Safe and Secure: Infants and Team

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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?

U of M

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

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

Bronson

Helen DeVos

Sparrow
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.

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
- What is your loading height??
  - ...is it less than 27 inches (68cm)??

Already this year, Jan 8, 2011

January 13, 2011
Patient dies after ambulance, car collide

February 7, 2011

February 8, 2011

February 16, 2011

Patient 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?
- What can we learn from international colleagues?
Tragedy you don’t want to be involved in

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

July 21, 2007 06:20 AM EDT

TO QUOTE STEVE “SID” CAESAR -
Director IHS ES

“We want everyone to get home safely each day”

To quote Steve “Sid” Caesar –
Director IHS ES

“We want everyone to get home safely each day”

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**

**Ontario EMS Occupant Safety**

30 August 2010

**Balance of concerns and risk during transport**

- Response and transport time
- Clinical care provision
- Occupant safety/protection
- Public Safety

**Ambulance transport a serious transport safety problem...**

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**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

**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

**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

An interhospital transport
? “Do no harm….”?

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)**
• > 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##

EMS Transport General Concerns
• Consequences can be predictable & likely preventable
• Costs of these adverse events are high in loss of life, financial burden and negative impact on delivery of EMS care
• Other high speed vehicles (eg. racing cars) have a different safety paradigm
• Design of interventions to mitigate injury is predicated on a valid testing model
• Complex both engineering and public health issues

USA EMS
• EMS Systems - >15,000
• Personnel - ~1 million (~30% F/T professional & 70% volunteer)
• Vehicles - ~50,000
(Type I, Type II, Type III, Freightliners, ?motorcycles)
• Transports - ~50 million
(to Emergency Depts ~ 50%, < 1/3 emergent)
• Cost - ~$8 Billion annually
• Safety Oversight - ? Disparate
USA EMS transport safety data estimates

- ~ 50,000 vehicles
- ~ 9,000 crashes a year
- ~ 23 pedestrians or occupants of other car
- ~10 serious injuries each day
- Cost estimates > $500 million annually

Moose crash data...? – not EMS crash data

Jan 2010 - Evaluating Trauma Management Performance in Europe

USA EMS transport safety data estimates

- ~ 50,000 vehicles
- ~ 9,000 crashes a year
- ~ 23 pedestrians or occupants of other car
- ~10 serious injuries each day
- Cost estimates > $500 million annually

Moose crash data...? – not EMS crash data

Jan 2010 - Evaluating Trauma Management Performance in Europe
…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.

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?

What is a survivable impact?

- 12 mph (20 km/hr)?
- ~30 mph – survivable
- ~60 mph – not survivable

What is a survivable impact?

$E = \frac{1}{2}mv^2$

$v^2 = 2as$
A survivable impact??

A serious problem...

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

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

A tragic emergency health care intervention outcome

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

Negative impact on system performance...

- BUT an EMS crash can kill all those involved AND wipe out a rural EMS system AND negatively impact a regions response capacity……

Real world answers to real world questions -

- What features will enhance safety of my new vehicle purchase?
- What color scheme do I want on my vehicle to make it safe?
- 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?

Ambulance Transport Safety

- Emergency care, public health, 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

In the USA there are more safety standards for moving cattle than for moving patients

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:

Creating a Safety Culture within a company must have leadership and support of upper management:
- Awareness
- Training
- Incentive

A tragic emergency health care intervention outcome

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

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

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

In this vehicle...

October 31, 2008 - Kentucky

We should use the best safety practices demonstrated in engineering

April 30, 2009 - Tennessee
...in automotive safety engineering

and in ergonomics

Range of reach. This is a well defined technical science

‘Workplace’ Hazards

Bigger is not necessarily better....

Important...

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

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

Duke Policies

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
If we know this – and its published….

Why do we do this?

Choose the Best Option

Immobilization board

Foldable
Vehicle Crashworthiness testing

USA - 2000 research
Europe - 2007 to meet LEN

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

Full Vehicle Crash Tests

Test 1 – Right side impact

Test 2 – Frontal

Preparation of test vehicles

2000 Full Vehicle Crash Testing
Pre-impact CTD positioning

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

Impact residue

During impact
CTD dynamics

Pre-impact CTD positioning

Post impact
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 that these practices are HIGHLY dangerous. NO evidence whatsoever that these practices are NOT dangerous, let alone safe.

NOT new technical data...

Richardson S.A., et al, Int. J. of Crash, 4:3, 239 – 259, 1999 Side facing 4-point harnesses demonstrated to be lethal, even at slow ground vehicle speeds.

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 sidemaking occupants are potentially lethal – and in NO WAY SUPPORTED BY ANY DATA OR INDEPENDENT AUTOMOTIVE SAFETY EXPERTISE.
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??

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.

The “Feedback Box” - A transportation safety monitoring and feedback device

Demonstrated Effectiveness

And when a rare crash happens….

Unit 302 Accident

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.

ACETECH™ Auto Vehicle Informatics (AVI) key features

THE ACETECH™ AVI advantage

- ACETECH™ AVI – Vehicle Informatics
  - Know where your vehicles are
  - Dispatch the closest, most appropriate unit
  - Improved productivity
  - Reduced service call times
  - Reduced carbon emissions
  - Reduce response times
  - Reduce risk (shorter response)
  - Fewer collisions
  - Reduced injuries
  - Plus panic/emergency button to alert primary

ACETECH™ ABC Miles Per Month

MEMS MONTHLY OVER SPEED VIOLATION TREND 2003/2004

MEMS ABC Miles Per Month
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

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

- The realm of burden and benefit
  - measuring the economic, ethical and risk benefit challenges
- Transport System Management
  - fleet safety and oversight technologies and policies
  - operations management – dispatch, congestion routing, deployment 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

its out there NOW

- 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

The EMS Safety Foundation: A practical and functional model

Interdisciplinary and Operational
- Innovation
- Collaboration
- Knowledge transfer
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

DISCUSSION TOPICS
- It's ALWAYS a SYSTEM
- ACCIDENTS
- VEHICLE DESIGN
  - To Avoid Accidents
  - For Occupant Safety
Using ergonomics in a systems approach for user centered Ambulance Design

(...its a system!!)

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 modeling
    - EMG
    - Continuous mapping of back/shoulder movement.

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.

Normal Curve

What’s the range in our group?
- Stature (body height)
- Sitting height
- Forward reach distance

Reach Data

<table>
<thead>
<tr>
<th>Variable</th>
<th>5th Percentile</th>
<th>95th Percentile</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sitting reach distances</td>
<td></td>
<td></td>
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<tr>
<td>(measured from rear of shoulder to anterior &amp; no accommodating of slight knee increase in the direction of reach)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Forward reach – finger tip (sitting)</td>
<td>2' 3½&quot;</td>
<td>3' 3&quot;</td>
<td>10 ½&quot;</td>
</tr>
<tr>
<td>Forward reach – pinch grip (sitting)</td>
<td>2' 2&quot;</td>
<td>3' 5&quot;</td>
<td>13 ½&quot;</td>
</tr>
<tr>
<td>Forward reach – hook grip (sitting)</td>
<td>2' 1½&quot;</td>
<td>3' 6&quot;</td>
<td>14 ½&quot;</td>
</tr>
<tr>
<td>Overhead reach – hook grip (standing)</td>
<td>6' 1&quot;</td>
<td>7' 6&quot;</td>
<td>15&quot;</td>
</tr>
<tr>
<td>Elbow height above seat (sitting)</td>
<td>7' ½&quot;</td>
<td>11' 10&quot;</td>
<td>4&quot;</td>
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</tbody>
</table>

Task Analysis
- Is – the identification of the range of “activities” performed (in and around the ambulance) and the description of discreet and sequential actions within these activities.
- In a recent project for assessment of paramedic work performed away from the ambulance I used
  - 10 activities
  - 50 tasks
  - 220 task steps
- My original ambulance design work involved many tasks and up to 1000 task steps.

Task Analysis - example
- 1.2 Rear compartment entrance
  - 1.2.1 Curb side door
  - 1.2.1.1 Grasp the handle
  - 1.2.1.2 Turn the handle
  - 1.2.1.3 Pull the door open
  - 1.2.1.4 Grasp one or two rails / place foot on lowest step
  - 1.2.1.5 Push off / pull up to move up to this step
  - 1.2.1.6 Move hand(s) on rail or to another rail
  - 1.2.1.7 Move other hand to the next step
  - 1.2.1.8 Push off / pull up to the next step
  - Etc......
- 1.2.2 Rear door
  - Etc......
Australia - NSW Peds/Neonatal Vehicle - NETS

NSW Australian Peds/Neonatal Vehicle

Australia, NETS Melbourne

Melbourne, Australia Neonatal Ambulance – stationary mode

Melbourne, Australia Neonatal Ambulance – in transit mode
Some new USA vehicle plans

RETTmobil 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

Rettmobil 2011 – May 11-13th


Registration link is now live!

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

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

Careflite’s new vehicle

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