What is the scope of EMS?

- Emergency care, public health, public safety and patient transport
- Bridge between the community and the hospital
- Volunteer – professional
- Urban – rural
- Disaster response
- Majority of transports NOT critical or life threatening

EMS Transport Surprising FACTS

- 97% are routine
- ONLY 3% are life threatening critical
- 25% there is NO Patient TRANSPORTED

Emergency Medical Service Safety

- What are the transport and other 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 and share with our international colleagues

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

EMS Safety timeline
- Didn’t know it was an issue – 60’s-70’s
- Knew it was an issue – but didn’t really know what to do – 80’s-90’s
- Safety technical data rolls out – past 10 years
- Change and adoption challenges – we are here now

Who am I?
- Nadine Levick MD, MPH
- Emergency Medicine Physician and Public Health Academic, (USA-Hopkins, Columbia SUNY & Australia – Royal Melbourne, Royal Childrens Hospitals, Royal Australian Flying Doctor Service)
- Chair, National Academies Subcommittee TRB EMS Transport Safety, USA
- Founder of EMS Safety Foundation
- Recipient, International Society of Automotive Engineers, Women’s Leadership Award for EMS Safety

12 years ago
A problem...
The baby no neck collar...

Anthropometrics

Smaller body, bigger head, shorter neck
EMS Safety Foundation

- Established in 2008 to fill a gap in
  - technical knowledge transfer
  - practical interdisciplinary R & D
  - evaluation and implementation of system safety enhancements for EMS and Medical Transport
- It is a not-for-profit institute

The EMS Safety Foundation: A practical and functional model

Interdisciplinary and Operational and International
- Innovation
- Collaboration
- Knowledge transfer

A System of Safety
Safe Systems Approach

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
- Public safety

Occupant Systems Safety
- Occupant Safety in EMS is driven by both operational and biomechanical systems.
- Systems Safety integrating these two issues is key.
- There is interaction of occupants with the system, with each other and with available seating options and vehicle interior, equipment and operational tasks.

Safety Performance
- Measurement
- Outcomes
- Technical expertise

Some new dimensions
- Vehicles – smarter, sleeker, safer – CHEAPER!
- Operations – new technology tools
- Interdisciplinary infrastructure – new global platforms

Safety of the...
- Provider
- Public
- Patient
Safety is a tool to save

- Lives
- Time
- Money

must be evidenced based

The Public Health Paradigm

1. Define the problem
2. Measure its magnitude
3. Understand the key determinants:
   a. Biologic etiology: host /agent/vector
   b. Environmental & biomechanic influences
   c. Social/behavioral practices of at risk pop.
4. Develop intervention/prevention strategies
5. Set policy/priorities
6. Implement and evaluate

Goals

- Cheaper
- Better
- Safer

EMS Transport Safety

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

In the USA 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
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.

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

In a nutshell...
- Understanding of the dangers in Ambulance Transport
- Overview of the opportunities to enhance safety

EMS Safety timeline
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Generation - Y
- Safe systems – CRM / transport system safety
- Risk perception
- Fleet and operations management
- Vehicle safety
- Scene safety
- Patient Handling
- Health and wellness
Your electronic 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

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**How do you use a QR code for the first time?**

1. Get any Tag reader App on your smartphone (free from your App store)
2. Open Tag App and scan the QR code
3. www.objectivesafety.net/PDFHO.htm
   *Form will open directly on your phone*

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**History of EMS**

- EMS is a relatively new industry
- An unusual history of beginnings within the mortician industry.
  - Early ambulances were hearse, 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

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**Sweden EMS in 1876**

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http://www.objectivesafety.net
Your Handout and Additional Resources
Transport for those in Peril - UK - 1884

Australian EMS in 1901

USA EMS in 1917

USA 1960's

USA 1980's Then....

USA 1980's Then....

And NOW!!...
1960 to 2013

A passenger vehicle - sure

A laundry or mail truck - ??

But avoid repeating old mistakes!

Innovation Now...

Equipment hard to reach
Don’t touch the left/roadside wall

EMS Expo 2012 – a booth

EMS Expo 2013 – INDEMO 1.0

Ambulance Safety Innovation Design Module 1.0
See us @booth 567

Expo 2013 – setting up @ booth 567
Ground Ambulance Transport Safety IS Complex AND Multidisciplinary

- Epidemiological Data Collection
- Risk Management
- Public Safety
- Transport Policy
- Safety Technology
- Regulations and Standards
- Driver Training
- Fleet Safety Program
- Communications Technology
- PPE
- Ergonomic Research
- Biomechanical Automotive Safety
- Biohazard/Chem Research

USA EMS Transport Safety Data Estimates

- ~ 80,000 vehicles
- ~ 9,000 crashes a year
- ~ One fatality each week
- ~ 2/3 pedestrians or occupants of other car
- ~10 serious injuries each day
- Cost estimates > $500 million annually

USA EMS

- EMS Systems - >19,000
- Personnel - ~1 million
  (~30% F/T professional & 70% volunteer)
- Vehicles - ~80,000
  (Type I, Type II, Type III, Freightliners, ?motorcycles)
- Transports - ~30 million
  (to Emergency Depts ~ 50%, < 1/3 emergent)
- Cost - ~$8 Billion annually
- Safety Oversight - ? Disparate

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

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

- Fatal crashes more often at intersections, & with another vehicle (p < 0.001)*
- 70% of fatal 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, Pirrallo RG, Kuhn EM, Prehosp Emerg Care 2001 Jul-Sep;5(3):261-9
***NIST 2003
##Ray AM, Kupas DF, Prehosp Emerg Care 2005 Dec; 9:412-415

**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

**and what is killing EMS ?**

USA 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


**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

**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

When is it safe to do what...?
- What are your policies???
  - If your patient is pink, warm and talking?
  - Are you required to notify the driver if you are out of your seat belt?
  - Are ‘routine procedures’ putting you at risk?

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

What is a survivable impact?

12 mph (20 km/hr)?
What is a survivable impact?

\[ E = \frac{1}{2} mv^2 \quad v^2 = 2as \]

~ 30 mph - survivable

~ 60 mph – not survivable

A serious problem...

Sept 9, 2013
September 7, 2013

Two injured in Wayne County ambulance crash

Medics: September 5, 2013
Southeast Missouri

Two men suffered moderate injuries Saturday when an ambulance in which they were riding ran off the road and hit an embankment, the Missouri State Highway Patrol reported.

Michael D. Hrinn, 54, and Harry Shaar, 73, both of Patterson, Mo., were passengers in a group of five who were driven by David Kern, 54, of Patterson, Mo., according to a crash report from the patrol.

The ambulance was traveling south about 6:05 p.m. Saturday on U.S. 67 two miles south of a mile north of County Road 94 in Wayne County when it ran off the left side of the road, hit an embankment and came to rest in the median, the report stated.

Irwin and Shaar were both suffered minor injuries in the crash, according to the report.

Irwin was taken by air to Saint Francis Medical Center in Cape Girardeau, and Shaar was taken by ambulance to Peppe Bluff Regional Medical Center in Peppe Bluff, Mo., the report said.

And yes, this meets KKK or NFPA

July 18, 2013

Utah Medics to Stand Trial for Traffic Death

SALT LAKE CITY — Two Utah medics are expected to stand trial in the death of a man hit by their ambulance.

The Salt Lake County Medical Examiner’s Office says 31-year-old John Martin was hit May 11 as he walked along State Road 120 near the intersection of State Road 96.

The driver said Martin stepped onto the roadway too close to where they were traveling.

June 6, 2013

Georgia EMTs and Patient Killed in Crash Involving Sami

Coffee County EMTs and a 64-year-old patient killed in collision

Your work environment!!
August 27, 2012 - NYC

2 dead when ambulance and SUV collide on Staten Island’s Hyland Boulevard

STATION ISLAND, N.Y. — At least two people were killed, one of them a 16-year-old ambulance student working as a paramedic for Staten Island University Hospital.

The crash happened on Hyland Boulevard shortly after 7 p.m., Monday, near the intersection of Vacant Avenue.

Paramedic David Restuccio killed

Fatal injuries among EMTs and paramedics, 2003-2010*

- Aircraft incidents: 34%
- Highway incidents: 32%
- Struck by vehicle: 7%
- Other transportation incidents: 7%
- Assaults and violent acts: 8%
- Other: 11%

Total = 97

* Data for 2010 are preliminary. Percents may not add to 100 due to rounding.

Source: Bureau of Labor Statistics, Census of Fatal Occupational Injuries
Science behind Policy

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

Richard P. Feynman 1988

Balance of concerns and risk during transport

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

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

The Emergency Department (ED)

An ambulance is not an ED / ICU on wheels
Neonatal transport crash
July 10, 2013
- Single vehicle collision, ran off the road
- Clear weather daytime
- No patient on board
- Non emergency
- All occupants wearing seat belts
- No intrusion
- Most other injuries minor
- Doctor killed with closed head injury
Your work environment!!

And yes, this meets KKK or NFPA

August 27, 2012 - NYC

2 dead when ambulance and SUV collide on Staten Island’s Hyland Boulevard

Staten Island, NY – A head-on collision between an ambulance and an SUV left two people dead, one of them a state trooper. The accident occurred at a paramedic for Staten Island University Hospital.

The crash happened on Hyland Boulevard shortly after 7 p.m. Monday, near the intersection of Sunset Avenue.

Paramedic David Restuccio killed

Sept 16, 2010

SUV Rips Side Off Ambulance in Deadly Maryland Crash

EMS Crew Escapes Serious Injury, Three Civilians Killed

Witnesses said the ambulance was traveling on the southernmost lane of a divided highway when it was struck by an SUV in the oncoming lane. The ambulance was transporting a patient to the hospital.

The impact was so forceful that the ambulance’s side was ripped off, and the driver and patient were thrown into the street. The driver was able to escape, but the patient died at the scene.
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 a result of a patient killed in a horrific crash involving an ambulance in Sussex County (DE) this morning.

The single vehicle crash happened around 8:30 a.m. on the I-95 off rAMP near the Lewes Rehoboth Joint company station in Angola.

The Mid-Sussex Rescue Squad ambulance was transporting a female Medical Center with a patient, 2 EMS Squad members, all 3 patients in the ambulance were seriously injured and one was transported to the hospital.

Tragically, for patient was killed as was the Sussex County EMS Paramedic, who was killed in the Line of Duty.

Sussex County EMS also suffered a severe injury last year when a Paramedic John Smith was seriously injured in a crash when a driver struck the Milford Fire Company ambulance he was riding in, while returning from a run. Additional details on this morning's crash will follow.

April 30, 2009 - Tennessee

In this vehicle...

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.
Important…

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

Nascar Safety Expert

- On ambulance patient compartment
  “It is a death vault”

Tom Gideon,
Head of Safety, GM Nascar

Goals

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

Priorities…… Research papers in the past 30 years

- EMS Safety
  - 40 papers - on ambulance safety
  - 2 papers - on ambulance ergonomics
  - 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: No longer such a New Field

- engineering
  - Turbell et al.
  - Sweden

- ergonomic
  - Levis et al., Sweden
  - Denehe, Germany

- epidemiology
  - Woodward, London
  - Calle et al.
  - National Center for Health Statistics
  - NIOSH, USA
  - Biggers et al., USA
  - Smith et al., USA

- non issue

? safe

safer
We should use the best safety practices demonstrated in engineering...in automotive safety engineering

ESV July 2009

Range of reach.. This is a well defined technical science

As well as epidemiological injury data

August, 2011

2012 EMS Safety Systems, Strategies and Solutions Summit
- One Day event, 30 presentations
- Held in Washington DC, Keck Center
- Simulcast Live to EMS Today
- Live Webinar Access - globally
- Over 100 participants live across 3 continents
- Greater that 10,000 downloads of handouts within the first week!

The 2012 TRB EMS Safety Summit
print this page & your smart phone will play the 8 sessions from the eTag! (even in B&W)
- Opening Address: A.J. Heightman
- Safety Developments Update – N. Levick
- Research needs assessment forms explained – E. Frazer
  1: Data and Recent Initiatives
  2: Transport, Human Factors - Bridging Diverse Disciplines
  3: Testing and Standards
  4: New systems safety technology solutions & telematics
  5: Fleet management strategies
  6: Innovative Vehicle Design
  7: Operationalizing Safety
  8: Panel: How to optimize the safety of your existing fleet
Wrap up – from Prof. Art Cooper

Its out there NOW
- TRB 2012 Summit – addressed the key and interdisciplinary applied solutions issues, in one day – please seek that information out. www.objectivesafety.net/TRBSummit2012.htm
- There have been two prior TRB Summits held, 2008, 2009 and both with vehicle engineering and transportation systems technical expertise

General approaches
- Policy
- Training
- Technology
- Vehicle design –chassis, interior features and layout, vehicle type
- Standards
- Learning from global best practices
- Contrast with an office chair
- Current fleet
- Future fleet

http://www.emssafetyfoundation.org/2012TRBSummitAgendawithLinks.pdf
**Safety Dimensions**
- Safe systems – CRM / transport system safety
- Risk perception
- Fleet and operations management
- Vehicle safety
- Scene safety
- Patient Handling
- Health and wellness

**Innovation**
- Collaboration
- Knowledge transfer

**Expo 2013 – INDEMO 1.0**

**Ambulance Safety Innovation Design Module 1.0**

**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
Your electronic handout/resource link

Or if you are < 30 years

www.objectivesafety.net/PDFHO.htm

Thank you!
Any Questions??
Electronic handout and resources available online
http://www.objectivesafety.net