Welcome to today's Injury Risk Management Research Centre (IRMRC)
UNSW, Sydney, December 2nd, 2008
Safety Science Seminar Series Webinar -

"The Ride of Your Life: Managing the risks and hazards of ambulance transport"

Guest Speaker – Nadine Levick MD, MPH

Start time is 4.30pm Australian EDT today

(Webinar will be 'open' from 3.30pm Aus EDT for sound and system checks)

EMS Safety Foundation
and Objective Safety
New York, USA

THE UNIVERSITY OF NEW SOUTH WALES

Injury Risk Management Research Centre (IRMRC)
UNSW, Sydney, December 2nd, 2008
Safety Science Seminar Series -

The Ride of Your Life:
Managing the risks and hazards of ambulance transport

Nadine Levick, MD MPH
Research Director, EMS Safety Foundation
CEO, Objective Safety
New York, USA

THE UNIVERSITY OF NEW SOUTH WALES

So what is a Webinar?

A Webinar is:

- Real time interactive web technology
- No other hardware is necessary aside from a computer connected to the internet and a microphone- if you choose to speak
- These interactive seminars can also be stored for later asynchronous use

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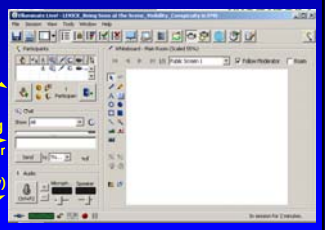
Webinar Basics

Raise Hand

Text messaging

(Type in your name and location now)

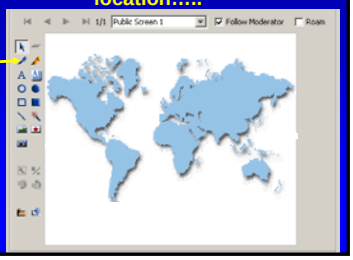
The 'mic' button



..use white board tools to mark your location…..

Line tool

(pick up your blue pen here – and mark where you are right now)



Today's Webinar is recorded!

The presentation
and
all comments typed in the text box!! are RECORDED

Slide handouts and Recording will be available via www.irmrc.unsw.edu.au and www.objectivesafety.net web sites within 48 hours

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This afternoon's Webinar

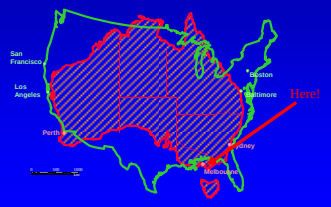
- Will cover:
  - An overview of ambulance transport safety data
  - Automotive and transportation safety dimensions
  - Ambulance transport safety challenges and opportunities
  - Some practical perspectives from the field
  - Research directions

Today's Webinar Hosts

- Injury Risk Management Research Centre (IRMRC), University of NSW, Sydney, Australia
- Center of Injury Research, (CIRCL) Pittsburgh, PA, USA
- Objective Safety and the EMS Safety Foundation, New York, USA

Where am I really from?

...Yes, it IS that big!



ASSOCIATED PRESS

Jump start

A RoboRoo Series II kangaroo lests dummy is used in New South Wales, Australia, to help automobile designers study a unique Australian road safety issue — traffic accidents with kangaroos.

Your Interactive Handout and Recording awaits you online at…

- www.irmrc.unsw.edu.au
- 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

Highlight some of the areas of ambulance transport system safety and risk management-

- Safety for the patient, the provider and the public
- System safety data
- Interdisciplinary aspects
- Innovations to optimize system safety performance

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 safest?
- 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?

In a nutshell

- Am here to try to save you
  Lives
  Time and
  Money

Firstly!

- An accident ?
- or
  a predictable and preventable event

A tragic emergency health care intervention outcome

It does happen….

A devastating tragedy…

- An ETT down the wrong hole may kill your patient and be a terrible burden for the pts family and for the medic involved
- BUT an EMS crash can kill all involved AND wipe out an EMS systems response capacity……

Thursday July 5th 2007…… Paramedic Allan Parson's killed

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

Posted By:[illegible] at July 5, 2007 4:38 PM (Suggest Removal)
to all the people worried about how fast the emt was going. would it be fast enough if it was your oved one in there.....

| Add your comments

Posted By:[illegible] at July 5, 2007 4:45 PM (Suggest Removal)
no mad: it would be too fast if they ran over my family member on their way to another's family member...

| Add your comments

Posted By:[illegible] at July 5, 2007 4:56 PM (Suggest Removal)
to K responder: Why can't I second guess this? A man is dead and I want to know if the actions and situation surrounding this were worth this sort loss. And I'd like to know what can be done so that 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 08:20 AM EDT

VAN WERT, OHIO (AP) -- The Ohio State Highway Patrol continues to investigate the crash of an ambulance that killed five people Friday night, including three emergency medical technicians. Troopers say the ambulance was broadsided by a semitrailer in Crane Township, about 65 miles southwest of Toledo.

The ambulance, with four Antwerp Emergency Medical Services workers aboard, was taking two victims from an earlier car crash to a hospital. Troopers say it was broadsided by a tractor-trailer at the intersection of County Road 176 and County Road 87. The ambulance then burst into flames.

The Highway Patrol says three EMS workers were killed. They were identified as 64-year-old Sammy Smith, 31-year-old Heidi McDougall and 25-year-old Kelly Rager. The two patients were also killed. They were identified as 64-year-old Robert Wells 60-year-old Armelda Wells of Hicksville.

Another emergency medical technician, Matt McDougall, and the truck driver, Gerald Chapman, Jr. of Indiana, were both taken to the hospital. It's not yet clear whether they suffered any injuries.

Authorities have not said who had the right of way at the rural intersection nor have they said if the ambulance's emergency siren and lights were turned on.

Antwerp fire chief says, "They were doing what they loved..."

Lisa Neely
July 20, 2007

By USA NICEW
usa@[illegible]
ANTWERP – They were lovers will to end

Emergency personnel throughout the region are also shocked and mourning their own.

"That's one of our worst scenarios when it's one of our own," said Con Shuherk of the Payne Fire Department.

"Everyone is a brotherhood," said Friend. "Everybody looks after everybody."

Randy Shaffer, director of Paulding County Emergency Management Agency, said the accident has had a deep impact.

"It has affected every emergency personnel in the county," he said. "We know it could happen at any time. We read about it in our newsletter. We just don't think it's going to happen to us."

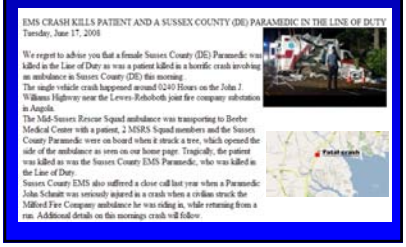
Shaffer said when a call came in that an ambulance was involved in an accident Friday, "I think every squad in the county activated."

Ambulance Transport Safety

- Emergency care, public heath, 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

Victoria's first on duty tragedy

June 17th 2008 a paramedic and a patient killed



In this vehicle…

October 31, 2008, Kentucky

Fatalities and funerals

2 counts of vehicular homicide… November 5, 2007 - PA

Drunken ambulance driver killed 2 in car crash - Pennsylvania

A 22-year-old ambulance driver drank before her shift and was impaired when she collided with a car in Marshall, killing two men instantly, Allegheny County District Attorney Stephen A. Zappala Jr. said today.

Shanea Leigh Climo, 22, of Evans City, is charged with two counts of homicide by vehicle and involuntary manslaughter, driving under the influence and several traffic offenses in the Sept. 23 collision at Perry Highway and Brush Creek Road. She was arrested this morning, arraigned and released on her own recognizance, authorities said.

Police said an on-board camera system in the ambulance helped them decide to file charges. The camera allegedly shows the face of the driver, Shanea Climo.

Zappala said Climo was traveling south on Route 19, transporting a patient with a do-not-resuscitate order to UPMC Passavant, when she ran a red light and hit a Chevrolet Cavalier driven by Douglas Stitt. Stitt and a passenger, Philip Bacon, were killed.

The patient later died, but his death was not believed to be related to the crash, Zappala said.

An interhospital transport ? "Do no harm…."?

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

FACTOR / PHASE	Paramedic/ patient (host)	Vehicle (agent)	Environment (physical/regulatory)	Sociocultural
pre crash (pre event)	driving history, driver education, speeding, abiding road laws	collision avoidance, anti lock brakes, vehicle weight, speed	tiered dispatch, EVOC implemented, road design, markings & surface	EMS image (scoop & run), public/paramedic awareness, disorientation from L & S
crash (event)	seat belt, restraint use, child safety seat use	air bags restraint design bumper & crumple zone design	collision speed, road side hardware	**It can send down happen**
post crash (post event)	gender, severity, age, underlying morbidity	ease of extrication, burn resistant fabrics	EMS system,quality trauma care, traffic management system	rehabilitation, documentation and data collection

- Effectiveness
- Cost benefit
- Ethics
- Social acceptability
- Societal need

Key Issues

- Mythology
  - That Emergency Medical Service personnel are safe
- Injury Hazards
  - Biohazard
  - Chemical/Radiation
  - Physical/Mechanical trauma – THE BIG PROBLEM
- Motor Vehicle Crashes are the highest cause of death at work – EMS has > 2X the mean national rate in USA
- An R & D and Regulatory Gap
  - Occupational Health and Safety
    - the workplace is in a vehicle – exposure data are scant
  - Automotive Safety
    - a vehicle is the work place – 'exempt' from automotive research and regulation

Some challenges

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

Ambulance Transport Hazards in the current world climate…

Epoch Times - MI5 Discover Al-Qaeda Buying Ambulances on Ebay Page 1 of 2

MI5 Discover Al-Qaeda Buying Ambulances on Ebay

By Gordon Thomas
G2 Magazine

Nov 11, 2008

London—MI5 have warned Britain's cash-strapped National Health Services that dozens of ambulances—along with old police cars and fire engines just then sold by state—are being snapped up by al-Qaeda operatives in the United Kingdom to mount suicide bomb attacks.

So serious is the problem that counter-terrorism officials at the Home Office have written to eBay, the Internet mechanism, asking them to stop selling emergency service vehicles, equipment and uniforms.

Emergency vehicles similar to these are suspected of having been purchased at auctions for use as suicide bomber vehicles. Charaul

1960 to 2007

A passenger vehicle - sure

A 'laundry or mail truck ??

A passenger vehicle – yes!

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

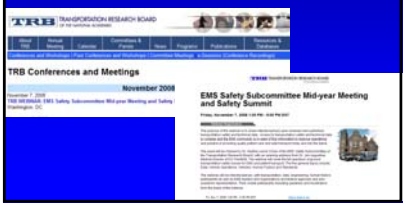
October 2008 JEMS Article "Rig Safety – 911"

What you need to know about ambulance safety & standards

Rig Safety 9-1-1

2008 - Air EMS on the NTSB's "Most Wanted List", where is ground EMS??

National Academies TRB EMS/Medical Transport Safety Summit – November 7, 2008



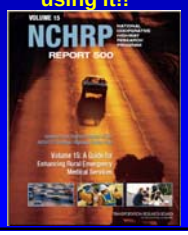
Key Elements to Ambulance Transport Safety

- Data capture
- Vehicle fleet operations and the transport environment
- Vehicle biomechanics and crashworthiness
- Ergonomics, human factors and biohazards
- Standards and Policy
- Ongoing safety management – evaluation and analysis

TRB Ambulance Transport Safety Summit Outline

- Systems Safety Engineering
- Transport safety, Biomechanics, Ergonomics, Clinical care and Outcomes
- Patient, Provider and Public safety focus
- Low hanging fruit
- Transfer knowledge into practice
- Path forwards

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



Creating a Safety Culture

within a company must start with upper management's commitment to safety

- Awareness
- Training
- Incentive

Safety - Why now?

- Operating optimally in a transportation environment that is largely devoid of specific safety standards for the hazards and risks present
- Bridge the gap between what technical information exists and what is accessible and applied to EMS

EMS Safety

- 'patient safety'

AND also

- 'provider' and 'public safety'

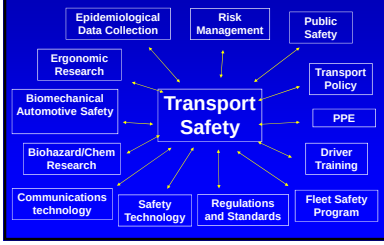
Some odd facts

- Ambulances are generally not built by the automotive industry
- Intelligent Transportation Systems (ITS), transportation safety engineering is not generally integrated into EMS systems
- Although all EMS systems have medical direction and oversight, it is rare for there to be transportation expertise oversight

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

Ground Transport Safety IS Complex AND Multidisciplinary



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

There are more safety standards for moving cattle than for moving patients in the USA

the EMS transport process

- communications/dispatch
- the patient
- restraining device/seat
- transporting device/gurney
- paramedics/transport nurses, doctors & family
- patient monitoring equipment
- clinical care & interventions
- protective equipment
- the vehicle
- the driver/driving skill
- other road users
- the road

TIME & PLACE

The Emergency Department (ED)

An ambulance is <u>not</u> an ED /ICU on wheels

Goals

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

Data Capture

- Vehicles
  - Total number and type
  - Total number of runs
  - Total number of miles traveled
- Providers
  - Total number and type
  - Hours worked
- Transportation adverse events, including mechanism – both injuries and fatalities
  - The vehicle
  - Patient
  - Provider
  - Public

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

USA EMS data

In the USA*

- ~ 50,000 vehicles
- ~ 5,000 crashes a year
- ~ One fatality each week
  - ~ 2/3 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 >10x higher than in Australia

*FARS/BTS 2005-6

Is it your service's tragic year?

- In the USA
  - ~ 50 fatalities a year
  - 15,000 EMS services
  - Each year one in 300 services experiences a fatality

How are we counting these events?

What are the relevant data bases?

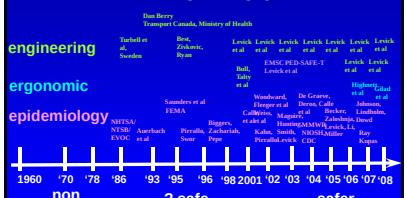
- CAA
- FARS
- NASS/CDS
- GES
- State Traffic Records
- FMCSA
- BLS
- Other

and what is an EMS crash?

- Definition of an EMS crash
- Definition of Emergency Response Mode

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

Ambulance Safety Research: A New Field



Fatal Crashes Predictable Risks

- More often at intersections, & with another vehicle (p < 0.001)*
- 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***
- 70% of fatal EMS crashes during Emergency Use#

*Kahn CA, Pirrallo RG, Kahn EM, Prehosp Emerg Care 2001 Jul-Sep;5(3):203-9
**Becker, Zalushnja, Levick, Li, Miller, Acc Anal Prev 2003
***Maguire, Hunting, Smith, Levick, Annals Emerg Med Dec 2002
#NHTSA, DOT FARS, 1995-2005

and what is killing EMS ?

EMS personnel fatalities*

- 74% transportation related
  - 1/5 of ground transport fatalities were struck by moving vehicles
- 11% were cardiovascular
- 9% were homicide
- 4% needle sticks, electrocution, drowning and other

*Maguire, Hunting, Smith & Levick, Occupational Fatalities in Emergency Medical Services: A Hidden Crisis, Annals of Emergency Medicine, Dec 2002

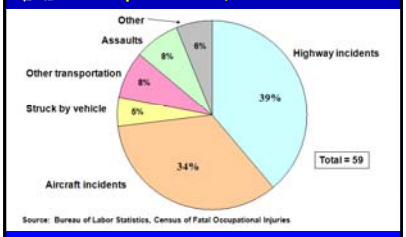
USA BLS data sources on EMS injuries

- Census of Fatal Occupational Injuries (CFOI)
  - Covers all work-related injury fatalities in the U.S.
  - Collected from multiple data sources
- Survey of Occupational Injuries and Illnesses (SOII)
  - Currently covers private wage and salary workers, but data for 2008 will include public sector also.
  - Establishment survey based on OSHA recordkeeping logs
  - Case data available for cases with days away from work

USA BLS Data available

- Occupation (EMTs and paramedics; Ambulance drivers and attendants, except EMTs)
- Industry (Ambulance services, including air and ground)
- Nature of injury
- Part of body affected
- Source of injury
- Event or exposure
- Gender, age, race of worker
- Time in job
- Hours worked when injured
- Worker activity and location type (fatal only)
- Median number of days away from work

Fatalities among EMTs and paramedics, 2003-2007



Australasian National Ambulance Statistics

Ambulance Services in Australia, New Zealand & Papua New Guinea

Annual Report on Government Services

CAA Annual Report Statistics

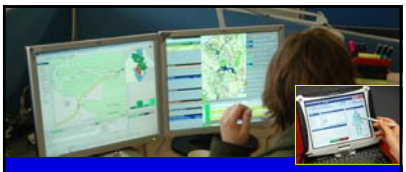
Council of Australasian Ambulance Authorities

- Ambulance Emergency response times (minutes)
- Report ambulance incidents, responses, patients & transport
- Emergency, urgent and non urgent incidents
- Patient numbers
- Cardiac arrest survived event rate
- Human resources
- Salaried personnel
- Volunteers
- Stations and Staffing
- Assets (number)
- Costs ($)
- Organisational expenditure per 1000 people
- Satisfaction Survey

Vehicle Operations

- Dispatch, priority, emergency response v immediate
- Scene safety, vehicle positioning
- Fleet mix
  - Rapid response vehicles
  - Vans, Trucks, Motorcycles, other
- Performance, training , supervision, evaluation, maintenance
- Impairment, hours of service, system safety oversight

Resource availability and allocation technologies



- Computer Aided Dispatch systems are different in each State & Territory
- Automatic Vehicle Location (AVL) – usually cities only
- Some have Duress alarms in vehicles and on handheld radios
- Crews are alerted by pager, radio or Mobile Data Terminal (MDT)
- Integration of VACCUS notebook electronic case recording nationwide
- Satellite phone communication in some regional and remote areas

Smart Consumers

Personnel

- Selection
- Education
- Training
- Safety Culture
- Reinforcement
- Evaluation

Performance

- Performance aids
  - Driving monitors
  - Technologies
- Management intensive
  - Feedback
  - Quality Improvement cycle
  - Systems Orientation

Elements of Fleet Safety Management

- Management Leadership
- Driver Selection Standards
- Driver Performance Monitoring
- Vehicle Selection, Inspection, and Maintenance
- Crash Analysis, Reporting, Corrective Action, and Records
- Program Evaluation

Measures of Effective Fleet Safety System

- Fleet Safety & Operational Practices that can be defended
- Management Accountability and Controls
- Loss prevention efforts that identify key loss drivers and establish action plans to control/reduce risk factors leading to losses

June 2007

The inevitable bottom line…

Accident Cost Table

REVENUE NECESSARY TO PAY FOR ACCIDENT LOSSES

THIS TABLE SHOWS THE DOLLARS OF REVENUE REQUIRED TO PAY FOR DIFFERENT AMOUNTS OF COSTS FOR ACCIDENTS

It is necessary for a motor carrier to generate an additional $1,250,000 revenue to pay the cost of a $25,000 accident, assuming an average profit of 2%. The amount of revenue required to pay for losses will vary with the profit margin

YEARLY ACCIDENT COSTS	PROFIT MARGIN				
	1%	2%	3%	4%	5%
$1,000	100,000	50,000	33,000	25,000	20,000
5,000	500,000	250,000	167,000	125,000	100,000
10,000	1,000,000	500,000	333,000	250,000	200,000
25,000	2,500,000	1,250,000	833,000	625,000	500,000
50,000	5,000,000	2,500,000	1,667,000	1,250,000	1,000,000
100,000	10,000,000	5,000,000	3,333,000	2,500,000	2,000,000
150,000	15,000,000	7,500,000	5,000,000	3,750,000	3,000,000
200,000	20,000,000	10,000,000	6,666,000	5,000,000	4,000,000

REVENUE REQUIRED TO COVER LOSSES

Safety saves time, lives AND money Canada, Nova Scotia

- Since 2000 working towards a goal of zero loss ratio with insurance provider
- 10 million kilometers per year
- 150 emergency response ambulance units
- Collision claim history measured in dollars per 100,000 kilometers traveled:
  - 2000/2001 $ 1725.00
  - 2001/2002 $ 1049.00
  - 2002/2003 $ 751.00
  - 2003/2004 $ 416.00
  - 2004/2005 $ 229.00

A problem

USA 2007 Insurance data –

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

Expensive….

The Huntsville Times • Subscribe • Today's Paper & More

Ambulance suit gets $3.1 million

Meridianville teen killed in wreck with speeding vehicle

Tuesday, May 01, 2007

By DAVID HOLDEN
Times Staff Writer david.holden@htimes.com

A federal jury awarded $3.1 million in damages Friday to the family of a Madison County woman who was killed in a collision with a speeding ambulance from Tennessee in 2005.

A felony charge of manslaughter is still pending in Madison County Circuit Court against the ambulance driver, Charles Christopher Eakes of Tennessee.

Dianna Christine Bowden, 18, of Meridianville died in a two-vehicle crash Oct. 13 involving the ambulance owned by Lincoln County Medical Center Emergency Services. The wreck occurred around 9:45 p.m. at U.S. 231/431 and West Limestone Road, about seven miles north of Huntsville.

Very Expensive

Law & Justice & ambulances — firegeezer on 30 Sep 2008 09:10 am

$24 Million Judgement Against AMR

AN ALAMEDA COUNTY, CALIFORNIA, JURY ORDERED AMERICAN MEDICAL RESPONSE (AMR) to pay nearly $24 million damages to a man who was permanently paralyzed after a traffic accident involving one of their ambulances.

On April 16, 2007, Louis Del Barba, 85, was driving his auto and making a turn when he was broadsided by the ambulance. The ambulance's speed was measured at 65 mph in a 35 mph zone. Experts agreed that such a speed, in rush hour conditions, was reckless and unsafe.

A press statement released yesterday by the plaintiff's lawyers stated:

> Mr.
>
> Del Barba had the right of way and was wearing a shoulder and lap seat belt when the crash occurred. As a result of the accident, he received numerous traumatic injuries and is paralyzed completely, save for some movement of his head and left arm. He is constantly dependent on a ventilator.Doctors believe that he can return to his 110-year-old family home if there are funds to fit a room for medical care. The jury felt strongly that Mr.

Key Fleet Factors

- Driver
- Vehicle
- Conditions

AON

Driver and impairment

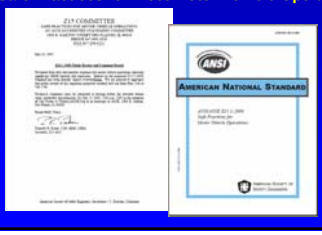
Human factors that influence willingness and ability to drive safely:

- Fatigue
- Distraction
- Experience
- Age
- Knowledge
- Attitude
- Hours of Service
- Physical well being
- Emotional state
- Alcohol
- Controlled Substances
- Prescription medication

AON

American National Standard ANSI/ASSE Z15.1-2006

Safe Practices for Fleet Motor Vehicle Operations



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

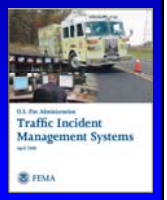
Clinical Care? Occupational Health and Safety…..?

- This IS a Transportation and Automotive Safety issue
- This is a Systems safety issue

EMS CANNOT Afford to keep paying out like this….

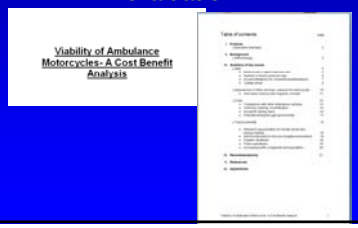
Traffic Incident Management Systems (TIMS)

- Released April 2008
- FEMA, USFA, IFSTA
- Covers setting up safe roadway incident work areas and using unified command at these incidents



Ambulance Motorcycles

NSW Ambulance a leading approach to innovation and outcomes evaluation



Safety advantage

- Response Times
- 77% < 10 minutes (Avg.- 3.5 mins)
- 23% < 5 minutes
- 78% cases in the CBD
- Difference between Paramedic responder in a car and a motorcycle to cardiac arrest- 2 minutes avg.
- One pt every 3 days- 5 minutes before assistance can get to them

Cost advantage

- Running costs half that of Subaru Forrester
- Quarter that of a Mercedes Benz
- Total running costs: leasing 3 motorcycles, uniforms, equipment, training, wages- $450 000.
- QALY- WHO $40 000/life saved

Motor Cycle Medics

- The benefits are not just going faster!
- Safety advantage- a not often thought advantage
- Response times- seems like an obvious one but…
- Cost advantage- Not just in the purchase price
- Safety advantage

Unique roles

- Motorcycles could be included in disaster planning as a vehicle which could play a role different to everyday requirements.

The real-time auditory feedback safety performance monitor

EMS Education - Articles

How to modify the risk-taking behaviour of emergency medical services drivers?

How to modify the risk-taking behaviour of emergency medical services drivers?

De Greeve K, Danso KF, Calle PA, Vanhaute OA, Buylaert WA.

Belgium concludes that for second tier units only a small amount of time is gained by high speed and an aggressive style of driving. Furthermore, we are convinced that a "black box" is a good tool to modify the risk-taking behaviour of emergency medical services drivers.

High speed and an aggressive style of driving are major risk factors for serious traffic accidents. Consequently, frontline emergency medical services vehicles have an increased collision risk. We report on two studies designed to modify the risk-taking behaviour of emergency medical services drivers.

Which is best, how many hours…??

'Feedback box' Program Objectives

- Change the culture
- Provide objective data
- Enhance and reward safety
- Improve driver performance
- Save maintenance / insurance dollars
- Aid accident / Incident investigation

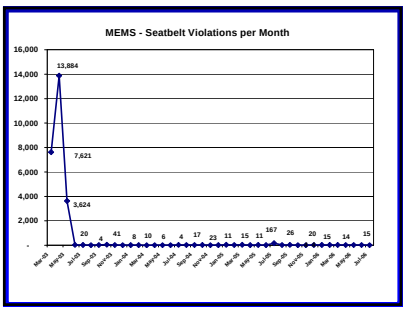
How The Feedback Box Works

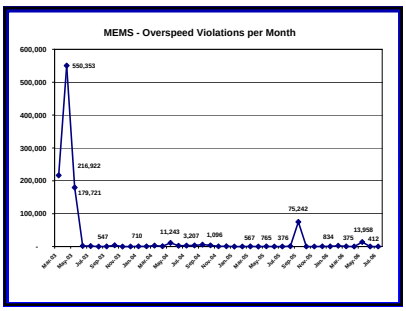
Recorders installed on each unit to measure:

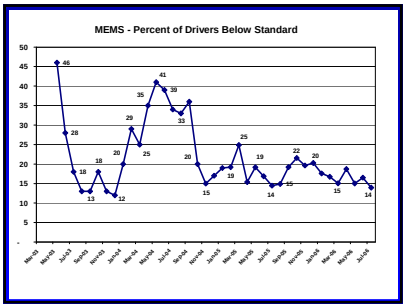
- Speed against user set limits – both running hot & cold
- Cornering velocity / hard braking / acceleration
- Use of seat belts, lights & sirens

Over speed - accelerating

- Listen for growl – 15 sec warning begins
- Growl frequency increases near end of warning
- Tone on – penalty points awarded
- Slow down – tone stops
- Accelerate again - growl on – slow down – growl stops - no points







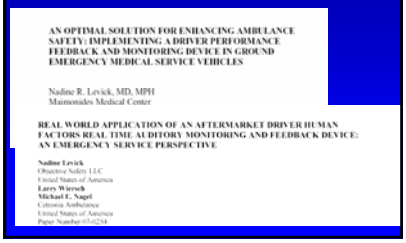
Monitor and feedback device in summary

- The system works
- Has objectively improved performance
- No increase in response times
- At fault accidents reduced
- Now accepted into the culture

However:

- The system requires constant monitoring
- Must be reinforced by management
- Rewards for good safety performance
- Consequences for poor performance

What about changing driver behavior in the real world??


AN OPTIMAL SOLUTION FOR ENHANCING AMBULANCE SAFETY: IMPLEMENTING A DRIVER PERFORMANCE FEEDBACK AND MONITORING DEVICE IN GROUND EMERGENCY MEDICAL SERVICE VEHICLES

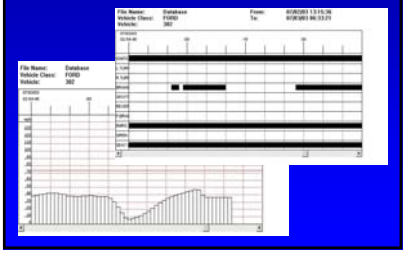
Nadine R. Levick, MD, MPH
Maimonides Medical Center

REAL WORLD APPLICATION OF AN AFTERMARKET DRIVER HUMAN FACTORS REAL TIME AUDITORY MONITORING AND FEEDBACK DEVICE: AN EMERGENCY SERVICE PERSPECTIVE

Nadine Levick
Objective Safety LLC
United States of America
Lauren Wiersch
Michael E. Nagel
California Ambulance
United States of America
Paper Number 07-0234

And when a rare crash happens….

Unit 302 Accident

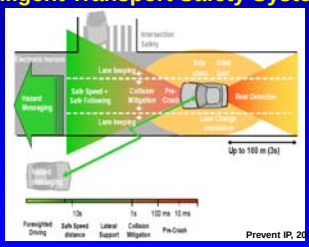


A key to safe ambulance transport

Transportation Environment

- Integration with Highway Safety strategies
  - Partnerships/collaboration and Information sharing
- Intelligent Transportation System (ITS) Technologies
  - Driver/vehicle performance monitoring & feedback devices
  - Collision avoidance vehicle technologies
  - Signal systems
- Roadside safety design and planning technologies
  - Vehicle positioning and scene safety issues
  - Hospital ambulance bay access and egress

Intelligent Transport Safety Systems

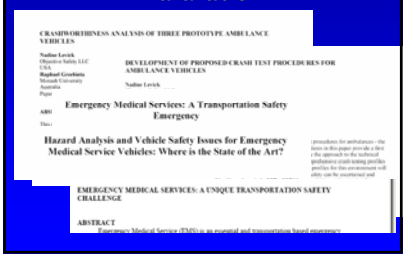


Prevent IP, 2005

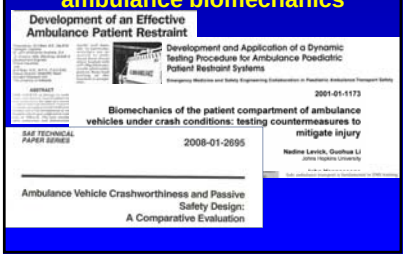
Vehicle Biomechanics & Crashworthiness

- Vehicle
  - Vehicle crashworthiness, vehicle hazards, occupant protection science and technology
    - Compact crashworthy vehicles (i.e., vans)
    - Non-hostile interiors
    - Lock down positions for equipment
    - Seat belts for all occupants – low over pelvis
    - Over-shoulder harnesses for all patients on the stretcher

Systems Safety Technical information available



Technical automotive safety ambulance biomechanics



Real world crash scenarios

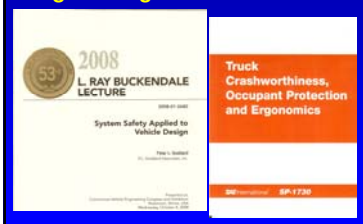
Intrusion vs Deceleration

- Intrusion
  = vehicle to vehicle or vehicle to fixed narrow object
- Deceleration
  = sudden stop – ie. sled test

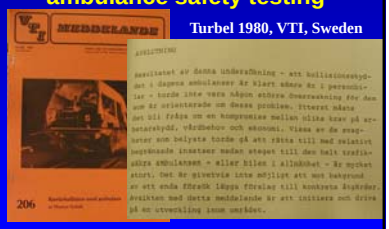
Intrusion

Deceleration

Automotive Systems Safety Engineering technical information

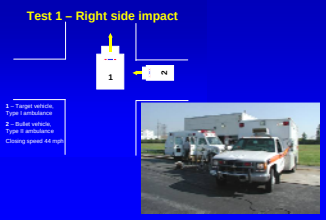


Sweden: 1980's a leader in ambulance safety testing

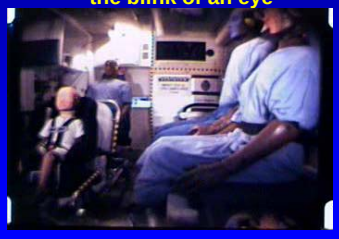


Full Vehicle Ambulance Crash Testing

Test 1 – Right side impact



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



NIOSH Ambulance Occupant Safety Crash Testing

Impact Direction

25 MPH !

NIOSH Ambulance Occupant Safety Crash Testing

Impact Direction

25 MPH !

Head Strike zone and harness hazards

28 mph (45 km/hr)

Richardson S.A., Grzebieta R. H. and R. Zou, Development of a Side Facing Seat and Seat Belt System for the Australian Army Perentie 4 x 4, *Int. J. of* Crash., Vol. 4 No. 3, pp. 239 – 259, 1999.

IRMRC

New Australian vehicles

Flexibility to manage two patients

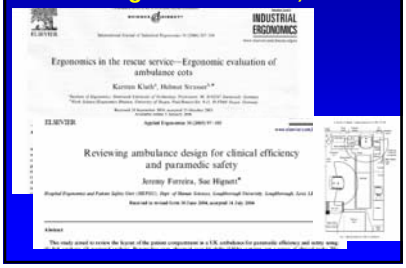
Ergonomics, Human Factors and Biohazards

- Equipment and Vehicle Layout and Design
  - Equipment interface ergonomics
  - Vehicle interface ergonomics and human factors
- Vehicle visibility and appropriate warning signals
- PPE
  - Head protection
  - Protective Clothing
  - Visibility
  - Biohazard protection

Important…

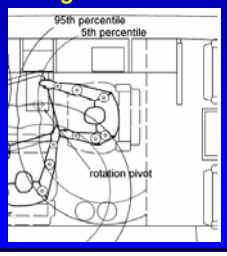
- Ergonomics and automotive safety issues are interrelated
- Crashworthiness priorities override the ergonomic issues

EMS Ergonomics 2005, 2006



December 2007 Prof Issachar Gilad

Range of reach



Chris Fitzgerald

- Ergonomist with extensive experience in ambulance design issues and practice for a number of ambulance environments

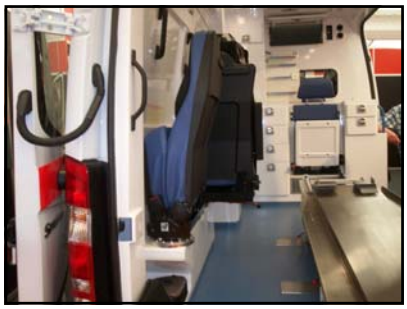
Australia, Melbourne

© Risk & Injury Management Services 2008

© Risk & Injury Management Services 2008

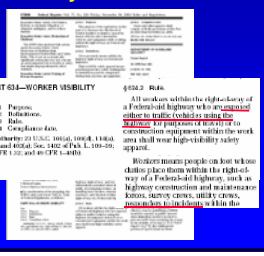
RETTmobil – 'Mobile Rescue' European EMS vehicle innovation

http://www.rettmobil.com/



Awkward tasks? Develop solutions!

Worker visibility Act: Help is on the way !! November 24th 2008



PART 634—WORKER VISIBILITY

Sec.
634.1 Purpose.
634.2 Definitions.
634.3 Rule.
634.4 Compliance date.

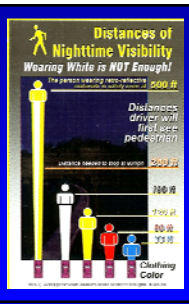
Authority: 23 U.S.C. 101(a), 109(d), 114(a), 315, and 402(a); Sec. 1402 of Pub. L. 109–59; 23 CFR 1.32; and 49 CFR 1.48(b).

§ 634.3 Rule.

All workers within the right-of-way of a Federal-aid highway who are exposed either to traffic (vehicles using the highway for purposes of travel) or to construction equipment within the work area shall wear high-visibility safety apparel.

Workers means people on foot who conduct place them within the right-of-way of a Federal-aid highway, such as highway construction and maintenance forces, survey crews, utility crews, [illegible] within the

Distances of Nighttime Visibility



Policy and practice ignorant of existing technical safety data

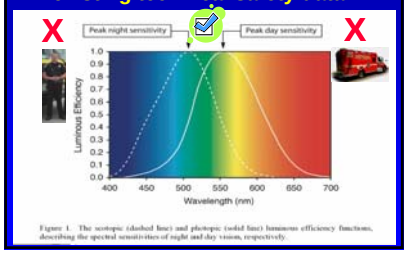
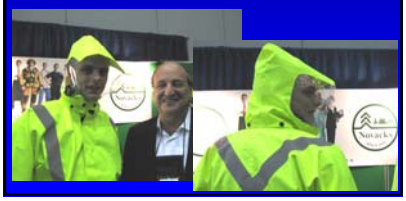


Figure 1. The scotopic (dashed line) and photopic (solid line) luminous efficiency functions, describing the spectral sensitivities of night and day vision, respectively.

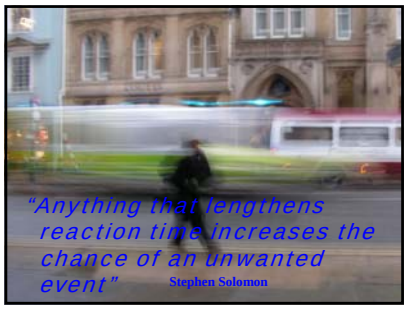
Night visibility

This addresses some very real risks, very creatively – and currently ONLY available in London Ontario!



John Killeen, Paramedic

- Intensive Care Paramedic, ACT Ambulance Service, Australian Capital Territory (ACT), Australia
- Lead operational expert in ambulance safety, visibility and conspicuity



" The multicolored (patterned) ambulance while distinctive, may suffer decreased conspicuity because of the effects of camouflage" *De Lorenzo & Eilers Annals EM 1991*

Color-blindness affects 10% of the population

- As seen with normal vision

- As seen with color blind vision

Emergency Vehicles – Viewer Awareness

For a timely, appropriate and safe response

- Location
- Size
- Shape
- Speed
- Intended path

Increasing safety with a 30% cost saving

Queensland Ambulance Australia

Summit County EMS - Colorado

Old vehicle

New yellow vehicle markings

Staff use lime-green vests & jackets

Under Way… Emergency Vehicle Visibility and Conspicuity Study

- Funded by the USFA conducted by IFSTA
- Looking at the effectiveness of reflective markings used on emergency vehicles
- Doing best practice research and working with manufacturers

Standards and Policy

- Operations and fleet management
  - USA : Z -15 (2006)
- Vehicle design safety and crashworthiness
  - Australia: ASA (AS/NZS 4535:1999)
  - Europe: CEN (EN 1789:1999/A1:2007)
  - USA: KKK-F 2007, AMD 2007 (not by national standardizing bodies)
- Worker and vehicle visibility
  - Some apparel, minimal vehicle visibility standards limited evidence base

Ambulance Standards??

- Australasia
- Europe
- USA
  - KKK?
  - AMD?
  - FMVSS?
  - NFPA?

Australia & New Zealand Ambulance restraint standard AS/NZS 4535:1999

- "Restraint systems shall apply to all equipment and people carried in an ambulance…"
- Dynamic Testing - 50th & 95th percentile manikins
- 24G in Forward and Rearward
- 10G in Transverse

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

European Committee for Standardization

Medical vehicles and their equipment - Road Ambulances

- "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.

What KKK-A-1822F, AMD and FMVSS state and don't state…

USA KKK ambulance purchase specifications GSA:KKK-A-1822F, Aug 2007

- Specifications for the purchase of a Star of Life Ambulance
- Static Pull test
- 2200 Lbs. static stretcher test in longitudinal, lateral & vertical
- No dynamic test for vehicle, occupants or equipment
- No automotive test manikin
- Voluntary www.ntea.com/WorkArea/downloadasset.aspx?id=1352

USA Ambulance Manufacturing Division (AMD) Ambulance Standards – August 2007

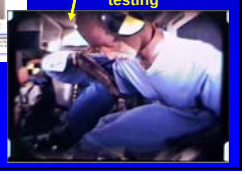
- No dynamic or impact test
- No automotive test manikin
- Mandates NO 'crumple zone'
- No impact tested anchorages for occupant restraint or equipment
- Internal, not independent

http://www.ntea.com/WorkArea/showcontent.aspx?id=1358

AMD 2007 - 025 'occupant safety testing'

- Compared with -

Accepted automotive safety occupant testing



AMD – static 'safety testing'

- Inconsistent with automotive safety principles – and specifies that a 'successful test' is -
  - No structural damage to any load bearing or supporting members, i.e., torn or broken material, broken welds, popped or sheared body rivets, bolts, and/or fasteners, shall be evident during the application of the force and after the release of the force.

Occupant protection……?? July 2007

No 'a'… then NO 'F' !!!!!

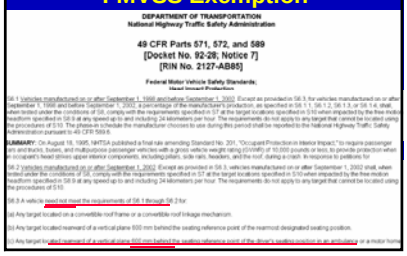
- $F = ma$

where F – force
m – mass
a – acceleration

Sir Isaac Newton (1642-1727), Philosophiae Naturalis Principia Mathematica (Mathematical Principles of Natural Philosophy), published in 1687. http://en.wikipedia.org/wiki/Newton's_laws_of_motion

Unacceptable, and non-automotive AMD/KKK-F '*safety testing*' practices and standards !!??

USA Ambulances: FMVSS Exemption



DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration

49 CFR Parts 571, 572, and 589
[Docket No. 92-28; Notice 7]
[RIN No. 2127-AB85]

Federal Motor Vehicle Safety Standards;
Head Impact Protection

S8.1 Vehicles manufactured on or after September 1, 1998 and before September 1, 2002. Except as provided in S8.3, for vehicles manufactured on or after September 1, 1998 and before September 1, 2002, a percentage of the manufacturer's production, as specified in S8.1.1, S8.1.2, S8.1.3, or S8.1.4, shall, when tested under the conditions of S8, comply with the requirements specified in S7 at the target locations specified in S10 when impacted by the free-motion headform specified in S9 at any speed up to and including 24 kilometers per hour. The requirements do not apply to any target that cannot be located using the procedures of S10. The phase-in schedule the manufacturer chooses to use during this period shall be reported to the National Highway Traffic Safety Administration pursuant to 49 CFR 599.6.

SUMMARY: On August 18, 1995, NHTSA published a final rule amending Standard No. 201, "Occupant Protection in Interior Impact," to require passenger cars and trucks, buses, and multipurpose passenger vehicles with a gross vehicle weight rating (GVWR) of 10,000 pounds or less, to provide protection when an occupant's head strikes upper interior components, including pillars, side rails, headers, and the roof, during a crash. In response to petitions for

S8.2 Vehicles manufactured on or after September 1, 2002. Except as provided in S8.3, vehicles manufactured on or after September 1, 2002 shall, when tested under the conditions of S8, comply with the requirements specified in S7 at the target locations specified in S10 when impacted by the free-motion headform specified in S9 at any speed up to and including 24 kilometers per hour. The requirements do not apply to any target that cannot be located using the procedures of S10.

S8.3 A vehicle need not meet the requirements of S8.1 through S8.2 for:

(a) Any target located on a convertible roof frame or a convertible roof linkage mechanism.

(b) Any target located rearward of a vertical plane 500 mm behind the seating reference point of the rearmost designated seating position.

(c) Any target located rearward of a vertical plane 500 mm behind the seating reference point of the driver's seating position in an ambulance or a motor home.

NFPA Ambulance Standard Development

- NFPA Ambulance Standard Development Public Comment
- The Public Comment period for the development of the new NFPA Ambulance Standard – is open until October 15, 2008
- http://www.emssafetyfoundation.org/NFPA Ambulance0001.pdf

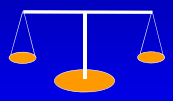
Ongoing Safety Management – evaluation and analysis

- Monitoring
- Measuring
- Mining the data

A number of potential interventions to enhance safety have been identified:

- Safety Policy
- Safety performance standards
- Vehicle crashworthiness
- Vehicle interior ergonomics
- Personal Protective Equipment design
- Driver selection, training and simulation
- Safety and risk awareness modification
- Risk behavior modification
- Intelligent Transportation Systems (ITS)

Balance of concerns and risk during transport



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

Benefit of Safety

- Safe practices save lives, time and money

This is about you and your safety

- What safety practices do you use??
  - Seat belts ?
  - EVOC training ?
  - Equipment lock down ?
  - Helmets ?
  - Driver Feedback technology ?
  - Tiered dispatch ?

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??

Safety Management

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

What do we know works…

- Vehicle Operations Safety Policies
- Squad bench lap seat belts
- Patient over the shoulder harnesses
- Securing equipment
- Forward and rear facing seating
- Some electronic technical devices
- Safety awareness
- Cultural change

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

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

PREDICTABLE PREVENTABLE and NO ACCIDENT

Conclusion

- EMS transport has serious hazards and safety issues
- Major advances in EMS safety research, infrastructure and practice over the past 5 years
- New technologies for vehicle design, occupant PPE and equipment restraint and driver performance are now available
- Development of substantive EMS safety standards is a necessity and a reality
- Failure to transfer knowledge from transportation and automotive safety is unacceptable and dangerous
- EMS is still way behind the state of the art in vehicle safety and occupant protection

Conclusion

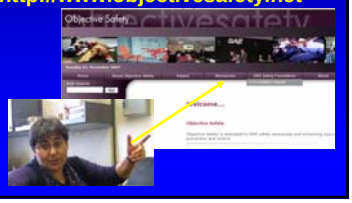
- There is some valuable technical information published on ambulance vehicle safety performance
- There are international models that address ambulance occupant safety issues
- Accessing and utilizing the existing technical information is key
- Applying the accepted principles of automotive safety performance is key

Acknowledgements

- EMSC funding –Targeted Issues Grant, PED-SAFE-T
- The late Capt. Garry Criddle – ExNHTSA/EMSC
- George Gillespie & Michael Schultze – US Military NAWC
- Joe McIntire & Joe Liscina - USAARL
- Veridian/Calspan/CenTIR – Vehicle test site
- Rick Pain – USA Transportation Research Board
- Eileen Frazer – Commission on the Accreditation of Medical Transport Services (CAMTS)
- Ambulance Association of America
- The USA EMS community
- John Killeen – ACT Ambulance
- Chris Fitzgerald – RIM Services
- Paul Riley – NSW Ambulance and Road Safety
- Bill Murphy - Ontario Ministry of Health
- Muttiah Jeyendra - Standards Australia
- Research assistants – Allison Better, Tony Tsai, Philip Lee, Puneet Gupta, Heith Waddell and Leo McFarland.

Thank you!

Any Questions??

Electronic handout available online

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