To quote Steve “Sid” Caesar –
Director IHS ES
“We want everyone to get home safely each day”

http://www.objectivesafety.net

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

January 10, 2008

This is not a crashworthy environment
Jan 28th, 2008

In a nutshell

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

April 7th, 2008

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?

Thursday July 5th 2007......

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

Friday July 20th 2007...

The worst ambulance crash in USA history
Fatalities and funerals

Firstly!

An accident?
or a predictable and preventable event

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

What is new
What is not new
What’s new

- New expertise and collaborations
- New automotive and transportation safety technologies
- New information
- New events

Outline

I. Review of data on ambulance crashes and safety standards and guidelines that exist for the ground EMS

II. Identification of ground EMS transport safety issues, hazards, and areas of risk to patients, providers, and public

III. Highlight unacceptable mythology and challenges to advancing EMS transport safety

IV. Profile innovation, new safety technologies and strategies and knowledge transfer to enhance safety and reduce risks of ground EMS and patient transport

EMS Transport Safety

- ‘patient safety’ AND also
- ‘provider’ and ‘public safety’

Key Elements to Safety

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

EMS Transport Safety

- ‘patient safety’ AND also
- ‘provider’ and ‘public safety’

Charged with Vehicular Homicide

From view, ambulance driver charged with vehicular homicide

A tragic emergency health care intervention outcome

A devastating tragedy...

It does happen...

Charged with Vehicular Homicide

2 killed, 3 injured... September 23, 2007 - PA

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

A tragic emergency health care intervention outcome

A devastating tragedy...

Charged with Vehicular Homicide

2 killed, 3 injured... September 23, 2007 - PA

2 counts of vehicular homicide... November 5, 2007 - PA
An interhospital transport? “Do no harm...”?

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.

Unique workplace

- In vehicles
- At roadside and other emergency scenes

The ‘workplace’ is also a crash scene

- 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

The ‘workplace’ IS a vehicle

- EMT’s often in vulnerable positions during transport.
- Bench seat
- Captain’s chair
- Standing or kneeling

The Emergency Department (ED)

An ambulance is not an ED/ICU on wheels
Ground Transport Safety IS Complex AND Multidisciplinary

Epidemiological Data Collection
Risk Management
Public Safety
Transport Policy
PSR
Driver Training

Transport Safety

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

National EMS data

In the USA:
- 50,000 vehicles
- ~ 5,000 crashes a year
- One fatality each week:
  - 25 pedestrians or occupants of other car
  - Approximately 1 child fatality per year
- ~10 serious injuries each day
- Cost estimates > $500 million annually
- USA crash fatality rate/capita 35x higher than in Australia

Is it your service’s tragic year?
- ~ 50 fatalities a year
- 15,000 EMS services
- Each year one in 300 services experiences a fatality

Ambulance Safety Research: A New Field

Non issue
Safe
Safer
1996
1998
2000
2002
2005

Funding??

Priorities...... Research papers in the past 30 years
- EMS Safety
  - 40 papers - on ambulance safety
  - 1 paper - on stretcher ergonomics
- Computer Workstations
  - 30,000 papers - on ergonomics of computer work stations
- Erectile Dysfunction
  - 100,000 papers - on Erectile Dysfunction

Ambulance Safety Research: A New Field

Funding??

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

So does it make sense?

- Gloves and universal precautions?... good biohazard protection BUT aren’t going to give much protection in an ambulance crash.

Predictable risks

- Fatal crashes more often at intersections, & with another vehicle (p < 0.001)*
- 79% of fatal crashes EMS crashes during Emergency Use
- Most serious & fatal injuries occurred in rear (OR 3.7 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#
- More likely to crash at an intersection with traffic lights (37% vs 18% p=0.001) & more people & injuries/crash than similar sized vehicles##

** Becker, Zaloshnja, Levick, Li, Miller. Acc Anal Prev 2003
# NIOSH, 2003
## Ray AM, Kupas DF, Prehosp Emerg Care 2005 Dec; 9:412-415

Absence of standards and oversight

- Challenges in identifying best practice
- Myriad of unregulated commercial products
- No safety performance standards
- Absent national safety oversight

USA 1960’s

- A passenger vehicle - sure
- A 'laundry or mail truck' - ?

UPS and Laundry trucks have very similar design and even more stringent safety requirements to EMS vehicles BUT very different cargo......

People are passengers and NOT packages or parcels

Some recent adverse outcomes

- What we need to consider, where is the “bang for buck” in ambulance transport 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

“Ambulance transport has a death toll...”

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

2007 Nascar Safety Expert

- On ambulance patient compartment
  “It is a death vault”
  Tom Gideon, Head of Safety, GM Nascar

and who’s life was he racing to save?

Clinical Care?  
Occupational Health and Safety.....?

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

So for EMS personnel...

- What’s going to kill you?
- What’s going to injure you?
This is not how you want to see your partner during a transport?

'Workplace' Hazards

Preventable…

- James Woodman
  - Is a paramedic who, on his first day as a paramedic, suffered a severe TBI when the ambulance he was riding in (in the back) was t-boned and rolled onto its side.
  - He remains in a persistent vegetative state in an ECF in Colorado.

- It is assumed that when the ambulance rolled onto its side, the life pack 10 struck James in the head...

What do ambulance crashes really cost?

- Loss of life and injury
- Negative impact on EMS system
- Collisions are the largest liability cost and exceeds 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/lawsuit
  - 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

A problem

2007 Insurance data –
- 27 fold more likely to have a claim based on transport than related to medical care
EMS CANNOT Afford to keep paying out like this.

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 ?

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

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

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??

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 designed by international EMS helmet technical experts for 2007-2008

It does happen....
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???

And very Predictable...
- Intersections are lethal environments

The real world
Intersection passenger car stopping distance* at 40 mph dry and wet

What are the solutions?
- Training?
- Practice Policy?
- Transportation Systems Engineering?
- Automotive Engineering?
- Education of other road users???

Safety concepts out there now
- Fleet Safety Management
  - Z-15
  - Driver monitoring and feedback
- Enhanced ambulance vehicle design
- Intelligent Transport Technologies - ITS
- Visibility and Conspicuity
- New Safety Standards
- Life Safety Initiatives
- Resources and information

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

Driver issues
- Placing monitoring for road safety and evaluation
- The role of training, learning valued and empowered
- Effective solutions for driver training
- Effective solutions for drivers' confidence
- Effective solutions for drivers' performance
- Effective solutions for drivers' understanding

*Stopping distance: Perception time + Reaction time + Vehicle braking time (varies with age, skill, agility, alertness, vehicle type, tire pressure, road etc.)
R & D
“Ripoff and Duplicate”
- Avoid reinventing the wheel at all costs
- Where are the best practices that we need to transfer knowledge from

Air EMS is a role model for safety initiatives and focus

Safety oversight of what and by whom
- Vehicle Safety
- Vehicle Design
- Safety Equipment Design
- Vehicle and Safety Equipment Testing and Standard development
- Safety policies

A Simple Question….
Safety is Good Business
And keep focus on ‘All hazards’ in addition to crashworthiness
- Driver age?
- Driving history?
- Patient condition?
- Dispatch?
- Vehicle stability?
- Driver feedback technologies?

Testing the real world
Intrusion vs Deceleration
- Intrusion = vehicle to vehicle or vehicle to fixed narrow object
- Deceleration = sudden stop – ie. sled test
Intrusion requires sophisticated, expensive equipment.
Deceleration measurably demonstrates forces generated during collision.
Dynamic Safety Testing accepted international standard for vehicle restraint systems.

If we know this – and its published.

Why do we do this?
Johns Hopkins University
Test 1 – Right side impact

Full Vehicle Crash Testing
Test 1 – Right side impact

And this all takes place in 60 milliseconds – the blink of an eye.
Risk/Hazards

- Predictable risks
- Predictable fatal injuries
- Serious occupational hazard
- Public safety hazards

EMS Best Practice, Sept 2006

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

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

Purpose of ‘Feedback box’ Program

- Enhance Safety
- Improve Driver Performance
- Save Maintenance Dollars
- Aid Accident / Incident Investigation

How the Device Works

- Computerized monitoring device installed on each vehicle to measure parameters
- Each driver has individual key “fob”
- Data collected every second including vehicle speed and performance, driver behaviors and emergency mode
- Auditory feedback of warning ‘growls’, and penalty tones
- Data downloaded automatically every day
### Demonstrated Effectiveness

-盲 data, no growls
- growls & tones ON, unidentified data capture
- identified data

### 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

### Demonstrated clearly
- Driver risk behavior can be substantially modified and improved with monitoring device, with real time auditory feedback.

### A key to safe transport

- Primarily to record events during and immediately preceding a crash
- Give no driver crash prevention feedback
- Administratively burdensome
- Intrusive
- Not demonstrated to be as effective in improving vehicle maintenance costs or as effective in modifying driver behavior long term

### Other monitoring devices

- Opticon
- Simulators

### The jury is out on

- Other monitoring devices are primarily to record events during and immediately preceding a crash.
- Opticon and Simulators provide no driver crash prevention feedback.
- They are administratively burdensome and intrusive.
- They have not demonstrated to be as effective in improving vehicle maintenance costs or as effective in modifying driver behavior long term.

### You want a system that works!!

- Does the system really work?
- Is it going to be a major burden on your staff to implement?
- What are the real costs?
- Are you going to have video of your company vehicle on youtube??

### ....May 21st, 2007, Seattle

#### Worker visibility Act:

Help is on the way!! November 24th 2008

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0 - blind data, no growls
II - growls & tones ON, unidentified data capture
III - identified data
There are grants to assist you...

Science not, next best guess

Operating in an environment where many aspects of safety are still devoid of safety standards – requires technical knowledge and understanding

Visibility and Conspicuity ...?.

Recent Visibility Webinar
www.GlobalEMSForum.org

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

Policy and practice ignorant of existing technical safety data
We've known for 10 years that red fire trucks are twice as likely as lime yellow trucks to crash at an intersection.

But what about those red trucks? Very cool – AND visible!!

Having access to that technical knowledge supports changes to improve safety practice.

Not rocket science...

Another excellent example - From this to ... this!

From this..... to this

Very cool, !!!

Day visibility
Night visibility

‘Safety’ approaches being driven by manufacturers claims and sales rather than by science and data

Safety Management

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

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

State Strategic Highway Safety Plans

- Required as part of the SAFETEA-LU legislation
  - (Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users)
- Effective October 1st 2007
- Focus is the 4 ‘E’s
  - Engineering
  - Education
  - Enforcement
  - Emergency Medical Services
- EMS is a core theme

State SHSP EMS Focus*

- EMS Section
  - Emergency Medical Services Dispatch Services
  - Emergency Medical Services Partnerships
  - Pre-hospital Training Programs
  - Road Condition and Incident Response
  - EMS Responder Crash Prevention

Integration and Collaboration


IAFC June 2007

The Effects of Sleep Deprivation on Fire Fighters and EMS Responders

State SHSP EMS Focus*

- EMS Section
  - EMS Legislation and Regulation
  - EMS Funding
  - Enhance Capabilities for Medical Response to Disaster
  - Expand Human Resources
  - EMS Education System
  - EMS Services
  - EMS Public Education and Information Programs

Ambulance Standards??

- KKK?
- AMD?
- FMVSS?
- NFPA?

USA Ambulances: FMVSS Exempt

Static Pull test
- 2200 Lbs. (8G’s) in Longitudinal and Lateral
- No dynamic test
- No definition to manikin mass
- No restraint for equipment
- Voluntary

Propaganda that kills...

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

Occupant protection......??

2007 USA ambulance ‘safety testing’ practices !??

No ‘a’... then NO ‘F’ !!!!!

- F = ma

where
- F – force
- m – mass
- a – acceleration

KKK certified and FMVSS exempt..?
A closer look

A few key words about restraint systems...

NOT new technical data...

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.
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…”

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

Bigger is not necessarily better……

Policy Changes
Use proven safety tools

NAEMT July 2006 Position statement

Policy makes a difference…

Patients must be in the over the shoulder harness, medics restrained in seat belts, equipment secured
1. Emergency Vehicle Operations Policy
2. Vehicle operations training and evaluation
3. A program of graduated driver responsibility
4. Drivers only age 25 and over
5. Complete stop at an intersection
6. Restricted use of Red Lights and Sirens
7. Monitoring of emergency vehicle operations

WEMSA covered some key and important policies and procedures
But...
- What about hours of service?
- What about visibility at the scene? For providers and the vehicles...
- What about protective equipment?
- What about ambulance design safety?
- What about reporting of adverse events?

Innovation

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

The EMS Safety Foundation
Intro and Logistics Webinars from December 11th 2007 & Jan 8th 2008
EMS Safety Foundation tab at www.objectivesafety.net

Ambulance Transport Safety Task Force (ATS) and the National Transportation safety Board (NTSB)

National Academies Transportation Research Board’s (TRB)
And Your New EMS Transport Safety Subcommittee

Jan 2008 National Academies Inaugural EMS Transport Safety Subcommittee
TRB EMS Safety Update

- Brought together NHTSA, FHWA, TRB, National Academies, DOT, CAMTS & EMS
- 3 presentations
  - TRB and TIAF
  - Safety airbags
  - General Ambulance Safety Issues and Directions
- Recorded presentations and handouts available at www.objectivesafety.net
- Potential for EMS safety research funding
- Next TRB meeting January 11-15, 2009 – all are welcome

Ambulance Transportation Safety Task Force
January 29th 2008

Major events for innovation sharing
- but regional and often language isolation
  http://www.rettmobil.org/

TRB
Jan. 16th
2008

Vehicle Occupant Safety design

2007 European design
Safety technology is a key focus

Ergonomic design

Ergonomic layout and equipment

NSW Australian vehicles

Flexibility to manage two patients

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

Norway initiatives

Sweden initiatives

Securing equipment

So....
- Which vehicle do you want to be in?
- Which vehicle is the best for efficient and effective patient care?
- Which vehicle provides optimal risk management?
- What is the optimal fleet mix?

Were we safer in the Cadillac???

An excellent model

Coming Soon!
Traffic Incident Management Systems (TIMS)
- USFA report to be released any day
- Research and writing by IFSTA
- Covers setting up safe roadway incident work areas and using unified command at these incidents
- Will be available in a downloadable format
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

No need to reinvent the wheel...

USFA Emergency Vehicle Safety Initiative

VFIS Summer 2006

Risk/Hazards

- Predictable risks
- Predictable fatal injuries
- Serious occupational hazard
- Public safety hazards

March 2007 - FHWA

Creating a Safety Culture

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

- Awareness
- Training
- Incentive

Tips for Emergency Vehicle Operations

Some simple and available solutions out there now

- Intersection Policy
- PPE
- Black boxes
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

What needs to happen NOW?
- Implement a Fleet Safety Program
- Correct the basic policies and procedures regarding:
  - Intersections
  - Use of occupant restraints
  - Securing equipment
  - Driver performance
  - Visibility and conspicuity
- Data
  - Epidemiology
  - Ergonomic
  - Safety oversight

What you can do now
- Have a written and implemented ‘safety program’
- Secure all equipment
- Secure occupants with standard belts
- Don’t drive through red lights/stop signs
- Use properly implemented “Feedback Boxes”
- Monitor crash events with common denominators (i.e. per 100,000 miles and per trip)

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

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

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

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