Evolving Safety Concepts
The Cutting Edge of Innovation in EMS Safety
better, safer AND cheaper

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

EMS operations are identified to be high risk. This presentation outlines the concept of a systems engineering safety approach and innovations developed and developing to address the key determinants of the safe operation of an EMS system.

Who am I?
- Nadine Levick MD, MPH
- Emergency Medicine Physician and Public Health Academic, (USA-Hopkins, Columbia SUNY, Montefiore & 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

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
He sure did not expect to be in that situation when he started his shift that day.
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

A System of 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
Much of what you shall hear today is thanks to the work of all of those in the:

**Letter to Abe Lincoln – 1864**

re: safety of ambulance design

Almost 150 years ago and tweeted...

1864 Ambulance Design Patent and diagrams

United States Patent Office

AMBULANCE

and tweeted...
**Systems safety of:**

- Dispatching a vehicle
- Getting you, your patient and equipment to, in and out of the vehicle
- Providing patient care inside the vehicle
- Occupant protection in crash and near miss situations
- Public safety

**System Design Constraints**

- Do the clinical work that is required and essential
- Not get hurt or killed
- Not hurt or kill anyone else
  - So...
- Clinical need
- Human tolerance of injury
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?

Ambulance Transport Safety IS Complex AND Multidisciplinary

Safety of the...

- Provider
- Public
- Patient

Safety is a tool to save

- Lives
- Time
- Money

must be evidenced based

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

Safety Performance

- Measurement
- Outcomes
- Technical expertise

Safety Dimensions

- Safe systems – CRM / transport system safety
- Risk perception
- Fleet and operations management
- Vehicle design safety
- Scene safety
- Patient Handling
- Health and wellness

Some new aspects

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

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
Safer Better Cheaper is NOW

- What are the practices that are costing us
- How to identify optimal safety improvements
- How to facilitate the integration of new safer practices

Sure a Culture of Safety, but the road map to get there is the key

Safety concepts out there now

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

Communication Technology trends

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

Smartphone navigation devices


Wearable tech..

93 per cent of Jawbone users in cities < 24 kms from epicentre woke up suddenly at 3:20 a.m

jawbone.com/blog/napa-eart... pic.twitter.com/2p10rgTXRM™ @llucartes
A lot is now possible and for less!

- Driver behavior
- Vehicle behavior
- Roadside ITS
- Fuel consumption/Economics
- Resource modeling

1980’s Then…

And NOW!…

USA 1980’s Then…

And yes now…

Equipment hard to reach

Innovation Yes Now…
But avoid repeating old mistakes!

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?

When is it safe to do what...?

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

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

~ 30 mph - survivable
What is a survivable impact?

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

~ 60 mph – not survivable

A survivable impact??

A serious problem...

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

There are now places to turn for independent safety technical info and resources

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EMS Safety Systems Strategies and Solutions Summit, February 29, 2012

- What are global best practice models
- Making it happen
- How can we translate global interdisciplinary best practice initiatives to North American EMS
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!!

Safety Systems, Strategies and Solutions Summit Feb 2012

- ~50 onsite – lead representatives
- Live online participation with international representation
- 7 focus areas and a panel
- >120,000 downloads of presentation handouts
- Multi-Media ‘e-document’ with QR tags
- You tube overview

TRB EMS Safety Systems Strategies and Solutions Summit
Session 1

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
Your TRB EMS Safety Systems Strategies and Solutions Summit Multimedia Document

http://www.emssafetyfoundation.org/2012TRBSummitMultimediaWithLinksBW.pdf

Some info about the

EMSSafety
Innovation, Collaboration & Knowledge Transfer

www.EMSSafetyFoundation.org

Typical EMS Safety Foundation Webinar agenda
- Montreal IIE 2014 lessons learnt
- SETONP white paper
- INDEMO 1.0 and 2.0
- New Tech task force
- Safety Road Map project
- Applied design solutions
- Google Glass and EMS
- ASTM 1517
- OSHA Emergency Responder safety meeting
- INEMSLF and U.S. Bureau of Labor Statistics
- The EMS and Highway Safety Connection: New Website
- Evidence-Based Guidelines for Prehospital Care Published
- FICEMS 2014 Strategic Plan
- Rettmobil update
- Rettmobil LIVE! 2014 Recorded Webinar

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

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

- This is a team of like minded innovators across EMS Medical Transport and a number of technical disciplines, who share the common mission of enhancing the safety of EMS delivery for all involved by promoting and advancing EMS safety innovation, collaboration, research, knowledge transfer, education and safety information dissemination.

In a nutshell

- EMS Safety Foundation is a not-for-profit multidisciplinary virtual think tank and test bed for safety innovation and knowledge transfer
- It is a virtual network integrating the end users and the technical experts
- A tool to enhance the safety of delivery of EMS services

World Expo/EMS Safety Foundation 2012 and 2013 Safety Innovation Awards

- 12 product winners
- 4-5 special mentions
- Criteria
  - Safety Innovation
  - Practical/Usability
  - Cost Efficiency

EMS Safety Foundation Ambulance Vehicle & Ergonomics Workshop
EMS Safety Foundation
Ambulance Innovation Workshop
and Design Clinic

Session A
Vehicle Safety and Occupant Protection
Gene Lukianov

Session B
Hands-on human factors operational safety and
task analysis
Chris Fitzgerald

EMS Safety Foundation
Safety Road Map Project
focus steps in safety as a system of improvement
with milestones eg. BHP example

Safety Road Map
- Not just a conceptual model
- Must have tangible steps
- Must be systems focused
- Measurable elements
- Immediate, short, medium and long term goals
- Reward and recognition driven

Rules/Policies Addressing
Known Hazards
- Federal Motor Carrier Safety Administration (FMCSA)
  - Cell phone use – November 2011
  - Hours of Service – December 2011
Federal Motor Carrier Safety Administration - FMCSA
http://www.fmcsa.dot.gov/

Nov 2011, Hand Held Cell Phone Ban

Dec 2011, New FMCSA Hours of Service

DOT HOS Rules
- Limits established for on-duty hours
- Establishes minimum levels of off-duty time-8 hours if on duty less than 12 hours FRA or if over 12 hours then 10 hour off-duty time
- Commercial airline pilot can fly up to 100 hrs/month
- Adopts 60/70 hour weekly maximum for truck drivers, 10 hour off-duty time

Fleet Management technologies
- ACETech/Ferno
- FleetEyes – Intermedix
- Zoll rescuenet and roadsafety fleet management systems
- Marvlis
- Telematicus
- Optima
- Northrop Grumman
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

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

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

Enhancing Ambulance Operational Practice with a Systems Safety Approach

Nadine Levick, MD MPH
Research Director, EMS Safety Foundation
CEO, Objective Safety
New York, NY
This addresses some very real risks, very creatively – and currently ONLY available in London Ontario!

But Patient Safety is just one part of this system.
Are the right things being studied? Are funds being spent on the right projects?

Another concerning project
http://www.theglobeandmail.com/globe-drive/culture/technology/is-this-the-ambulance-of-the-future/article20135891/

Engineering research is different

Key Safety dimensions
- Clinical task performance
- Ergonomics/Human factors
- Biomechanics and crashworthiness

ALL THREE ARE INTERRELATED

Ebola!
**Vehicle Crashworthiness testing**

USA - 2000 research  
Europe - 2007 to meet CEN

**Full Vehicle Crash Tests**

Test 1 – Right side impact
- Target vehicle, Type I ambulance
- Bullet vehicle, Type I ambulance
- Closing speed 44 mph

Test 2 - Frontal
- Bullet vehicle, Type III ambulance
- Target vehicle, Type II ambulance
- Closing speed 34 mph

**2000 Full Vehicle Crash Testing**
Pre-impact CTD positioning

**Testing the real world**

Preparation of test vehicles

**And this all takes place in 60 millisecs – the blink of an eye**
A few key words about restraint systems...


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

Beware some provider restraint systems are dangerous

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

Leadership and Innovation

“Being responsible sometimes means pissing people off... By procrastinating on the difficult choices, by trying not to get anyone mad, and by treating everyone equally "nicely" regardless of their contributions, you'll simply ensure that the only people you'll wind up angering are the most creative and productive people in the organization.”

Innovation

New Technologies, Innovation and You!
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.

Technical Collaboration is key
And what is the loading height of your ambulance??

Size matters…. Less than 27 inches will save your back!!!!

Emergency Vehicles – Viewer Awareness

For a timely, appropriate and safe response

- Location
- Size
- Shape
- Speed
- Intended path

Policy and practice ignorant of existing technical safety data

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

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

Spectrum of dimensions
- Vehicle design innovation
- CAD
- Resource allocation
- Fleet performance –
  - Monitoring: System that gives management data of vehicle efficiency and use
  - Feedback: Directly to drivers at the wheel
- Public Alerts

Fleet Management technologies
- FleetEyes – Intermedix
- ACETech/Ferno
- Zoll rescuenet and roadsafety fleet management systems
- Drivecam
- Marvlis
- Telematicus
- Optima
- Northrop Grumman

Telematics
- How much technology and data and of what type do you need to improve fleet safety performance
Telematicus

Fleet Management capability
Vehicle database
- Individual vehicle data
- Fleet mileage collection/Checklists
- Link to other systems (SAP, Fleet)

Maintenance & Service Plans
- Repair history & Scheduling
- Action planning

Reporting
- Export to Excel for manipulation
- Scorecards views, Crystal Reports reporting
- Direct Feedback

Soterawireless & Intel’s Eric Dishman

http://www.soterawireless.com/
From Wired August 2014
This $500 Display Makes Your Junker Car Feel Like a Fighter Jet

Hot off the Press!!!
CAMTS reference entitled:
“Safety and Quality in Medical Transport Systems: Creating an Effective Culture”

Get it at Amazon

Safe Practices for Motor Vehicle Operations
ASSE/ANSI Z15.1 2012

Newly Revised ANSI/ASSE Z15.1-2012 Standard is now available.
- These practices are designed for use by those having the responsibility for the administration and operation of motor vehicles as a part of organizational operations.
Z15.1 Technical Brief

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

SAE equipment restraint

For restraint systems – not vehicle design & not based on crashworthy vehicles

International approaches
- European, non-north American vehicles have NO squad bench nor after market structural vehicle modifications that can potentially decrease crashworthiness integrity
So What is RETTmobil??

RETTmobil is -

- A major European Emergency Rescue Congress, Trade show and Symposium
- Held in Fulda, Germany
- Established in 2001
- Attended by ~ 25,000 attendees
- Brainchild of Prof Peter Sefrin
- Over 500 exhibitors, >20 Countries!

Prof. Dr. Peter Sefrin

- Prof. Dr. med. Peter Sefrin
- Chief Physician of German Fire Services Association, Würzburg Germany
- Founder of RETTmobil

EMS Safety Foundation Delegation seeking out International Innovation

Birds eye view
Thank you to Dlouhy
Clever knowledge transfer, a game changer from Dlouhy in Europe

The old expensive and not versatile and the new… Rapidly and game changing technology and cheaper, better, very versatile
This year
Challenges of change – even if it makes sense

- Innovation demonstration model, INDEMO 1.0, a new knowledge transfer tool
Ambulance Safety Innovation Design Module 1.0

www.INDEMO.info

Launched @EMS Expo 2013 – EMS Safety Foundation
INDEMO 1.0
Ambulance Safety Innovation Design Module
Safer, Better, Cheaper!

A full scale interactive physical model
change in ambulance design based on technically sound automotive and ergonomic science
improvement potential could be developed, visualized, demonstrated and evaluated.

Simplicity is the Ultimate Sophistication - Leonardo da Vinci
Designs so that you can do your work with optimum safety and efficiency.

Based on state of the art science, practice and input from the world’s leading experts in automotive safety and human factors.

Designs that are cheaper, better, safer.

EMS Safety Foundation's new demonstration Project: Ambulance Safety INDEMO 1.0

- Designs so that you can do your work with optimum safety and efficiency.
- Based on state of the art science, practice and input from the world’s leading experts in automotive safety and human factors.
- Designs that are cheaper, better, safer.
This project focused on system of safety as a central part of the operational process, not a parallel aspect. Vehicle dimension selection was based on automotive safety testing parameters, the interior layout based on integrating pilot task analyses with a range of ergonomic technical data across a spectrum from seating to reach parameters and across body size range.
youtube video
http://www.youtube.com/watch?v=q0kPYOzgNyQ&feature=c4-overview&list=UUQj31V_yV1cvdwyBETc80w
– taken as we were getting set up at EMS Expo

Even on twitter...

EMS World Expo

- 84,771 downloads of 2012’s presentation
  http://www.emssafetyfoundation.org/2012EMSEpoNewOrl
  eansHO.pdf
- Strategies and Solutions for Ambulance Transport Safety Systems
  Sep 10 2013 - Handout:
  http://www.objectivesafety.net/2013EXPOLasVegasHO.pdf
- How to Design Your Next Ambulance
  Sep 11 2013 - Handout
  http://www.objectivesafety.net/2013EXPODesignHO.pdf

Michael Hartford – Limington Fire Dept
https://www.youtube.com/watch?v=3T2fAVK_Xs

Take homes

- Technical info is key
- Invaluable info from EMS Safety Foundation
- Basic principles
  – Forward and rear facing
  – Remaining seat belted
- Design work areas around people
Other new tools we have now

Google Glass May Help Emergency Physicians Improve Patient Care

July 17, 2014

July 22, 2014

http://thehealthcareblog.com/blog/2013/10/08/why-badly-designed-ipad-apps-put-patients-at-risk/

The EMS and Highway Safety Connection: New Website
http://safety.fhwa.dot.gov/hsip/shsp/ems/connection

EMS evidence-based guidelines

FICEMS Strategic Action Plan

Science behind Policy

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

Richard P. Feynman 1988

Conclusion

- Innovation
- Collaboration
- Knowledge transfer

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

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

Key dimensions

1) safety must be inherent to operational process design
2) engagement of appropriate interdisciplinary expertise in systems design and safety analysis is essential
3) an understanding of the complex interplay between patient, provider and public safety from a systems perspective and culture is key to addressing effective and safe operational EMS performance.

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Your electronic handout/resource link

Or if you are < 30 years

This presentation handout

www.objectivesafety.net/PDFHO.htm

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Thank you!  
Any Questions??

Electronic handout and resources available online  
http://www.objectivesafety.net