vehicle Crashworthiness testing

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

Full Vehicle Crash Tests

Test 1 - Right side impact
Test 2 - Frontal
Pre-impact CTD
Positioning

2000 Full Vehicle Crash Testing
Pre-impact CTD positioning

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

Preparation of test vehicles

Impact residue

During impact
CTD dynamics

In the absence of standards or automotive peer review
Unsafe systems are being marketed to you

In contrast to this setting
High speed crash, rolled and the occupants (patient and medics) had only minor scratches

A few key words about restraint systems...
Systems safety failure AND dangerous
Overwhelming existing evidence these practices are HIGHLY dangerous
NO evidence whatsoever that these practices are NOT dangerous, let alone safe

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

Immobilization board
Foldable
Choose the Best Option

Invehicle technologies to enhance transport safety
- Aftermarket in vehicle electronic e-safety devices with monitoring and feedback
- Numerous options now available
- Simple smartphone apps — to invehicle hardware

What about changing driver behavior in the real world??

The “Feedback 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

Demonstrated Effectiveness

MEMS MONTHLY OVER SPEED VIOLATION TREND 2003/2004

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<tr>
<th>Series</th>
<th>Mar</th>
<th>April</th>
<th>May</th>
<th>June</th>
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<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
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<tbody>
<tr>
<td>I - blind data, no growls</td>
<td>0.044</td>
<td>0.017</td>
<td>0.018</td>
<td>3.886</td>
<td>5.244</td>
<td>15.843</td>
<td>12.059</td>
<td>9.94</td>
<td>14.823</td>
<td>13.429</td>
<td>9.319</td>
<td>7.24</td>
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<tr>
<td>II - growls &amp; tones ON unidentified data capture</td>
<td>0.025</td>
<td>0.057</td>
<td>0.025</td>
<td>4.725</td>
<td>5.877</td>
<td>19.289</td>
<td>15.765</td>
<td>12.13</td>
<td>18.094</td>
<td>16.61</td>
<td>17.49</td>
<td>15.76</td>
</tr>
<tr>
<td>III - identified data</td>
<td>0.025</td>
<td>0.057</td>
<td>0.025</td>
<td>4.725</td>
<td>5.877</td>
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</tr>
</tbody>
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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.

THE ACETECH™ AVI advantage
- ACETECH™ AVI – Vehicle Informatics
  - Know where your vehicles are
  - Dispatch the closest, most appropriate unit
  - Improved productivity
  - Reduced carbon emissions
  - Reduced response times
  - Fewer collisions
  - Reduced injuries
  - Plus: Panic /emergency button to alert to operations

Methodology & Functionality
- “Learn” - All trips recorded [Start/Stop Trip]
- Established the benchmarks
- Exceeds the guidelines
- “Guide” - Speed feedback activated
- Smart Clinics
- Automated application update
- “Sustain” - Messaging
- Incident Management
- ISG
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

October 29, 2009

- This is where the technical experts were, operational EMS providers and the government agencies too

What could you learn from the National Academies – right NOW and gratis

- The realm of burden and benefit
  - measuring the safety of the system
  - determining the economic, ethical and risk benefit challenges
- Transport System Management
  - fleet and system technologies and policies
  - strategies for managing of resources, benchmarking
- Vehicle safety
  - occupant protection design and testing
  - vehicle performance safety
- vehicle and personnel human factors issues
- Dissemination and Policy
  - Knowledge transfer
  - Standards, specifications and policy

The EMS Safety Foundation: A practical and functional model

Interdisciplinary and Operational
  - Innovation
  - Collaboration
  - Knowledge transfer

The EMS Safety Foundation

November 2009 Webinar for Public Access

www.EMSSafetyFoundation.org and www.objectivesafety.net

TRB 2009 Summit – addressed the key and interdisciplinary issues, in one day – please seek that information out.

There have been two TRB Summits held, 2008, 2009 and both with vehicle engineering and transportation systems technical expertise

See www.trb.org, and for the Summit archives:
www.objectivesafety.net/TRBSummit2008.htm
www.objectivesafety.net/TRBSummit2009.htm

Interdisciplinary and Operational

- Innovation
- Collaboration
- Knowledge transfer

The EMS Safety Foundation

Ambulance Innovation Workshop and Design Clinic

Session A
Vehicle Safety and Occupant Protection
Gene Lukianov
Session B
Hands-on human factors operational safety and task analysis
Chris Fitzgerald

October 2nd, 2010

Background:

- EMS Safety Foundation has been established to fill a gap in
  - technical knowledge transfer
  - practical interdisciplinary R & D
  - evaluation and implementation of system safety enhancements for EMS and Medical Transport
- It is a not-for-profit institute

Texas - Careflite’s new vehicle

EMS Safety Foundation

Ambulance Innovation Workshop and Design Clinic

Session A
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October 2nd, 2010
DISCUSSION TOPICS

- It's ALWAYS a SYSTEM
  - ACCIDENTS
  - VEHICLE DESIGN
    - To Avoid Accidents
    - For Occupant Safety

Overarching approach – evidence based
- General approach
  - to measure & quantify the problem as much as possible
  - measuring forces, dimensions, duration and frequency, postures and movements
  - use (new) technology
    - Force gauges
    - Biomechanical modelling
    - EMG
    - Continuous mapping of back / shoulder movement

Using ergonomics in a systems approach for user centered Ambulance Design
(...its a system!!)

Designing ambulances around people
- A systems approach!!!!
- The interaction of what paramedics do in and around the ambulance are part of a system.
- If you change part of the system it may have an impact on other parts of the system which may then compromise the safety features – domino effect.
What's the range in our group?

- Stature (body height)
- Sitting height
- Forward reach distance

Australia - NSW Peds/Neonatal Vehicle - NETS

NSW Australian Peds/Neonatal Vehicle
Scotland neonate/peds transport

Clear safety message

Some new USA Peds vehicle plans

**RETThotel is -**

- A major European Emergency Rescue Congress, Trade show and Symposium
- Held in Fulda, Germany
- Established in 2001
- Attended by ~20,000 attendees
- Brainchild of Prof Peter Sefrin
Vehicle Occupant Safety design
European design
Safety technology is a key focus

Safe and Ergonomic design

Collaboration and Outcomes
- Interdisciplinary Collaboration is what is key – not orthopedic folks talking to cardiologists – BUT collaboration between the health care folks appropriate automotive and occupant protection engineers and transportation system design and industry standards that make sense – and
- Meaningful measures of outcome and performance

Texas’ Careflite’s new vehicles

Registration link is now live!

Rettmobil 2011 – May 11-13th

Rettmobil Delegation??
May 11-13th, 2011

Registration link is now live!
Careflite's new vehicle

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 operations and policy
- We must be outcomes driven
- We MUST cease to be a fiefdom in a discipline we have no technical background or expertise in

this vehicle is safety crash tested by automotive experts

Unlike this vehicle

So what do we need to do ??
- Reach out to the appropriate experts – they sure do want to help us
- STOP being philistines and be the scientists we are trained to be and at least seek a scientific approach
- Get your heads out of the sand – there is plenty of valid technical information – FMCSA, TRB, SAE
- Make policy and purchase decisions on technically sound data, not a marketing brochure
- HAVE MEANINGFUL AND TRANSLATABLE OUTCOME MEASURES FOR YOUR SERVICES SAFETY PERFORMANCE

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

Conclusion
- Patient transport has serious hazards and safety issues
- Major advances in patient transport safety research, infrastructure and practice over the past 5 years
- Development of substantive ambulance transport safety standards is a necessity and a reality
- Multidisciplinary safety issue that EMS and patient transport cannot solve internally
- Failure to transfer knowledge from transportation and automotive safety is unacceptable and dangerous
- Ambulance transport is still way behind the state of the art in vehicle, transportation and occupational safety

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