Safety Strategies for EMS Fleets: What Works?

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- To quote Steve "Sid" Caesar – Director IHS ES

"We want everyone to get home safely each day"

Emergency Medical Services (EMS) Transport Safety

This afternoon's scope

- Key Issues
  - Where is the state of the art
  - What are the questions we need to ask
  - Which are effective systems safety solutions
- Future
  - Goals
  - New technologies
  - Futuristic vehicles
  - New policies
  - New practices
  - New Standards

Emergency Medical Services (EMS)

An important and unique system

- Public safety, public health and emergency service
- Is there to save lives
- A more recent service compared to Fire and Police

EMS Safety Crisis

"The Chinese word for 'crisis' (危機) is made up of the words 'danger' (危) and 'opportunity' (機)"

Firstly, the DANGER…

- The state of EMS transport safety research is an EMBARRASSMENT
- Lags at least 30 years behind general automotive and transportation safety research
- Global EMS vehicle safety research is sparse
- EMS Safety research is NOT EVEN ON THE PLAYING FIELD of state of the art automotive safety research
- 'Reinventing the wheel' – should be avoided at all costs

Then, The OPPORTUNITY

- This is vehicles, and this is transportation safety
- Vehicle and transportation safety technology and infrastructure exists
- Ditto drivers, and driver safety technology
- Collaboration, and the multidisciplinary model
- Optimal use of very scarce resource

Firstly!

- An accident ?
- or a predictable and preventable event

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

Real world answers to real world questions -

- What policies offer the safest system?
- What features will enhance safety of ambulance vehicles?
- What technologies will optimize transport safety performance?
- What color scheme is best for vehicles and staff to make it safest?
- What data should be collected when something goes wrong, and how to best analyze it?

Emergency Medical Service Transport

- What are the transport safety issues that pertain to this important public service and public safety industry?
- What do we know of the risks and hazards and how can we measure these ?
- How can the safety of this transport system be optimized?

A tragic emergency health care intervention outcome

It does happen….

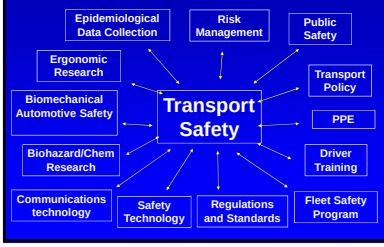
EMS Transportation Safety Key elements

- What is the appropriate data to collect?
- Which is the optimal method to capture it?
- How do you identify and implement appropriate solutions?

A serious fleet and safety problem…

- Ambulance transport
  - the most lethal vehicle on the road both per mile travelled and per vehicle
  - is exempt from federal safety oversight
  - has the worst transportation safety data capture for any ground transportation system AND…..
  - Is THE VEHICLE THAT COMES TO RESCUE YOU ON THE HIGHWAY!!

Ground Ambulance Transport Safety IS Complex AND Multidisciplinary



the EMS transport process

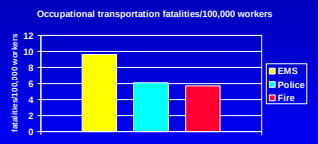
- communications/dispatch
- the patient
- restraining device/seat
- transporting device/gurney
- paramedics/transport nurses, doctors & family
- patient monitoring equipment
- clinical care & interventions
- protective equipment
- the vehicle
- the driver/driving skill
- other road users
- the road

TIME & PLACE

Ambulance Transportation Safety

- Dispatch policy and procedures
- Vehicle Operations Safety
- Vehicle Crashworthiness
- Vehicle Ergonomics
- Clinical care policies
- Scene Safety

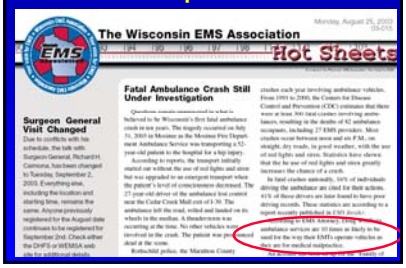
Occupational transportation fatalities..



- WE HAVE A BIG PROBLEM HERE

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

2003 a problem...


The Wisconsin EMS Association

Hot Sheets

Fatal Ambulance Crash Still Under Investigation

Surgeon General Visit Changed

2007 a bigger problem

2007 Insurance data –

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

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

EMS CANNOT afford to keep paying out like this….

So an ambulance is..

- Most lethal vehicle on the road per mile traveled
- >3 times more lethal per vehicle than other vehicles on the road
- Not designed by automotive engineers - nor are design features based on known automotive safety technology or ergonomic science
- NO transportation systems oversight

Absence of standards and oversight

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

Why is this crash different from every other crash

A devastating tragedy…

- In contrast to medical error – such as an ETT down the wrong hole which may kill the 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……

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 45-year-old Sammy Smith, 31-year-old Heidi McDougall and 21-year-old Kelly Ragar. 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 Nicely

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."

Jan 25th, 2008

Hughestown ambulance crew responding to fire injured in crash - Pennsylvania

Both members of a Hughestown ambulance crew were injured while responding to a fatal fire in Duryea on Thursday, said Hughestown Hose Co. Chief Jamie Merlino.

The ambulance collided with a tractor-trailer at 2:46 a.m. at McAlpine Street and Foote Avenue.

The occupants of the ambulance were EMS Lt. Stephanie Koblinski and Fire Police Lt. Joseph Meranti.

Koblinski was treated at Geisinger Wyoming Valley Medical Center, Plains Township, for minor bruises and later released.

A member of Meranti's family said he was still in the hospital as of 4 p.m. Thursday but had no further comment on his condition.

Merlino confirmed the ambulance had its sirens on as it was driving through a traffic light, which had just turned green, when it was struck by a single-axle tractor-trailer.

The identity of the tractor-trailer driver was unavailable Thursday, but a report is expected to be filed on Saturday morning, said Pittston City police Chief Jeffery J. Tayoun.

The ambulance was a 2003 Ford E-450 Medtec Apollo which Hughestown began using two months ago.

Merlino said the insurance company has totaled the ambulance.

Duryea fire Chief Jeff Hughes said the crash had [illegible] effect on the outcome of the fire[illegible] because another ambulance had already taken fire victim Ronald Matyuka to the hospital.

Hughestown should have a new ambulance within two weeks, but borough residents would not be without [illegible]

Avoca will provide ambulance services from 6 a.m. to 6 p.m. while Duryea will cover the 6-p.m.-to-6-a.m. shift.

EMS Transport Safety

- 'patient safety'

  AND also
- 'provider' and 'public safety'

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

USA EMS

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

USA 1960's

History of EMS

- EMS is a relatively new industry
- An unusual history of beginnings within the mortician industry.
  - Early ambulances were hearses, once motorized usually a Cadillac, a vehicle in which an occupant could be transported in the recumbent position
- Over the past 100 years, the sophistication of EMS medical care has advanced dramatically
- EMS communications and transportation technology have not kept up with that pace

1960 to 2007

Some recent adverse outcomes

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 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

What is a survivable impact?

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

IRMRC

~ 30 mph - survivable

What is a survivable impact?

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

IRMRC

~ 60 mph – not survivable

A survivable impact??

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

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

Posted Sysinnocent at July 5, 2007 4:58 PM (Suggest Removal)
to all the people worried about how fast the emt was going, would it be fast enough if it was your loved one in Jhere.....

| Add your comments

Posted Sysinnocent at July 5, 2007 4:49 PM (Suggest Removal)
to made it would be too fast if they ran over my family member on their way to another's family member...

| Add your comments

Posted Sysinnocent at July 5, 2007 4:58 PM (Suggest Removal)
to X 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.

Transport oversight?

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

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

Why ISN'T EMS on the NTSB's "Most Wanted List"??

Clinical Care? Occupational Health and Safety…..?

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

… Nov 8th's Fatality

Putnam Co. paramedic dies in ambulance crash

VALHALLA, N.Y. - A Putnam County paramedic returning from an ambulance call has died after the vehicle went off the road and struck a tree.

Authorities say Matthew Lamb of Carmel was riding in an Empire State Ambulance Corp. vehicle at 5 a.m. Wednesday when it went off the road and struck a tree in Garrison.

Lamb suffered massive head trauma. State police senior investigator Bruce Cuccia told the Journal News it appears the driver fell asleep.

Carmel Fire Chief Daryl Johnson says Lamb was taken off life support and pronounced dead on Thursday at the Westchester County Medical Center.

The driver, Jonathan Romero of the Bronx, suffered minor injuries.

Jan 28th, 2008

April 14th, 2008

Ambulance worker loses arm in accident - West Nyack, New York

An emergency service worker lost her right arm today after the ambulance in which she was a passenger crashed into a truck parked along Route 59 near the flyover to the Palisades Center mall.

Bonnie Ames, 20, was taken by helicopter to the Westchester Medical Center in Valhalla where she underwent surgery.

"She's out of danger, but she lost her arm," Raymond Florida, director of **Rockland Paramedic Services** said early this evening.

"We used multiple units from the jaws of life to extricate her," West Nyack Fire Chief George Drescher said. "She appeared to be seriously injured."

The paramedic van driver, 19-year-old Scot
there to Westchester Medical Center, said

April 20, 2008..??

June 17th 2008
a paramedic and a patient killed

EMS CRASH KILLS PATIENT AND A SUSSEX COUNTY (DE) PARAMEDIC IN THE LINE OF DUTY
Tuesday, June 17, 2008

We regret to advise you that a female Sussex County (DE) Paramedic was killed in the Line of Duty as was a patient killed in a horrific crash involving an ambulance in Sussex County (DE) this morning.
The single vehicle crash happened around 0240 Hours on the John J. Williams Highway near the Lewes-Rehoboth joint fire company substation in Angola.
The Mid-Sussex Rescue Squad ambulance was transporting to Beebe Medical Center with a patient, 2 MSRS Squad members and the Sussex County Paramedic were on board when it struck a tree, which opened the side of the ambulance as seen on our home page. Tragically, the patient was killed as was the Sussex County EMS Paramedic, who was killed in the Line of Duty.
Sussex County EMS also suffered a close call last year when a Paramedic John Schmitt was seriously injured in a crash when a civilian struck the Milford Fire Company ambulance he was riding in, while returning from a run. Additional details on this mornings crash will follow.

In this vehicle…

October 31, 2008 - Kentucky

February 11, 2009 – North Carolina

EMS Driver Charged After Ambulance Crash - North Carolina

A Rockingham County ambulance slid off the road and flipped over Wednesday afternoon.

The crew was transporting a patient to a nursing home when the ambulance went off the road. The County Emergency Services Director Steve Hale says the weather may have played a role in the crash. "He said it kinda, when he dropped off and started to correct it fished on him abit, so you know he was just an overcorrection trying to take the wind and everything else into play, may have been a factor."

April 30, 2009 - Tennessee

Arlington, Texas – June 18, 2009

Paramedic, woman involved in ambulance crash in Arlington - Texas

A paramedic and a pregnant woman were taken to a hospital after their ambulance collided with a truck in Arlington early this morning.

The ambulance was heading east on East Arkansas Lane when it collided with a pickup going north on South Collins Street about 2 a.m. said Jim Gibbs, a spokesman for American Medical Response, the ambulance company.

The ambulance was responding to a non-emergency call and did not have its lights or sirens on, he said.

Citing patient privacy, Gibbs declined to release details about the woman, but an Arlington police dispatcher said she was in labor.

Two ambulances arrived at the crash scene. The paramedic and woman were taken to the Medical Center of Arlington and have been released without injuries.

â€œThey were shaken up a little, but they â€™re OK,â€ Gibbs said. The drivers of both vehicles refused treatment.

Arlington police were investigating the cause of the accident.

Minnesota - June 20, 2009

Woman Struck, Killed By Ambulance In St. Paul - Minnesota

The ambulance, along with other emergency responders, was at a Walgreens parking lot in St. Paul responding to a report of a car that had gone through a fence and into an alley.

When the ambulance backed up the alley to get closer to the crash, it hit the woman, who was pronounced dead at the scene. Her identity has not yet been released.

"Words fail us at times like these. They fail to express the depth of our sadness for those who lost a loved one today. They fail to touch the anguish of the paramedic crew whose jobs sent them on a fateful run. We will fully investigate the circumstances of the tragic accident, and as the day ends in grief, our thoughts and prayers are with the family of the victim as they go through this difficult time," said St. Paul Mayor Chris Coleman in a statement.

Fatalities and funerals

Charged with Vehicular Homicide

Penn Twp. ambulance driver faces charges in crash - Pennsylvania

A Penn Township Rescue 6 ambulance driver faces a charge of homicide by vehicle in an Oct. 30 accident in Hempfield that killed a Westmoreland County Prison guard.

A Penn Township Rescue 6 ambulance driver faces a charge of homicide by vehicle in an Oct. 30 accident in Hempfield that killed a Westmoreland County Prison guard.

Jason Fait, 30, of 9050 Barnes Lake Road, North Huntingdon, was arraigned this week and will have a preliminary hearing at 1:45 p.m. Sept. 27 before Jeannette District Judge Joseph DeMarchis. Bond was set at $25,000 unsecured. Fait also was charged with reckless driving, careless driving and other traffic offenses.

State police at Greensburg said Fait was driving an ambulance west on Route 130 at 5:49 a.m. Oct. 30 when he ran a red light at North Greengate Road and hit a Ford Bronco driven by Frank Scalise Jr., 46, of Murrysville, that was traveling south.

Scalise, who began working at the prison in 1992, was reportedly on his way there at the time. According to the criminal complaint, Scalise was taken by medical helicopter to UPMC Pittsburgh. He died Nov. 3 of blunt-force trauma of the head, according to the Allegheny County Medical Examiner's Office.

Fait was not injured, but the ambulance was heavily damaged. Police indicated the ambulance was returning to its station after transporting a patient and did not have lights or sirens activated. Asked about Fait's employment status Friday, a representative of the ambulance association had no comment.

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, Phillip 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…."?

Date last updated: Tuesday, January 20, 17:14 PST

LexisNexis

Pa. ambulance involved in crash; patient pronounced dead at scene

By Elizabeth Evans
The York Dispatch (Pennsylvania)
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An Adams County ambulance making a patient transfer to York Hospital collided with a car at the intersection of routes 30 and 116 in West Manchester Township at 9:47 this morning, and the patient was pronounced dead at the scene.

York County Deputy Coroner Claude Stahley said the patient, a woman, was being transported from Gettysburg Hospital because she was suffering a "significant" heart condition.

He said he's still trying to determine whether she was into cardiac arrest and died prior to the crash, or whether she suffered a fatal heart attack because of or after the crash. Stahley said she suffered no significant traumatic or life-related injuries.

EMS Transportation Safety Standards…. An oxymoron?

October 2008 JEMS Article "Rig Safety – 911"

Goals

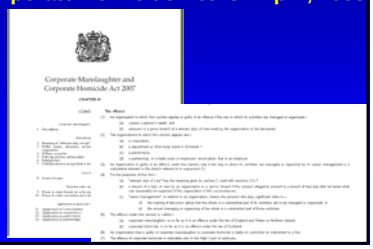
- Standards for safety
- Policy based on Science
- Databases to demonstrate outcome

Valuable information… EMS exempt

FMCSA - Exceptions

- Unless otherwise specifically provided, the rules do not apply to —
  - (f)(1) All school bus operations as defined in §390.5;
  - (f)(2) Transportation performed by the Federal government, a State, or any political subdivision of a State, or an agency established under a compact between States
  - (f)(3) The occasional transportation of personal property by individuals not for compensation nor in the furtherance of a commercial enterprise;
  - (f)(4) The transportation of human corpses or sick and injured persons;
  - (f)(5) The operation of fire trucks and rescue vehicles while involved in emergency and related operations;

Canada - Corporate Manslaughter Corporate Homicide Act: 8th April, 2008


Corporate Manslaughter and Corporate Homicide Act 2007

EMS safety data estimates

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 35x higher than in Australia

*FARS/BTS 2005-6

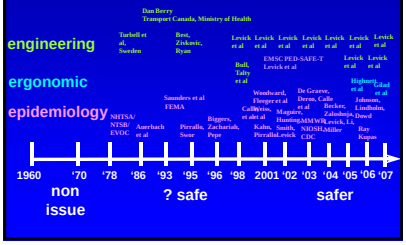
Is it your service's tragic year?

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

Commercial vehicle comparisons

- Estimates for ambulance fatality/mile traveled are 3 to 50 fold the rate of large truck fatal crashes
  - Large trucks - 2.2 fatal crashes/100 million miles traveled in 2005
  - Ambulance - 7.7 to 109 fatal crashes/100 million ambulance miles traveled
- Injury estimates
  - 37 truck crash injuries/100 million miles
  - Ambulance estimates of crash injury of 308 to 4,360 injuries/100 million ambulance miles traveled
- Ambulance vehicle occupant crash fatality percentage is double that for large trucks.

Ambulance Safety Research: A New Field



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#
- More likely to crash at an intersection with traffic lights (37% vs 18% p=0.001) & more people & injuries/crash than similar sized vehicles##

*Kahn CA, Pirralis RG, Kuhn EM. Prehosp Emerg Care 2001 Jul-Sep;5(3):261-9
**Becker, Zalzdnnja, Levick, Li, Miller, Acc Anal Prev 2003
***Maguire, Hunting, Smith, Levick, Annals Emerg Med Dec 2002
#NIOSH, 2003
##Ray AM, Kupas DF, Prehosp Emerg Care 2005 Dec; 9:412-415

And very Predictable…

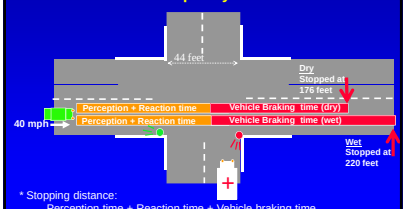
- Intersections are lethal environments

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…..

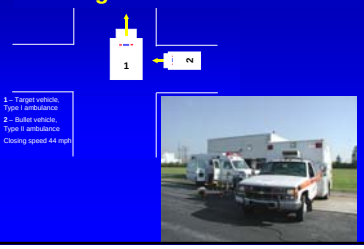
The real world

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

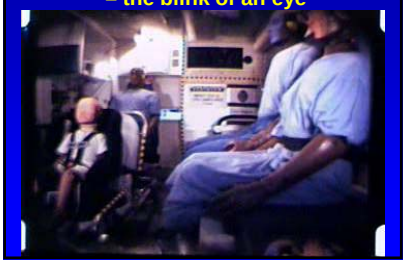


* Stopping distance:
Perception time + Reaction time + Vehicle braking time
(varies with age, skill, agility, alertness + vehicle type, tire pressure, road etc)

What is actually happening during an ambulance crash



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



NOT new technical data…

Richardson S.A., et al, Int. J. of Crash., 4:3, 239 – 259, 1999

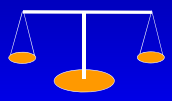
Side facing 4-point harnesses demonstrated to be lethal, even at slow ground vehicle speeds

NOT new technical data…

Richardson S.A., et al, Int. J. of Crash., 4:3, 239 – 259, 1999

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

Balance of concerns and risk during transport

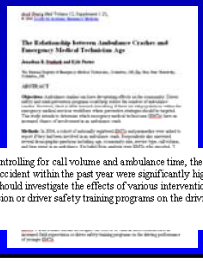


- Response and transport time
- Clinical care provision
- Occupant safety/protection
- Public Safety

The Driver

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

EMS Driver issues



Conclusions: When controlling for call volume and ambulance time, the odds of having been in an ambulance accident within the past year were significantly higher for younger EMTs. Future studies should investigate the effects of various interventions such as increased field supervision or driver safety training programs on the driving performance of younger EMTs.

Which is best, how many hours…??

Fleet Driver Training… what really works?

Innovation

R & D
"Ripoff and Duplicate"

- Avoid reinventing the wheel at all costs
- Where are the best practices that we need to transfer knowledge from

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

EMS Association Policies -WEMSA

WEMSA – October 2007

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

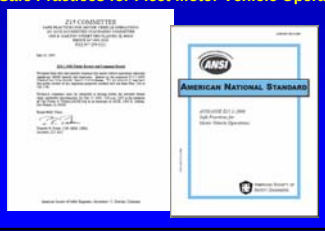
WEMSA covered some key and important policies and procedures But….

- 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?

ASSE September 2007, Fleet Forum November 2008 and NIOSH/OSHA February 2009, Its not magic…..

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

Z15 Incident Rates

- Incident rate based on number of vehicles operated:

  Incident rate = $\frac{\text{Number of incidents x 100}}{\text{Number of vehicles}}$

- Incident rate based on vehicle mileage:

  Incident rate = $\frac{\text{Number of incidents x 1,000,000}}{\text{Vehicle mileage}}$

- Injury incident rate based on vehicle mileage:
  - Injury incident rates, the most frequently used indicator of incident severity, are useful for tracking events that have the potential to affect financial or operational performance of the operating unit.

  Injury incident rate = $\frac{\text{Number of incidents with injury x 1,000,000}}{\text{Vehicle mileage}}$

- Incident rates based on service activity:
  - Motor vehicle operations that pose injury risks other than those associated with driving should also use the service activity as the basis of a safety performance rate. The number of deliveries, stops, or loads should be considered as appropriate indicators of performance.

  Incidents per 10,000 transports = $\frac{\text{Number of incidents x 10,000}}{\text{Number of transports}}$

- Vehicle injury rates based on work hours:

  Vehicle incidents per 200,000 hours = $\frac{\text{Number of incidents x 200,000}}{\text{Number of hours worked}}$

ISO 39001 – Being developed

ISO 39001 - Principles of RTS management systems

a) Focus on loss of life and health
b) Holistic view
c) Focus on results
d) Leadership
e) Process approach
f) Continual improvement
g) Best available information
h) Transparent and inclusive process
i) Tailored implementation
j) Systematic and structured
k) Part of decision making

Road Safety at Work Library

http://www.geolibrary.org/library/default.aspx?CategoryID=627

UPS: The 'Big Brown'

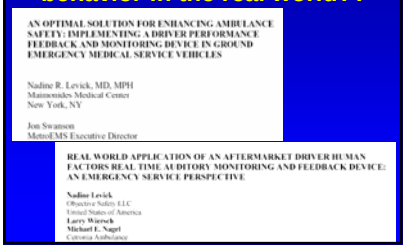
- No left turns – instead make three rights
- Don't back up
- Don't employ any drivers under 25 years of age
- Don't employ anyone with a history of driving convictions

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

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
New York, NY

Jon Swanson
MetroEMS Executive Director

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
Larry Wartsek
Michael L. Nagel
Catonia Ambulance

Real-time invehicle telematics feedback and monitoring

- Not a "black box"
- Driver feedback operates instantly, in real time and automatically as thresholds are approached
- No manual component to identify hazardous performance
- Data downloads wirelessly
- IS effective form of driver monitoring – but also is a TRAINING device

Purpose of 'Telematics Real – time 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

MEMS Snapshot

- Serve 500,000 people in Little Rock area
- Deploy 29 units daily
- 58,000 calls per year
- 2,400 square mile service area
- 195 full time / 75 part time uniformed employees
- 1.9 million miles annually
- Mean response time: 6 minutes

Graduated implementation for evaluation

- Phase I-
  - Blind data - no growls or tones, no ID capture
- Phase II-
  - Warning growls and penalty tones only
- Phase III-
  - Fully operational, identified data capture

Pilot 1

- Parameters monitored
  - Vehicle speed, cornering, seat belt use, back up spotters
  - Use of lights and sirens
  - Miles traveled
- Penalty counts for exceeding parameters are recorded, stored and downloaded daily for analysis and reports generated
- Response times and fiscal balances were reviewed pre and post implementation

Pilot 1

- A fleet of 36 ambulances, 250 drivers and 1.9 million miles of vehicle operations were monitored by the system for 18 months.
  - Blind data collected from March 2003 for 3/12
  - Identified data captured with the system fully operational from June 2003.
- The parameters measured are –
  - Speed against user set limits – both hot & cold
  - Cornering velocity, g-forces, hard braking/acceleration
  - Use of seat belts, lights & sirens, turn signals
  - Parking brake, back up spotters

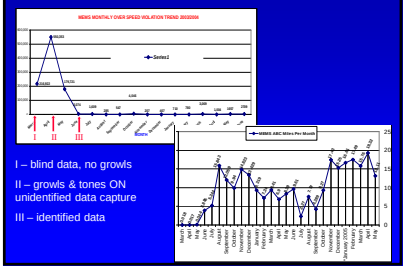
Pilot 1

- Parameters are monitored every second
  - Penalty counts for exceeding these parameters are recorded, stored on an on-board computer and downloaded daily to a base station for analysis and reports generated.
- Response times and fiscal balances were reviewed pre and post implementation of the monitoring and feedback system

MEMS Settings Pilot 1

- Speed - 15 second warning period
  - Non Emergency 74 / 78 mph
  - Emergency 84 / 88 mph
- Cornering - warning at 25%
  - Low Over Force - 39%
  - High Over Force - 55%
- Seat Belt Distance
  - 2 / 10ths mile

Initial Demonstrated Effectiveness

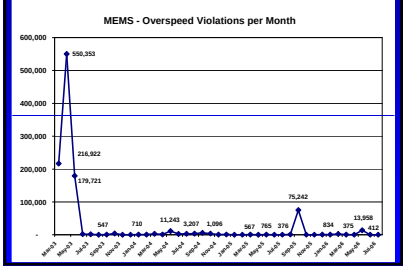


I – blind data, no growls

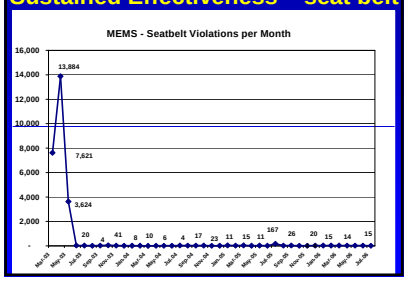
II – growls & tones ON unidentified data capture

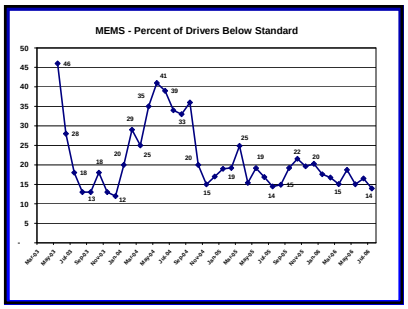
III – identified data

Sustained Effectiveness - speed



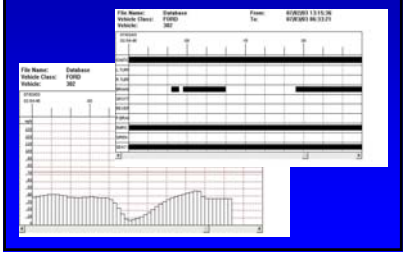
Sustained Effectiveness – seat belt





And when a rare crash happens….

Unit 302 Accident



Results Summary

- Implementation was well received by the providers.
- Over 1.9 million miles of vehicle operations recorded.
- Performance improved from a baseline low of 0.017 miles btw penalty counts (>56 counts/mile) to a high of 15.8 miles btw penalty counts.
- Seatbelt violations dropped from 13,500 to 4
- 20% cost saving in vehicle maintenance within 6 months.
- No increase in response times
- Fewer crashes and less severe crashes - Only one vehicle mishap
- Sustained improvement in safety proxies over 18 months, with no inservice or retraining after the initial introduction period.

Implementation Environment Pilot 2

- CAC deploys 13 units daily, covers 450,000 miles annually
- CAC has 20 Emergency Vehicles and 11 Non-emergency Vehicles
- Mean response time of 11 minutes
- 152 drivers

Graduated implementation for evaluation

- Phase I-
  - Blind data - no tones, no ID capture
  - 11/1/04 to 4/30/05
- Phase II-
  - Warning and penalty tones only
  - 5/1/05 to 6/30/06
- Phase III-
  - Fully operational, identified data capture
  - 7/1/06 to 8/31/06

Auditory alarm warning thresholds Pilot 2

Speed Low Speed (LSCOUNT) High Speed (HSCOUNT)	10 second warning period - 73 / 78 mph - >79 mph
Cornering Low Over Force (LFCOUNT) High Over Force (HFCOUNT)	warning at 25% - 38% - 48%
Reverse Count (RVCOUNT)	- 1 count for each time vehicle is placed in reverse without engaging reverse spotting switch
Seat Belt Distance (SBCOUNT)	- 1/10th mile with no belt secured

Demonstrated Results

- Over 950,000 miles of vehicle operations were recorded
- Major reduction in high over speed penalty counts
  - 14.94 penalties/mile in Phase I
  - 0.00003 penalties/mile in Phase III.
- Major reduction in seatbelt violations
  - 4.72 violations/ mile traveled in Period I
  - 0.001 violations/ mile traveled in Period III a fold reduction in seat belt violations
- Similar trends were seen in low over speed and over force parameters

Results

	Phase I 11/01/04-04/30/05	Phase II 05/01/05-06/30/06	Phase III 07/01/06-08/31/06
Distance -miles	193,210	682,320	75,957
LSCOUNT [LSCOUNT/mile]	89,250 [2.16]	100,195 [0.15]	96 [0.001]
HSCOUNT [HSCOUNT/mile]	12,936 [14.94]	14,448 [0.02]	2 [0.00003]
LFCOUNT [LFCOUNT/mile]	37,347 [0.19]	64,328 [0.09]	1,250 [0.02]
HFCOUNT [HFCOUNT/mile]	552 [0.003]	1,210 [0.002]	56 [0.001]
RVCOUNT [RVCOUNT/mile]	15,697 [12.31]	69,779 [0.10]	7,100 [0.09]
SBCOUNT [SBCOUNT/mile]	40,893 [4.72]	45,366 [0.07]	99 [0.001]

Response times

- There was no increase in average response times during the study period:
  - 11:14 minutes in 2004
  - 10:36 minutes in 2005
  - 10:46 minutes in 2006

suggests a moderate overall improvement in response times during the study period.

Crashes

There were:

- 19 vehicle incidents in 2004
- 11 in 2005
- no major vehicle crash during the fully implemented phase of the study period.

Direct Cost savings

- Decreased crashes
- Cost saving in vehicle maintenance expenses:
  - $271,091in 2004
  - $242,965 in 2005
  - $237,193 in 2006

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

A key to safe ambulance transport

Limitations

- No categorization of type/severity of crash
- Variable performance and exposure data per individual providers
- Unique environment may not be uniform across EMS services or generalizable
- No metric exists to provide a performance measure of the safety or risk exposure of an EMS system – which may differ depending on environment, transport hazards, call incidence and frequency, driver training and age..

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 monitoring
- Must be reinforced by management
- Rewards for good safety performance
- Consequences for poor performance

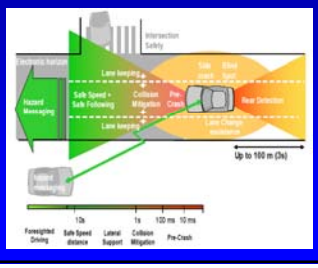
Demonstrated clearly

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

Demonstrated Effectiveness

- Change driver behavior
- Carrot not stick
- Vehicle maintenance improvement
- Decreased administrative burden
- Insurance benefits

Intelligent Transport Safety Systems



Visibility and lighting issues

Policy and practice ignorant of existing technical safety data

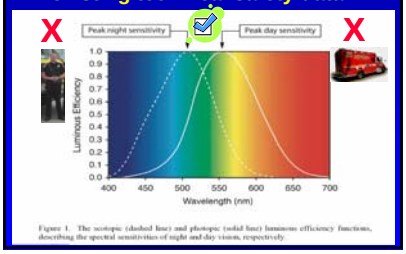
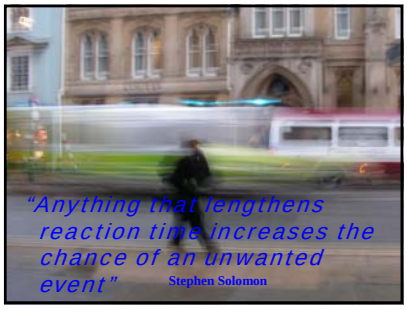


Figure 1. The scotopic (dashed line) and photopic (solid line) luminous efficiency functions, describing the spectral sensitivities of night and day vision, respectively.



Emergency Vehicles – Viewer Awareness

For a timely, appropriate and safe response

- Location
- Size
- Shape
- Speed
- Intended path

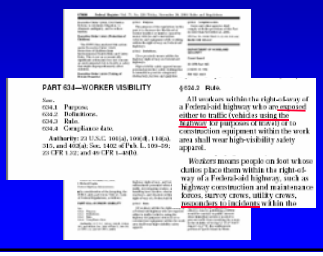
But whatever color …. If you run a red light someone will be killed

Color-blindness affects 10% of the population

- As seen with normal vision

- As seen with color blind vision

Help has arrived !! Worker visibility Act: 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).

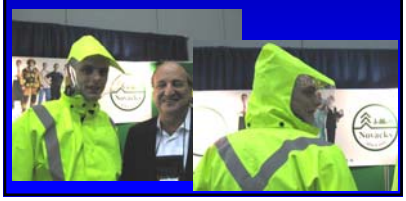
§ 634.3 Rule.

All workers within the right-of-way of a Federal-aid highway who are engaged 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 whose duties place them within the right-of-way of a Federal-aid highway, such as highway construction and maintenance forces, survey crews, utility crews, emergency responders within the

Not rocket science..

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



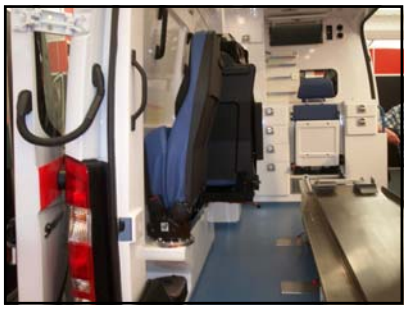
" The multicolored (patterned) ambulance while distinctive, may suffer decreased conspicuity because of the effects of camouflage" *De Lorenzo & Eilers Annals EM 1991*

International approaches

- The state of the art non-USA vehicles have NO squad bench nor the after market structural vehicle modifications that can potentially decrease crashworthiness integrity that were seen in study vehicles.

EMS Safety Foundation

Innovation, collaboration & knowledge transfer



Vehicle Occupant Safety design

European design

Safety technology is a key focus

Safe and Ergonomic design

Ergonomic layout and equipment

JOURNAL

Local News

IRHA selected to test new ambulance

New design smaller, more cost efficient, say health officials

Manitoba Health is looking to act on its original plan by implementing a pilot project, giving the RHA's a year to
out the Sprinter design to see if it could be a replacement to the current Fleet Mac ambulance design.

According to Christenson, the Sprinter design looks similar to delivery vans, and boasts a whole new set of saf
and technology features such as GPS.

It's a lot smaller, so that makes it a lot easier for paramedics to be strapped in but still be able to reach all the
equipment needed to tend to a patient," said Christenson.

Christenson also explained that the new ambulances require less maintenance, and have an overall smoothe
quieter ride. They also are lower to the ground and come equipped with new 'no-lift' stretchers, that eliminate
85 per cent of strenuous lifting paramedics do to get patients in and out of the vehicle.

Safety first - Passive Safety

Fold-in ridges on subframe

Front axle module

Front axle module after crash

- A main feature in a front-end crash is the "disconnectable" front axle, which releases additional deformation zones in the longitudinal frame member when a particular force level is reached.
- On a frontal crash, transmission and engine will be pushed underneath front occupants.

Is safety crash tested by automotive experts

Unlike this vehicle

So….

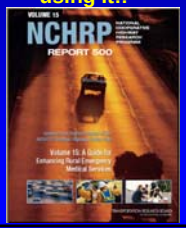
- Which vehicle do you want to be in ?
- Which vehicle is the best for efficient, and effective patient care?
- Which vehicle provides optimal risk management ?
- What is the optimal fleet mix?

Were we safer in the Cadillac???

Fleet Mix ?

No need to reinvent the wheel...

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



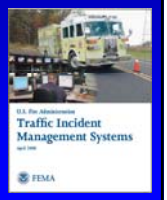
March 2007 - FHWA

Tips for Emergency Vehicle Operations

USFA Emergency Vehicle Safety Initiative

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



Risk/Hazards

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

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 "Telematics"

What do we know works…

- Vehicle Operations Safety Policies
- Squad bench lap seat belts
- Patient over the shoulder belts
- Securing equipment
- Forward and rear facing seating
- Telematics feedback 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

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

Summary

- Transport systems engineering and human factors safety hazards are serious issues in EMS transport injury and fatality
- Ambulance transport is devoid of acceptable safety standards, and national oversight and minimally addressed by any meaningful data
- Transport safety technologies exist and have been demonstrated to have a substantial and sustained improvement in safety performance

Thank you! Any Questions??

a .pdf handout of this presentation awaits you online

www.objectivesafety.net