October 22, 2010, Winnipeg, Manitoba

Ambulance Transport Safety - Are You on the Ride of Your Life?  
Why the Sprinter Rocks!

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

October 22, 2010

A tragic time for EMS in Canada

CUPE Local 873

Ambulance Paramedics’ Petition on Fatal Accident This Morning – Canada

October 19th, 2010

October 18, 2010

An ambulance lies on its side after a crash with an SUV in Cooper City, Fla. Three paramedics and one patient were inside the vehicle at the time.

October 15, 2010

GALAX, Va. – Five people, including four people in an ambulance, were injured late Friday Oct 15 in a crash at the intersection of East Stuart Drive and Cranberry Road.

Who am I?

Nadine Levick, MD, MPH
Emergency Medicine Physician and Public Health Academic, (USA-Hopkins, Harlem, Maimonides, Brookdale & Australia – Royal Melbourne, Royal Childrens Hospitals, Royal Australian Flying Doctor Service)
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Where am I really from?

...Yes, it IS that big!

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What I hope to cover today
- Ambulance transport safety “is part of a system”
- Patient safety…and provider and public safety too?
- “It’s an unsafe system…why?”
- Issues with Ambulance manufacturing
- Need for measurement for safer performance
- Creating a ‘culture of safety’ thru awareness, training, design, technology and incentive.

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?
- What can we learn from international colleagues

Things can go wrong – but when there are sound safety policies and technologies in place, and the system is well prepared, you can minimize harm

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

http://www.objectivesafety.net
Your Handout and Additional Resources

Emergency Medical Services (EMS)
An important and unique transport system
- Public safety, public health and emergency service
- Is there to save lives

Ontario EMS Occupant Safety
30 August 2010
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.

Tragedy you don’t want to be involved in

Patient Safety UK- A routine concept...

But Patient Safety is just one part of this system

EMS Transport Safety

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

Balance of concerns and risk during transport

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

Some odd USA and also Canadian 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 a serious transport safety problem...

- the most lethal vehicle on the road both per mile travelled and per vehicle
- is exempt from federal commercial fleet safety oversight (FMCSA)
- 2/3 fatalities not in the ambulance
- Exempt from most FMVSS standards

Data...

- What is your transport safety record in your service?
- How can you improve if you don’t have a meaningful measure of safety performance?
- Transport safety is not guesswork, it is a science

ESC – Does your ambulance have it??

- Transport Canada announced that effective August 31, 2011, automakers must install Electronic Stability Control (ESC) technology in Canadian vehicles.
- ESC helps drivers stay in control when they need to swerve or brake suddenly to avoid an obstacle or turn corners on slippery roads.
- Vehicles equipped with ESC are involved in fewer severe collisions caused by loss of control, resulting in significantly fewer deaths and injuries

So

- What’s important
- What’s not important

Data...

- What’s going to save your life
- What might take your life

What is factual
- What is garbage

What’s going to hurt you
- What’s going to protect you

What is new
- What is not new
Some new dimensions
- Vehicles – smarter, sleeker, safer – CHEAPER!
- Operations – new technology tools
- Interdisciplinary infrastructure – new global platforms

Systems safety of:
- Getting you, your patient and equipment in and out of the vehicle
- Providing patient care inside the vehicle
- Occupant protection in crash and near miss situations

Safety Performance
- Measurement
- Outcomes
- Technical expertise

What is a safe speed and how do we identify that?

What is a survivable impact?
$E = \frac{1}{2}mv^2 \quad v^2 = 2as$
- 12 mph (20 km/hr)
- ~ 30 mph - survivable
- ~ 60 mph – not survivable

A survivable impact??

A serious problem...
Transport related aspects -
- dispatch of EMS/Medical transport vehicles
- transport policies and protocols
- vehicle fleets and vehicle design
- vehicle purchase standards
- Intelligent Transportation Systems (ITS) technology
- driver training
- driver performance monitoring
- roadside and road design
- integrated traffic safety technologies
- scene safety and visibility
- safety data capture
- safety oversight

Transport Medicine

- Impact Biomechanics
- Transport Ergonomics
- Fleet Safety

A “Fleet” to many in Emergency Medical care means….

Safe Systems Approach

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

Firstly!
- An accident?
- or
- a predictable and preventable event

A tragic emergency health care intervention outcome

A devastating tragedy...
- An ETT down the wrong hole may kill your patient and be a terrible burden for the pts family and for the medic involved
Negative impact on system performance...

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

Ambulance Transport Safety

- Emergency care, public health, public safety, and patient transportation.
- Important Principle: Ambulance transport safety is part of a system, the overall balance of risk involves the safety of all occupants and the public:
- All get home safely

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?

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

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

Absence of standards and oversight

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

What we need to consider, where is the ‘bang for buck’ in ambulance transport safety:

Creating a Safety Culture

- Awareness
- Training
- Incentive

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 driving/driver skill
- other road users
- the road

Safety policies
The Emergency Department (ED) is not an ED/ICU on wheels. Vehicle design and safety is not what we are trained to do! Would we ask vehicle builders to write cardiac arrest protocols…? Vehicle design and safety is not what we are trained to do!!!

Do we ask vehicle builders to write cardiac arrest protocols…? Vehicle design and safety is not what we are trained to do!!!

Would we…? Seeing that we are health care providers—let's look at it this way—
- Would we use medical equipment that was built by folks who were not technically qualified or trained biomedical engineers and who just said—"this device is safe"?
- Or would we expect them to be qualified in this field and that their products were tested in a meaningful way to ensure that they were safe?

April 14th, 2008

April 20, 2008...??

Ground Ambulance Transport Safety IS Complex AND Multidisciplinary
- Epidemiological Data Collection
- Risk Management
- Public Safety
- Environmental Research
- Biomechanical
- Automotive Safety
- Behavioral/Chem Research
- Communications Technology
- Safety Technology
- Regulatory and Standards
- Driver Training
- Fleet Safety Program
- Safety

Do we ask vehicle builders to write cardiac arrest protocols…? Vehicle design and safety is not what we are trained to do!!!

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June 17th 2008
a paramedic and a patient killed

In this vehicle...

October 31, 2008 - Kentucky

April 30, 2009 - Tennessee

August 2009 – Impaired...

October 22, 2009, TN
Patient and Provider killed, Attendant Critical

December 2009
January 14, 2010

February 1, 2010

Sept 16, 2010

This IS a Transportation and Automotive Safety issue

Safety is a tool to save

• Lives
• Time
• Money

must be evidenced based

Important…

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

The laws of physics prevail…

• and they don’t care what your job title is or if you are a patient, a provider or a member of the public

Science behind Policy

• “For successful technology, reality must take precedence over public relations, for Nature cannot be fooled.”

Richard P. Feynman 1988

Science behind Policy
MedStar Ambulances Will No Longer "Run Hot" When Transporting Cardiac Arrest Patients (4/21/2010)

- "MedStar ambulances will no longer 'run hot' - when paramedics inside are giving chest compressions to patients in cardiac arrest, officials say." This "policy, which took effect Friday, will affect about 1,400 of the more than 100,000 calls to which MedStar responds annually in the 15 Tarrant County cities it serves.

Safety is Good Business

A problem

2007 Insurance data –
- 27 fold more likely to have a claim based on transport than related to medical care

2003 Insurance data –
- 10 fold more likely to have a claim based on transport than related to medical care

Expensive….

Very Expensive

EMS CANNOT Afford to keep paying out like this….

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

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

Dynamic Safety Testing
• requires sophisticated, expensive equipment
• measurably demonstrates forces generated during collision
• accepted international standard for vehicle restraint systems

Dynamic Sled Testing of Ambulance Pediatric Restraints

Deceleration Sled test (upon impact) 24 G, 30mph

Why do we do this?

Testing the real world
And this all takes place in 60 milliseconds – the blink of an eye.

Impact residue

During impact

CTD dynamics

A few key words about restraint systems…

Systems safety failure AND dangerous

Overwhelming existing evidence these practices are HIGHLY dangerous

No evidence whatsoever that these practices are NOT dangerous, let alone safe

NOT new technical data…


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

What do we know now??

- Intersection crashes are the most lethal
- There are documented hazards, some which can be avoided
- Occupant restraint with standard belts is effective. (Over the shoulder belts for patients, with the gurney in the upright position where medically feasible)
- All equipment should be locked down
- Some vehicle design features are beneficial - automotive grade padding in head strike areas, seats that can slide toward the patient
- Head protection??
- Electronic Driver monitoring/feedback systems appear to be highly effective
Air EMS is a role model for safety initiatives and focus

An Aviation Safety Plan

Air Safety Approach
- Safety Program Planning
- Evaluating
- Analysis of Safety Performance
- Analysis of Safety Information and Data
- Analysis of Risk Profiles and Plans

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

An interhospital transport? “Do no harm…”?

Predictable risks
- Fatal crashes more often at intersections, & with another vehicle (p < 0.001)
- 70% of fatal crashes EMS crashes during Emergency Use
- Most serious & fatal injuries occurred in rear (OR 2.7 vs front) & to improperly restrained occupants (OR 2.5 vs restrained)
- 74% of 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

Is response time really a meaningful measure of patient outcome??
- What are the confidence limits?
- What about demographics, population density?

Jan 2010 - Evaluating Trauma Management Performance in Europe

Data Envelopment Analysis
- EMS Stations/
  - 10,000 citizens
  - 100 km rural road length
- EMS Transportation Units/
  - 10,000 citizens
  - 1000 km² area
- EMS response times/
New Information/Technical Developments Jan 2006- Jan 2010

• NRC 2006: - EMS fatalities identified as one of the 4 E's
• CAA 95/96 – EMS identified as one of the 3 E's
• International Ergonomics Association (IEA): - publication June 2007
• Transportation Safety Research Organization (TSRO): - publication December 2007
• Swedish NHTSA:
• 1960-1980: - 36% of EMS fatalities
• 1990-2000: - 15% of EMS fatalities
• National Academies TRB: - EMSS Technical summary
• NHTSA: - EMS Safety Report
• SAFETEA-LU, 2006 – EMS identified as one of the 4 E's
• Enhanced Safety of Vehicles (ESV) - publications June 2007, 2009
• International Ergonomics Association (IEA) - publication June 2006
• APEA: 
• Emergency Medical Services: A Hidden Crisis, Annals of Emergency Medicine, Dec 2002
• Maguire, Huntington, Smith & Levick, Occupational Fatalities in Emergency Medical Services: A Hidden Crisis, Annals of Emergency Medicine, Dec 2002

A challenge we know now...

... is that there is a major problem with the present approach and what is being done currently
• and many practices are in conflict with, or not supported by, existing technical engineering science

And...

This is in a setting where
• transport safety is the major and most costly adverse event in EMS
• And there have been all sorts of major technical and informational developments since Jan 2006

So does it make sense?

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

Current accepted safety design and transport system technologies are being ignored, and worse...

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

Is there an acceptable rate of morbidity and mortality for pre-hospital transport systems??
We should use the best safety practices demonstrated in engineering

...in automotive safety engineering

and in ergonomics

Range of reach. This is a well defined technical science

A challenge we know now...

- ...is that there is a major problem with the present approach and what is being done currently
- and many practices are in conflict with, or not supported by, existing technical engineering science

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?

But what about head protection?
New EMS helmet prototypes

VEHICLE DESIGN and SAFETY

PASSIVE SAFETY: Crashworthiness
- Vehicle Structural Design
- Front and Rear Compartment Design
- Seating and Restraint Systems
- Occupant Containment
- Impact Friendly Surfaces

ACTIVE SAFETY
- ESC (Electronic Stability Control)
- ABS (Anti Skid Braking System)
- Advanced Safety Systems

ESC: ELECTRONIC STABILITY CONTROL

Electronic stability control systems are second only to seat belts in terms of the potential for saving lives and reducing injuries... is a major step forward for global auto safety.

Statement by Nicole Nason, Administrator, National Highway Traffic Safety Administration, On the Adoption of Electronic Stability Control as a Global Technical Regulation

And now for some MYTH BUSTING

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

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

Yet another potentially lethal example marketed as a ‘safety innovation’ Yet outside of automotive safety practice
Airbags in the back...?? Hazardous for this environment

Absent safety testing standards, any meaningful crash or injury mechanism data or effective occupant positioning – as per the automotive engineers, rear compartment airbags are likely to be highly hazardous.

Yes, the ride of your life....

- Sure... these vehicles all parade around the EMS and Fire shows
- BUT...
- NOT ONE of these vehicles has been to the automotive safety shows or scrutinized by the automotive safety industry

Ambulance Vehicle Standards??

- KKK?
- AMD?
- FMVSS?
- CMVSS?
- NFPA?
- SAE...?
- ASTM...?
- International
  - ASA
  - CEN

October 2008 JEMS Article
"Rig Safety – 911"

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

USA Ambulances: FMVSS Exempt

USA KKK ambulance purchase specifications

- 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
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


Propaganda that kills...
July 2007

Occupant protection…..??

May 13, 2010..

2 killed in Iowa ambulance crash
2 dead and 2 injured in collision Thursday

KKK/AMD – static ‘safety testing’

- Ignorant of automotive safety principles – and specifies -
  - 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.

KKK Specification and AMD Standards both default to the FMVSS for safety – however..

- FMVSS has a specific exemption for ambulance vehicles once you are 600mm or 2 feet positioned rearward of the driver
- KKK require a ‘national test lab’ to conduct AMD ‘tests’ BUT NOT an automotive test lab!
- No dynamic impact tests AT ALL
- No crashworthiness tests

Ridiculous current 2009 USA ambulance ‘safety testing’?!? – is NOT consistent with accepted automotive safety practice...

No ‘a’… then NO ‘F’ !!!!!

\[ F = ma \]

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

Yes a “nationally recognized testing lab” – BUT - NOT an automotive/occupant safety crash test lab!!
FMVSS exempt……

Visibility and lighting issues

Hmm…

It isn’t like this in the rest of the world

Day visibility

Night visibility

Here’s the real world at 6 ft…

August 2009 – Visibility review
Policy and practice ignorant of existing technical safety data

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

Where is it...?.

Camouflage....

Color-blindness affects 10% of the population

Emergency Vehicles – Viewer Awareness

For a timely, appropriate and safe response

- Location
- Size
- Shape
- Speed
- Intended path

Having access to that technical knowledge supports changes to improve safety practice
But whatever color .... If you run a red light someone will be killed

Resource availability and allocation technologies

• VSSM (Visual System Status Management) provides a geographic view of call demand through the application of varying shades of color to indicate call density


Innovation

• Driver feedback technologies
• Tiered dispatch
• Enhanced ambulance vehicle design
• Intelligent Transport Technologies – ITS
• New platforms for interdisciplinary exchange
• New Safety Standards

Safety concepts out there now

Transport performance

• Driver training?
• Real time safety performance outcomes?
What about changing driver behavior in the real world??

Invehicle technologies to enhance transport safety
- Aftermarket in vehicle electronic e-safety devices with monitoring and feedback

Human Interface approaches
- Hardware fitted to the vehicle
- Non hardware App Driven cellular technology

Optimizing driver performance monitoring and feedback: An innovative approach utilizing a global mobile interactive e-platform

The analysed system data that sits behind each Trace Assessment

Realtime mapping from London for 2.5hr of a trip of attempting to park in NYC after a snow storm and whilst 'Law and Order' filming was underway

Driver’s Individual performance against company set performance targets in the system
- Needle points to individual driver performance against targets
- Green area represents the difference between standard and stretch targets
- Goals can be varied by region, market, team as required
- Performance is updated and presented in real time.
How did the UK pilot drivers perform? 

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<th>Total number of trips</th>
<th>Distance per Trip</th>
<th>Harsh breaking &lt; -4.0</th>
<th>Severe Harsh breaking &lt; -4.6</th>
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Harsh Braking per 100 trips

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

- The realm of burden and benefit
  - Measuring the safety of the system
  - Determining the economic, ethical, and risk benefit challenges
- Transport System Management
  - Fleet safety and oversight technologies and policies
  - Operations management – dispatch, congestion routing, deployment of resources, benchmarking
- Vehicle safety
  - Occupant protection design and testing
  - Vehicle performance safety
  - Vehicle and personnel human factors issues
- Dissemination and Policy
  - Knowledge transfer
  - Standards, specifications, and policy

October 29, 2009 TRB Summit

Its out there NOW

- TRB 2009 Summit – addressed the key and interdisciplinary issues, in one day – please seek that information out.
- There have been two TRB Summits held, 2008, 2009 and both with vehicle engineering and transportation systems technical expertise

Independent Technical Expertise

- The “kitchen design” is completely unacceptable and a failure in health care delivery, occupant protection and ergonomics.
- Independent technical expertise must be here and involved

What the independent technically expert occupant protection and automotive safety engineers say about our current ambulances and ‘safety’ approaches:

- “The rear compartment Death Vault”
- “The Kitchen Design must go”
- “The Kill, Kill, Kill (KKK) spec”
- “The organ donor harness system”

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.

The EMS Safety Foundation

- www.EMSSafetyFoundation.org
- 2010 Retrmbol Delegation

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The EMS Safety Foundation: A practical and functional model
Interdisciplinary and Operational and International
- Innovation
- Collaboration
- Knowledge transfer

R & D “Ripoff and Duplicate”
- Avoid reinventing the wheel at all costs
- Where are the best practices that we need to transfer knowledge from

Automotive engineers addressing EMS Safety Foundation Workshops

The science of Stretcher lifting & loading

Stretcher Load - # 1 (CNLOAD01)
EMS Safety Foundation Delegation seeking out International Innovation

RETTmobil is -
- A major European Emergency Rescue Congress, Trade show and Symposium
- Held in Fulda, Germany
- Established in 2001
- Attended by ~ 20,000 attendees
- Brainchild of Prof Peter Sefrin

EMS Responder Rettmobil 2010 Delegation

Vehicle Occupant Safety design
- European design
- Safety technology is a key focus

Safe and Ergonomic design
Flexibility to manage two patients

Patient Transferring Slides

Texas - Careflite's new vehicle

Careflite's new vehicle
Size matters.... Less than 27 inches will save your back!!!!

Which of these two vehicles would you want?
Sprinter v Ford Transit crash test
http://www.youtube.com/watch?v=C3kN6WF5vAA

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

Accessibility
Best-in-class interior compartment accessibility of any full size van

• 20 inch side step (lowest height in the segment)
• 27 inch load floor (lowest height in the segment)
• 18 3/4 inch rear bumper step pad height

Some Sprinter Features
• Premium CDI turbo Diesel engine with SCR technology to meet the EPA / CARB 2010 emission standards.
• Best in class cargo capacity
• Best in class wall-to-wall turning diameter
• Best in class available payload capability
• Superior safety standard with ABS, ASR, BAS, ESP and 3-point seat belts on all passenger seats
• Most versatile commercial van on the market

Load Adaptive Electronic Stability Program (ESP)
- ADAPTIVE ESP uses the driving angle and the wheel speeds to calculate the direction in which the driver intends to drive.
- ESP checks whether the vehicle is moving in a different direction than the driver intends.
- The ESP system can take over the steering by intervention of the engine management system or by braking the spinning wheel.

Details and Technology
- The Electronic Stability Program (ESP®) comprises the following functions:
  • EBD (electronic brake force distribution) – This system prevents the rear wheels from locking under braking.
  • ABS (anti-lock braking system) – Prevents the wheels from locking and ensures steering control while severe braking.
  • ASR (acceleration skid control) – This system regulates wheel spin by intervening in the engine management and by braking the spinning wheel. A deactivation switch allows engine intervention to be switched off at lower speeds to raise the slip threshold.
  • BAS (Brake Assist) – If an emergency braking situation is detected, this system actively increases braking pressure up to the slip threshold.

Summary:
- Enhances active safety under severe driving situations
- Improves turn-holding and directional stability by automatically adjusting for load weight.
- A warning light in the instrument cluster lights when ADAPTIVE ESP and ASR interventions are in progress.
- ADAPTIVE ESP is standard on all Sprinter models.
Details and Technology (cont.)

- **ROM (Rollover Mitigation)** – This system helps to detect rollover tendencies during maneuvers with low road speed and high lateral acceleration.
- **RMI (Rollover Movement Intervention)** – This system helps to detect rollover tendencies in dynamic maneuvers and in high-speed evasive maneuvers with a high lateral acceleration.
- **LAC (Load Adaptive Control)** – An adaptive algorithm which calculates the vehicle mass and center of gravity using various parameters such as acceleration, speed, and the accelerator position.
- **EUC (Enhanced Understeering Control)** – Provides enhanced stability under heavy under steer, for example when driving quickly through tight-radius corners.

### Load adaptive Electronic Stability Program (ESP)

- **SRS Systems**
  - **Seat Belt technology** (a most important passive safety feature)
    - The system is equipped with a 3-point seat belt on every seat.
    - Driver and front passenger seats are equipped with Emergency Tensioning Devices (ETDs) and belt force limiters.
  - **Passive Safety**
    - The Sprinter is equipped with a 3 point seat belt on every seat.
    - Driver and front passenger seats are equipped with Emergency Tensioning Devices (ETDs) and belt force limiters.
    - If a collision exceeds a preset threshold, the ETDs instantly remove slack from the seat belt. Field tests have shown that the seat belt forces on the occupants.
    - Depending on the crash severity, the electrical fuel pump and the stationary heater will be switched off. The driver and passenger doors are unlocked and the windows are opened by 2 inches.
    - The hazard warning system is also switched on automatically.

### Passive Safety - SRS Systems

- **Load Adaptive Control** – is an adaptive algorithm which calculates the vehicle mass and center of gravity using various parameters such as acceleration, speed, and the accelerator position.

### Safety first - Passive Safety

- **Front view module**
  - A main feature in a front-end collision 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, the transmission and engine will be pushed underneath front occupants.

- **Passive Safety**
  - A main feature in a front-end collision 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, the transmission and engine will be pushed underneath front occupants.

- **Fold-in ridges on subframe**
  - **Safety first** -- Passive Safety

- **Manitoba’s new fleet**

- **RMS selected to test new ambulance**

- **CEMS selected to test new ambulance**

- **RMS selected to test new ambulance**

- **Manitoba’s new fleet**
Transportation Research Board is an excellent resource… we should be using it!!

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

Collaboration and Outcomes
- Interdisciplinary Collaboration is what is key – not orthopedic folks talking to cardiologists – BUT collaboration between the health care folks appropriate automotive and occupant protection engineers and transportation system design, ergonomists and industry standards that make sense – and
- Meaningful measures of outcome and performance

Technical Collaboration is key
- We are NOT the experts in this science
- We cannot afford to play the silo game here, it is costing lives, time and money
- We MUST have a meaningful evidenced based approach to design, operations and policy
- We must be outcomes driven

this vehicle 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?

Fleet Mix?

Were we safer in the Cadillac???

Is this acceptable…?

- There are ambulances rolling out of the showroom on a daily basis – as we speak – being designed by health care providers and built by after market retrofitters, who are not at all governed as are other passenger vehicle manufacturers by the standards set by the society for automotive engineers

So what do we need to do ??

- Reach out to the appropriate experts – they sure do want to help us
- STOP being philistines and be the scientists we are trained to be and at least seek a scientific approach
- Get your heads out of the sand – there is plenty of valid technical information – FMCSA, TRB, SAE
- Make policy and purchase decisions on technically sound data, not a marketing brochure
- HAVE MEANINGFUL AND TRANSLATABLE OUTCOME MEASURES FOR YOUR SERVICES SAFETY PERFORMANCE

Risk/Hazards

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

Goals

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

**Future**

- Meaningful Goals
- New policies
- New practices
- New standards
- New vehicles
- New technologies

**Safety Management**

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

**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
- Some electronic technical devices
- Safety awareness
- Cultural change

**Conclusion**

- EMS transport has serious hazards and safety issues
- Major advances in EMS safety research, infrastructure and practice over the past 5 years
- Development of substantive EMS safety standards is a necessity and a reality
- Multidisciplinary safety issue that EMS cannot solve internally
- 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, transportation and occupational safety

**And....**

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

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Thank you!

Any Questions??

Electronic handout and resources available online

http://www.objectivesafety.net