

**ANNUAL CONFERENCE & EXPO 1 2014**  
 May 11 - July 3, 2014 - Palais des Congrès de Montréal - Montréal, Canada

**Modeling Healthcare Operations III**  
 Rm 516-E : 12.30

**Innovation in Operational Modeling of Ambulance Design - the INDEMO Project**

Nadine Lovick, MD MPH  
 Research Director, EMS Safety Foundation  
 CEO, Objective Safety, New York, NY  
 Ronald Rolfsen, University Oslo, Norway, EMSSF  
 Advisory Board  
 Chris Fitzgerald, CEO RMS and Director of Human Factors, EMSSF



www.EMSSafetyFoundation.org

Thanks to:



**EMSSafety FOUNDATION**  
 Innovation, Collaboration & Knowledge Transfer

www.EMSSafetyFoundation.org

and our colleagues of the  
**Innovation Consortium**



www.EMSSafetyFoundation.org

**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



www.EMSSafetyFoundation.org

**EMS Transport Surprising FACTS**

- 97% of transports are routine
- ONLY <3% are life threatening critical**
- 25% of calls NO Patient is TRANSPORTED



www.EMSSafetyFoundation.org

**We now have**

- Disruptive technologies
- Design innovation
- New tools
- Lean platforms


.... The challenge is – how to change the status quo make these viably integrated



www.EMSSafetyFoundation.org

**Why??**


**Ambulance Safety design modeling?**



www.EMSSafetyFoundation.org

**Outcomes are of concern**

- EMS operations are identified to be high risk.
- High fatality rates in vehicle crashes and decelerations
- High injury rates in patient handling in and around the vehicle.



www.EMSSafetyFoundation.org

**Some adverse outcomes**




www.EMSSafetyFoundation.org

**Key EMS Safety Dimensions**

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



www.EMSSafetyFoundation.org

### Vehicle Design Safety

This presentation covers just one aspect of the systems engineering safety approach to addressing the key determinants of the safe operation of an EMS system.



Presented by: Christopher J. Koenig, MD, MPH  
www.EMSSafetyFoundation.org

**How to design an operational environment where the EMT can safely do the work that is key to improving patient outcomes??**



Presented by: Christopher J. Koenig, MD, MPH  
www.EMSSafetyFoundation.org

### Ask the end user...?

- Well obviously YES – but they are health care providers and are trained to make do with what they have
- They know what they are required to do, and they have wish lists based on their experience – both good and bad



Presented by: Christopher J. Koenig, MD, MPH  
www.EMSSafetyFoundation.org

**BUT THEY ARE NOT TRAINED IN AUTOMOTIVE OCCUPANT PROTECTION OR HUMAN FACTORS AND ERGONOMICS!**

- user involvement is key BUT in combination with technical expertise in those specialist areas



Presented by: Christopher J. Koenig, MD, MPH  
www.EMSSafetyFoundation.org

**Core safety concepts have been clear for many years now.. And accessible to the industry gratis.. But ignored even in this setting of high morbidity and mortality**

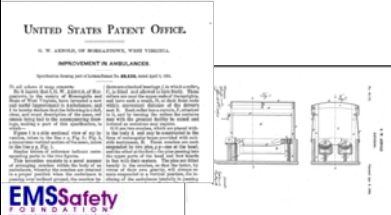


Presented by: Christopher J. Koenig, MD, MPH  
www.EMSSafetyFoundation.org

### Letter to Abe Lincoln – 1864 re: safety of ambulance design



### 1864 Ambulance Design Patent and diagrams Almost 150 years ago



### The Emergency Department (ED)



Presented by: Christopher J. Koenig, MD, MPH  
www.EMSSafetyFoundation.org

### An ambulance is not an ED /ICU on wheels



**The Laws of Physics Prevail..**

PHILOSOPHIÆ  
NATURALIS  
PRINCIPIA  
MATHÆMATICÆ

IMPRIMATUR  
S. PETRI, AP. DE FRATE  
1687

Philosophiæ Naturalis Principia Mathematica, July 1687

**EMSSafety**  
FOUNDATION

[www.EMSSafetyFoundation.org](http://www.EMSSafetyFoundation.org)

**USA 1980's Then....**

**EMSSafety**  
FOUNDATION

[www.EMSSafetyFoundation.org](http://www.EMSSafetyFoundation.org)

**And NOW!...**

**EMSSafety**  
FOUNDATION

[www.EMSSafetyFoundation.org](http://www.EMSSafetyFoundation.org)

**USA 1980's Then....**

**EMSSafety**  
FOUNDATION

[www.EMSSafetyFoundation.org](http://www.EMSSafetyFoundation.org)

**And now almost 40 years later...**

**EMSSafety**  
FOUNDATION

[www.EMSSafetyFoundation.org](http://www.EMSSafetyFoundation.org)

**Real world crash performance...**

**EMSSafety**  
FOUNDATION

**Equipment hard to reach**

**EMSSafety**  
FOUNDATION

**..cutting edge in ambulance safety**

**EMSSafety**  
FOUNDATION

**Innovation Yes Now...**

**EMSSafety**  
FOUNDATION

[www.EMSSafetyFoundation.org](http://www.EMSSafetyFoundation.org)

**EMSSafety**  
FOUNDATION

[www.EMSSafetyFoundation.org](http://www.EMSSafetyFoundation.org)

**Europe and Scandinavia**

**EMSSafety**  
FOUNDATION

**EMSSafety**  
FOUNDATION

**But avoid repeating old mistakes!**



**'Safety' approaches being driven by manufacturers claims and sales rather than by science and data**



**Key concept re: design of ambulance vehicle interiors**

- Involves interrelationship of transportation safety and the human factors and ergonomic aspects for the patient, provider and public

**There appeared to be a need for a different tool to engage and educate the end user and to be providing a platform for change within a service/industry**



Illustration © Alexander S. Kozlovsky, Tractor  
www.EMSSafetyFoundation.org



Illustration © Alexander S. Kozlovsky, Tractor  
www.EMSSafetyFoundation.org

**Ambulance Safety Innovation Design Module 1.0**

[www.INDEMO.info](http://www.INDEMO.info)



Illustration © Alexander S. Kozlovsky, Tractor  
www.EMSSafetyFoundation.org

**Based on technically sound scientific principles**



Illustration © Alexander S. Kozlovsky, Tractor  
www.EMSSafetyFoundation.org

**And what is the loading height of your ambulance??**



Illustration © Alexander S. Kozlovsky, Tractor  
www.EMSSafetyFoundation.org

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







### Innovation Design Module (INDEMO) 1.0

- 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.

EMSSafety FOUNDATION

© 2014 EMSSafety Foundation  
www.EMSSafetyFoundation.org

### Vehicle Crashworthiness Performance

Sprinter v Ford Transit crash test  
<http://www.youtube.com/watch?v=C3kN6WF5vAA&feature=related>

Sprinter V Transit Crash Test

EMSSafety FOUNDATION

© 2014 EMSSafety Foundation  
www.EMSSafetyFoundation.org

this vehicle is safety crash tested by automotive experts

EMSSafety FOUNDATION

© 2014 EMSSafety Foundation  
www.EMSSafetyFoundation.org



During impact

CTD dynamics

Impact residue

EMSSafety FOUNDATION

© 2014 EMSSafety Foundation  
www.EMSSafetyFoundation.org

### Integrated Systems Engineering

- System of safety - a central part of the operational process, not a parallel aspect

EMSSafety FOUNDATION

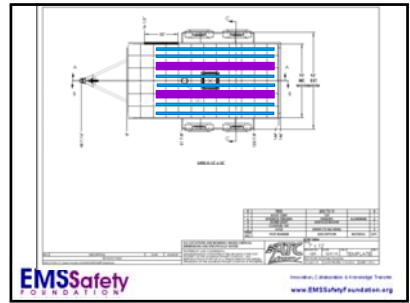
© 2014 EMSSafety Foundation  
www.EMSSafetyFoundation.org

### Process

- Vehicle dimension selection was based on automotive safety testing parameters
- 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.

EMSSafety FOUNDATION

© 2014 EMSSafety Foundation  
www.EMSSafetyFoundation.org



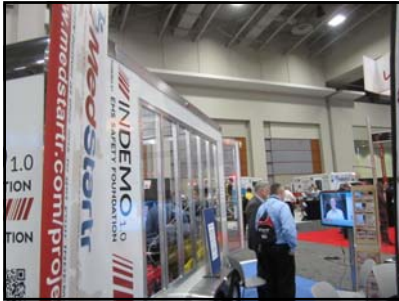


**Go to the target audience**

- Bring the INDEMO 1.0 project to EMS conferences, national and regional
- Install PTZ cameras to share the concept remotely
- Make friends with EMS Media
- Publish in scientific journals

EMSSafety FOUNDATION  
Innovative | Affordable | Knowledge Transfer  
 www.EMSSafetyFoundation.org





**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.

**EMSSafety**  
FOUNDATION

Innovation | Education | Knowledge Transfer  
www.EMSSafetyFoundation.org

**Your electronic presentation handout/resource link**

Or if you are < 30 years

[www.objectivesafety.net/PDFHO.htm](http://www.objectivesafety.net/PDFHO.htm)

**EMSSafety**  
FOUNDATION

Innovation | Education | Knowledge Transfer  
www.EMSSafetyFoundation.org

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

**EMSSafety**  
FOUNDATION

Innovation | Education | Knowledge Transfer  
www.EMSSafetyFoundation.org

**Thank you!**  
**Any Questions??**  
Electronic handout available online  
<http://www.objectivesafety.net>

**EMSSafety**  
FOUNDATION

Innovation | Education | Knowledge Transfer  
www.EMSSafetyFoundation.org