"The Truth: Ambulance Safety – What You Can’t Afford Not To Know"

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New York, USA

The DEADICATED Paediatric/Neonatal Critical Care Transport Team,
A Health & Safety Education Day, "How Safe Are You?"
London, ON, October 4th, 2007

A tragic emergency health care intervention outcome
It does happen....

This is an important week

Drive Safely Work Week
Key Elements to Safety

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

Ontario

Challenges of Demographics

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<th>Percentage</th>
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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

Safety is Good Business
A devastating tragedy...

- An ETT down the wrong hole may kill your patient and be a terrible burden for the patient's 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......

Five Killed in Crash of Ambulance and Semi

Friday July 20th 2007...
The worst ambulance crash in USA history

Objectives

- To identify the safety issues that are key regarding paediatric patient transport for the patient, the provider and the public
- To describe safety innovation and dispel safety myths
- To instruct providers on strategies for preventing crashes and for reducing risk of injury to patients, providers and the public during transport

Outline

I. Review data on ambulance transport safety
II. Highlight important predictable and preventable occupant risks and hazards during pediatric transport
III. Demonstrate what happens during an ambulance crash
IV. Review of guidelines, standards and innovation
V. Outline practices and strategies to enhance occupant safety and reduce risks of crash-related injury

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
One in ten (~6 million) ambulance transports involves a child. Only ~1.8 million are children <5 yrs. Ambulances ≠ standard passenger vehicles. Pediatric patients in ambulances ≠ children in passenger cars. Standard automotive safety practices cannot be applied directly to ambulances.

In contrast to the bus and truck industries, which have comprehensive safety oversight, transportation safety interventions, and 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.

Ambulances are generally not built by the automotive industry. Although all EMS systems have medical direction and oversight, it is rare for there to be transportation expertise oversight.


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?

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

Your colleagues in EMS...

Because one injury is one too many...

EMS in Ontario Canada
- Of 1.6 million calls and 1.1 million transports
  - 1 in 7 providers were injured resulting in a Worker Compensation claim
  - 69% reported having been assaulted by patients
  - 85% experienced the death of a child
  - 91% exposed to a multi-casualty situation
  - Only 4% of the profession over the age of 55 represent

Sept 26th, 2007
Charged with Vehicular Homicide

September 2007: It's not magic....

The Crash Event - Crash Testing

Intrusion vs Deceleration

If we know this – and it's published....

Why do we do this?

NOT new technical data...

An introduction

What one needs to know

What do the tests really mean

And, what tests are meaningful

Intrusion = vehicle to vehicle or vehicle to fixed narrow object

Deceleration = sudden stop – ie. sled test

Side facing 4-point harnesses demonstrated to be lethal, even at slow ground vehicle speeds.
Firstly!

» An accident?

» or

a predictable and preventable event

This is not acceptable

In the USA*

» ~ 5,000 crashes a year

» ~ One fatality each week

» ~33 pedestrians or 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

EMS Provider Fatalities

» 12.7 fatalities/100,000 EMS workers

» Greater than 2 x the national average (5.9 fatalities/100,000)

» Similar to Police (14.2/100,000) and Fire Fighters (16.5/100,000)


and what is killing EMS?

EMS personnel fatalities*

» 74% transportation related

» 15% of ground transport fatalities were struck by moving vehicles

» 11% were cardiovascular

» 9% were homicide

» 4% needle sticks, electrocution, drowning and other


So does it make sense?

» Gloves and universal precautions?...

… good biohazard protection BUT aren’t going to give much protection in a ambulance crash

Occupational transportation fatalities..

> WE HAVE A BIG PROBLEM HERE

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)**

» 82% of fatally injured EMS rear occupants unrestrained**

» > 74% of EMT occupational fatalities are MVC related***

» Serious head injury in >65% of fatal occupant injuries#


** Becker, Zaloshnja, Levick, Li, Miller. Acc Anal Prev 2003


# NIOSH, 2003

## Ray AM, Kupas DF, Prehosp Emerg Care 2005 Dec; 9:412-415

C45 - A criminal offence to not act in a way that protects the worker

Goals

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

Balance of concerns and risk during transport

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

What are the solutions?

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

A problem

2007 Insurance data –

- 27 fold more likely to have a claim based on transport than related to medical care

"Ambulance transport has a death toll....."

Carl Craigle EMT-P, Chief Platte Valley Ambulance

This month....

Ambulance suit gets $3.1 million
What do ambulance crashes really cost?

- Loss of life and injury
- Negative impact on EMS system
- Collisions are the largest liability cost and exceed 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
  - Litigation (settlement/transfer)
  - Medical/Disability costs of injured EMTs
  - Hiring of new employees to replace injured personnel
  - Retraining and psychological counseling of personnel involved and others
  - Increased insurance rates

June 2007

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 $1944.00
  - 2002/2003 $711.00
  - 2003/2004 $418.00
  - 2004/2005 $228.00

Tragedy you don’t want to be involved in

Tragedy you don’t want to be involved in

An interhospital transport ? “Do no harm…”?

The Emergency Department (ED)

An ambulance is not an ED /ICU on wheels

The Peds EMS/transport process
Pediatric Transport Safety IS Complex AND Multidisciplinary

Epidemiological Data Collection

Risk Management

Public Safety

Transport Safety

Ergonomic Research

Biomechanical Automotive Safety

Biomechanics/Chem Research

Communications Technology

EMS Policies

Pre

Driver Safety

Fleet Safety Program

Transport Safety Regulations and Standards

Fleet Safety Program

Fleet Safety Program

Fleet Safety Program

Fleet Safety Program

Communications Technology

EMS Policies

Pre

Driver Safety

Ergonomic Research

Biomechanical Automotive Safety

Biomechanics/Chem Research

Occupational Health and Safety

This IS an Automotive Safety issue

This IS a Transport System issue

Pediatric critical care transport--the safety of the journey: a five-year review of vehicular collisions involving pediatric and neonatal transport teams: GA Woodward, EW Fleegler - Pediatr Emerg Care, 2002

Towards safer neonatal transfer: the importance of critical incident reporting and review can reduce the number of adverse events during the transfer of critically ill infants.


Collisions/crashes among pediatric transport teams are unusual. They resulted in deaths, injuries, and disability. Injury has not been caused by the actions of a team member, the vehicle, or external environment.

Neonatal Transport

The continuous process of critical incident reporting and review can reduce the number of adverse events during the transfer of critically ill infants.

Careful planning and knowledge about the environment in which the team will be operating is essential. The team must be aware of the environment and be prepared to act quickly.

Knowledge, opinions and behaviors

Child and Provider Restraints in Ambulances: Knowledge, Opinions, and Behaviors of Emergency Medical Services Providers

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 (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.

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

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

What are the risks?
- Lack of tiered dispatch systems
- Frequent use of high speed
- Issues of adherence to road laws
- High use of L & S.
- Rear cabin
  - not subject to any automotive safety regulation
  - minimal structural crashworthiness features
  - inadequate and poorly studied occupant and equipment restraint utilization and safety
- The only design standards that are written specifically for ambulance vehicles (KKK specs) are purchase specifications, not performance specifications

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
  - Captains chair
  - Standing or kneeling

View of Ambulance interior from rear

The ‘workplace’ is also a crash scene

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 ?

Safety oversight of what and …. by whom
- Vehicle Safety
- Vehicle Design
- Transportation systems safety
- Safety Equipment Design
- Vehicle and Safety Equipment Testing and Standard development
- Safety policies

The National Transportation Safety Board (NTSB)?

History and Mission

This page is designed by The National Transportation Safety Board (NTSB) - Safety in Transportation.

The NTSB's mission is to carry out its responsibility to the American people to assess the safety of the nation's transportation systems and to issue appropriate safety recommendations. The NTSB has no authority to regulate transportation operations and does not seek to blame or apportion responsibility. This page is designed to provide information about the NTSB and its mission.

Safety in Transportation

The National Transportation Safety Board (NTSB) is an independent federal agency responsible for investigating all transportation accidents in the United States. The NTSB is committed to performing their mission in a safe, efficient, and effective manner. The NTSB is funded by the United States Congress and is independent of all other federal agencies. The NTSB is composed of members appointed by the President, with the advice and consent of the Senate. The NTSB is headquartered in Washington, D.C. and has regional offices in Chicago, Atlanta, and Los Angeles. The NTSB is also a member of the International Forum on Advanced Transportation Safety (IFATS).
A Simple Question….

Global EMS Vehicle Safety Standards vs Specifications and Guidelines

- EMS Safety and Performance Standards
  - Australia & New Zealand 4853
  - Commission European Community (CE) EN1789
- Non EMS Specific USA Standards
  - [Aviation - FAA/CAA/JAA]
  - [New ASSE/ANSI Z15 - fleet vehicles]
- USA Other
  - Purchase Specification: KKK & NTEA – AMD
  - Guideline: EMSC Do's and Don'ts, and (CAAS and CAMTS)

Commission on Accreditation of Ambulance Services - CAAS

Commission on Accreditation of Medical Transport Systems - CAMTS Accreditation Standards

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

NTSB 1979 Accident Report

- Recommendations
  - EVOC
  - LICENSE RECORDS

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
  - Mostly criteria

Transport Safety Guidelines EMSC/NHTSA fact sheet

- Do's
  - DO drive cautiously at safe speeds observing traffic laws.
  - DO tightly secure all monitoring devices and other equipment
  - DO ensure available restraint systems are used by EMTs and other occupants, including the patient.
  - DO transport children who are not patients, properly restrained, in an alternate passenger vehicle, whenever possible.
  - DO encourage utilization of the DOT NHTSA Emergency Vehicle Operating Course (EVOC), National Standard Curriculum.

- Don'ts
  - DO NOT drive at unsafe high speeds with rapid acceleration, decelerations, and turns.
  - DO NOT leave monitoring devices and other equipment unsecured in moving EMS vehicles.
  - DO NOT allow parents, caregivers, EMTs or other passengers to be unrestrained during transport.
  - DO NOT have the child/infant held in the parent, caregiver, or EMT’s arms or lap during transport.
  - DO NOT allow emergency vehicles to be operated by persons who have not completed the DOT EVOC or equivalent.

Occupant protection……??

July 2007
Unacceptable, and ridiculous current 2007 USA ambulance ‘safety testing’ practices !!!?

No ‘a’… then NO ‘F’ !!!!!

\[ F = ma \]

where 
- \( F \) – force
- \( m \) – mass
- \( a \) – acceleration

**Common European Community (CEN) EN 1789:1999/A1:2003**

- 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.

**USA Ambulances: FMVSS Exempt**

DOT NHTSA, FMVSS 49 CFR Parts 571, 572 & 589 Docket no. 92-28; notice 7

ASTM F 1086 - 94

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

Identifying predictable and preventable transport related risks and hazards
- Systems approach
  - Communications
  - Personnel
  - Transport
  - Equipment
  - Environment

Road accidents kill 1.2 million and injure children

Haddon/Baker/Runyan Phase-Factor Matrix as applied to EMS Safety

‘Workplace’ Hazards

But what about head protection?

It does happen....
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

New EMS helmet prototypes for 2006-2007

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???

EMS Best Practice, Sept 2006

Ambulance Safety Research: A New Field

Non issue

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

No need to reinvent the wheel...
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

Commercial Motor Vehicle Driver Training Curricula and Delivery Methods and Their Effectiveness
Commercial Motor Vehicle Carrier Safety Management Certification
The Role of Safety Culture in Preventing Commercial Vehicle Crashes
The Impact of Behavior-Based Safety Techniques on Commercial Motor Vehicle Drivers
Health and Wellness Programs for Commercial Motor Vehicle Drivers

July 2007

August 2007

An excellent model

http://www.EveryoneGoesHome.com
Tips for Emergency Vehicle Operations

A few months ago...

May 21st, 2007, Seattle

Help is on the way ???

November 24th, 2008

Not rocket science...

Distance of Nighttime Visibility: Driving While in Low Light.

September 11, 2007

U.S. Department of Labor
We’ve known for 10 years that red fire trucks are twice as likely as lime yellow trucks to crash at an intersection.

And very Predictable...

Intersections are lethal environments

Science not, next best guess

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

Safety at the scene

Protective Equipment
Vehicle Crash Testing
Test 1 – Right side impact

Preparation of test vehicles
Pre-impact CTD positioning

Closing speed 44 mph

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

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

New concepts out there now
- Black Boxes
- Tiered dispatch
- Helmets
- Enhanced ambulance vehicle design
- Intelligent Transport Technologies - ITS
- New Safety Standards
Vehicle Occupant Safety design

2007 European design
Safety technology is a key focus

Ergonomic design

Ergonomic layout and equipment

The Driver
▶ Driver selection
▶ Driver monitoring and feedback
▶ Driver Impairment
▶ Driver training

What about changing driver behavior in the real world??

Demonstrated Effectiveness
▶ Change driver behavior
▶ Carrot not stick
▶ Vehicle maintenance improvement
▶ Decreased administrative burden
▶ Insurance benefits

Driver behavior monitoring and feedback device

Demonstrated Effectiveness

A key to safe ambulance transport

Legends
- 1 - blind data, no growth
- 2 - growth & trend
- 3 - unregistered data capture
- 4 - identified data

Levick NR, Swanson J. Proceedings - 49th Annual Conf. of the Assoc. for the Advancement of Automotive Med, September 2005

AMBEX-999 Research Forum 2006 – Research most likely to change practice award

Levick NR, Swanson J, Proceedings - 49th Annual Conf. of the Assoc. for the Advancement of Automotive Med, September 2005

AMBEX-999 Research Forum 2006 – Research most likely to change practice award
Protective devices/concepts

To prevent a crash:
- Driver feedback
- Driver monitoring
- Driver testing
- Vehicle Intelligent Transportation System (ITS) Technologies
- Timed dispatch
- Appropriate policies

In the event of a crash:
- Vehicle crashworthiness
- Seatbelt systems
- Equipment lock downs
- Paving
- Head protection

Intelligent Transport Safety Systems

Vehicle visibility and conspicuity

Policy Changes

CPR?

Integration and Collaboration

EMS Network

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

Flexibility to manage two patients

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

Australia, Melbourne

Newborn Emergency Transport Service (Victoria)

Clear safety message

New UK London Ambulance/neonatal vehicles

Securing equipment
Rash of “Safety Concept” vehicles... Devoid of substantive automotive safety engineering input or testing

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.....”

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....

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

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

Were we safer in the Cadillac??

Creating a Safety Culture within a company must start with upper management’s commitment to safety
- Awareness
- Training
- Incentive
**Important Principles !**

1. Ambulances are NOT standard passenger vehicles

2. Paediatric patients in ambulances have needs which differ from children in passenger cars

3. Design, performance and practice policy should be based on properly conducted science

**Important Principles !**

**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

**Very Important Principles !**

1. A culture of safety
2. Drive cautiously
3. Wear your belts & restrain all occupants
4. Secure all equipment
5. Integrate scientific data into your policies and procedures

- Unrestrained occupants and equipment are a potential injury risk to all occupants

**PREDICTABLE PREVENTABLE and NO ‘ACCIDENT’**

**Conclusions**

- Prevention is key - The paediatric ambulance transport environment includes predictable and preventable occupant risks.
- Unrestrained occupants and equipment are a potential injury risk to all occupants.
- Every member of a paediatric transport program must play a role to actively manage risk and to avoid taking unnecessary risk.
- Focus on safety of ALL aspects of the transport environment.
- Safe patient transport practices exist & should be used.
- New technologies for vehicle design, occupant PPE and equipment restraint and driver performance are now available. Be ready to integrate them into your practice.
- A need for a defined pathway for translation of problem identification to resolution and policy implementation.

**And….**

- It is no longer acceptable for patient transport to be functioning outside of automotive safety and PPE safety standards for prevention of and protection of EMS/transport providers and the public from injury or death.

**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