

NI EMS Conference
March 24th, 2018

The Cutting Edge of Innovation in EMS Transport Safety and You!

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CEO, Objective Safety, New York, USA
Chair, TRB, EMS Subcommittee, National Academies



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



and the National Academies of Science, Medicine and Engineering
Transportation Research Board's ANB10(5) EMS Safety Subcommittee



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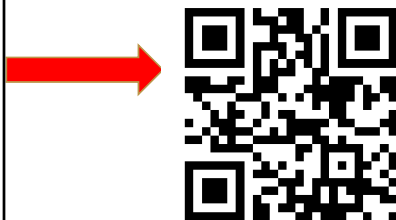
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Why are we here today

- 3,40,226 Factories in the country
- 23,090 are Major Accidental Hazard units, employing total 22,12,657 persons
- 25,173 injuries reported in 2014 of which 1,141 were classified as Fatal injuries.
- 4,275 in Indian factories 2010 and 2012 actual numbers could be at least 10 X higher
- EMS can be a safety system role model for the nation

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What are we to do today?

- Ambulance safety principles and statistics
- EMS transport safety interdisciplinary and operational issues
- Guidelines and standards distributed by national and international organizations
- Video of ambulance crash testing will highlight important predictable and preventable automotive and occupant risks and outline strategies to enhance safety.
- Safety culture, safety development, personal protective equipment, vehicle design, fleet management, transport systems and policy
- New safety systems and technologies including AI augmented dispatch, fleet telematics and drone integrated systems with a review of what is on the horizon in.

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Dr Subroto, 2018 EMS Safety Foundation Leadership Award



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Leading Change



What concepts I hope to cover this morning

- 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.

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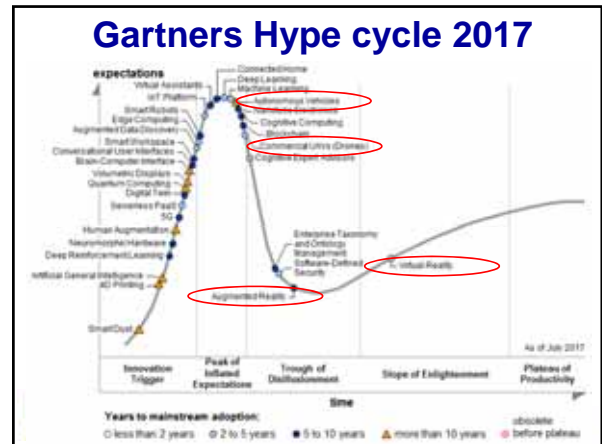
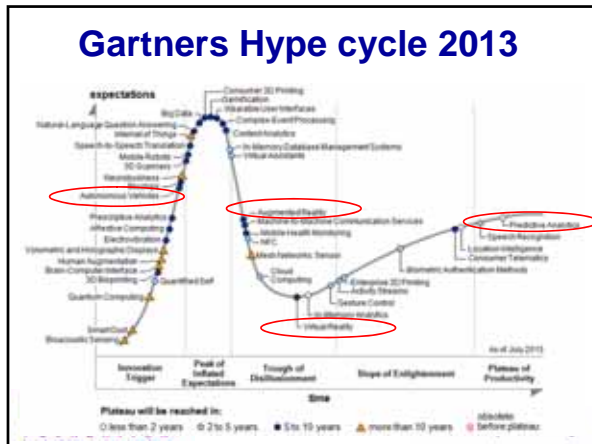
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You're also going to hear about

- Voice activated commands
- Drones
- Vertical take off vehicles
- Fleet mix
- Smart phone technology
- Wireless patient monitoring
- Connected health
- Health Information Exchange (HIE) Applications
- Virtual reality
- Artificial intelligence

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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**

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USA EMS transport safety data estimates

includes police report data* and estimates based on known data capture deficiencies

- ~ 81,000 vehicles
- upto 9,000 crashes a year
- ~ One fatality each week
 - ~ 2/3 pedestrians or occupants of other car
- ~10 serious injuries each day
 - >50% not ambulance occupants
- Cost estimates > \$500 million annually

*FARS/GES 2014 - <http://www.nhtsa.gov/Files/HealthSafety/2014/20NHTSA%20Ground%20Ambulance%20Crash%20Data.pdf>

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USA government stats.....

In the absence of a data capture system for EMS safety performance Government estimates can understate the situation

WHEN AMBULANCES CRASH
EMS Provider & Patient Safety

4,500 34% 33%

84% OF EMS PROVIDERS WERE NOT RESTRAINED

ONLY 33% WERE SECURED

SIT DOWN & BUCKLE UP!
Save Your Points, Not You or Your

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EMS work environment!!



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<25 mph - A survivable impact??



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

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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.....

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

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What is a survivable impact ?



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12 mph (20 km/hr)?

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What is a survivable impact?

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



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What is a survivable impact?

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



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~ 30 mph - survivable

What is a survivable impact?

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



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~ 60 mph – not survivable

A survivable impact??



A serious problem...

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Firstly!

■ An accident ?

■ or
a predictable and preventable
event

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Occupant protection.....??

Medic Survivors

Medic Fatality



Safety in this vehicle...?



Single vehicle crash rear compartment fatality



Safety is Good Business

Safety & Security

Safety is Good Business
Whether you are a new motor carrier just starting out or an established company with years of experience, safety is good for your business. Good safety practices can save lives, reduce injuries, and improve your bottom line. Use these links to learn more about the benefits of safety and how to achieve them.

Overview

- Getting Started with FMCSA Registration
- Industry 10 to help you meet your Safety Goals
- CCR Requirements
- What Happens if I Don't Comply With Regulations?
- Industry Best Practices

Why Safety is Good Business

Crashes are devastating in terms of fatalities and injuries, financial costs, damaged reputations, the inability to attract and retain good drivers, and general goodwill in the industry and community.


Not just a USA problem





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



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EMS Safety's frontier -

- the interface of disruptive new tech and operational practice at all levels of the EMS system and across disciplines



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So what is safety?



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So what is safety?

- condition of being protected against undergoing or causing harm, injury or loss

And.. what is innovation?

- Something new, original and more effective

Emergency Medical Services (EMS)

An important and unique transport system

- Public safety, public health and emergency service
- Is there to save lives

EMS Safety Crisis

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

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 Transport Safety

- 'patient safety'
- AND also
- 'provider' and 'public safety'

AND very different from the hospital patient safety models

Safety of the...

- Provider
- Public
- Patient

Safety is a tool to save

- Lives
- Time
- Money

must be evidenced based

Safety in EMS is INTERDISCIPLINARY

clinical practice
public health
automotive safety
impact biomechanics
human factors
fleet safety

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

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- What is new
- What is not new

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- Innovation
- Collaboration
- Knowledge transfer

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1980's Then....




And NOW!...

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USA 1980's Then....




And 2018...

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Safety challenges to address

- High per vehicle and per mile travelled fatality rates
- Vehicles essentially designed outside of the automotive safety and occupant protection arena
- Exempt from federal commercial fleet safety oversight (FMCSA) and most FMVSS
- Driven by drivers overrepresented in high risk group: under 25 years of age/male
- Dangerous driving practice: Travel at high speed and run red lights

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Challenging design related Human Factors

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Equipment hard to reach



Interior design exposes EMS to unnecessary automotive and ergonomic hazards



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'Workplace' Hazards



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



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this vehicle is safety crash tested by automotive experts



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Unlike this vehicle



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India in many ways is better positioned – and has less obstacles of ‘EMS tradition’

- Already has a very well structured Ambulance Standard
- Ambulance vehicles that are practical and efficient

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Rapid integration of innovation



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Emergency Medical Service

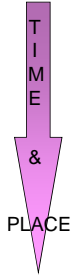
- What are the transport safety issues that pertain to this important public service and public safety industry?
- What do we know of the risks and hazards and how can we measure these ?
- How can the safety of this transport system be optimized?
- What can we learn from and share with our international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

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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



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The Emergency Department (ED)



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An ambulance is not an ED /ICU on wheels



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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

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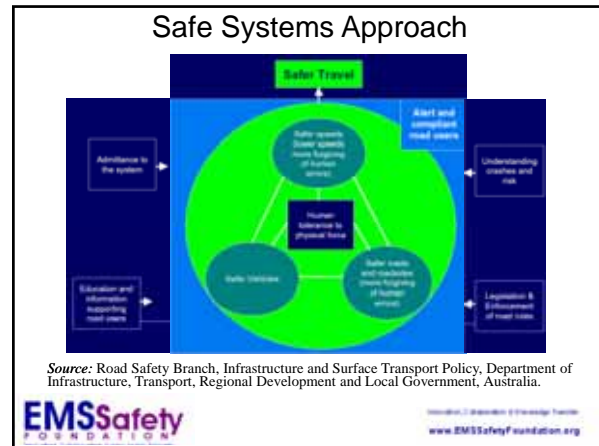
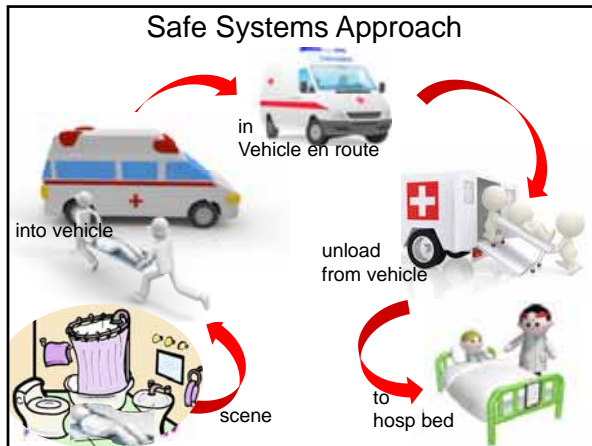
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Systems safety of:

- 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

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- ## 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
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- ## 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?
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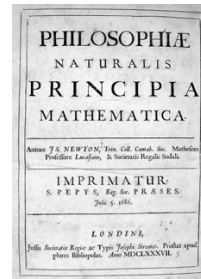
- This IS a Transportation and Automotive Safety issue

▪ Transport Medicine

Key elements to transport safety

- Impact Biomechanics
- Transport Ergonomics
- Fleet Safety

The Laws of Physics Prevail..



Philosophiæ Naturalis Principia Mathematica, July 1687

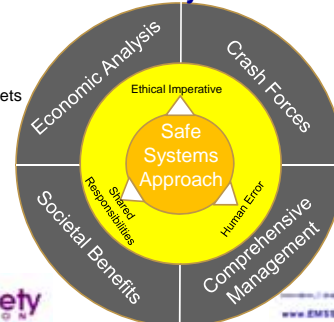
Safety Performance

- Measurement
- Outcomes
- Technical expertise

Vision Zero

A conscious decision to eliminate death and serious injuries

- Leadership
- Setting up targets
- Knowledge
- Community Engagement



Suboptimal design and practices result in bad outcomes for health care delivery and EMS service safety

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A tragic emergency health care intervention outcome



Rollover Crash Kills Medical Technician

Ambulance Runs Off I-66 and Rolls Over, Injuring Two Employees and a Patient

By Don Wertz
A medical technician was killed and two employees were injured when an ambulance rolled over on Interstate 66 in Maryland on Tuesday. The ambulance was carrying a patient when it rolled over. The crash occurred on the northbound side of the highway. The ambulance was traveling southbound when it rolled over. The crash occurred at approximately 10:30 a.m. on Tuesday. The ambulance was carrying a patient when it rolled over. The crash occurred on the northbound side of the highway. The ambulance was traveling southbound when it rolled over. The crash occurred at approximately 10:30 a.m. on Tuesday.

It does happen....

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But what about head protection?



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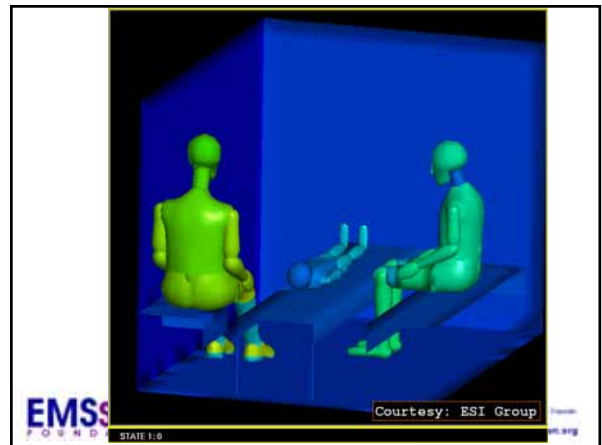
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Testing the real world



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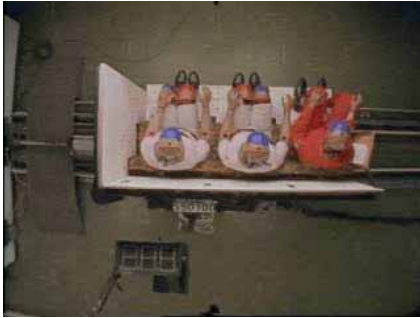
**A harness is NOT a solution
it will just break your neck at
speeds that you would
otherwise not have an injury**

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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

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Beware some provider restraint systems are dangerous



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

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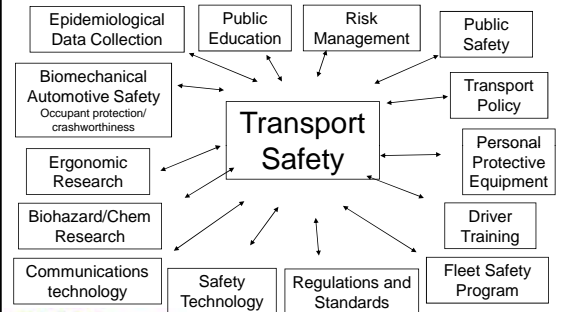
Being seated IN an automotive seat is what will protect you

- Anything that allows or encourages you to get up out of your seat will also encourage you to be injured or killed – it is potentially lethal to be out of your seat in any fashion
- 4 or 5 point harnesses over both shoulders for sidefacing occupants are potentially lethal – and in **NO WAY SUPPORTED BY ANY DATA OR INDEPENDENT AUTOMOTIVE SAFETY EXPERTISE**

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Ambulance Transport Safety IS Complex AND Multidisciplinary



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Optimize the safety of your present environment

- Wear your seat belts – remove only for critical intervention and notify the driver
- Secure all your equipment effectively
- Minimize use of risky driving practice
- Don't run red lights!!!

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Design solutions to minimize provider hazard

- Optimized design of ambulances so you can reach your patient and equipment without getting out of your seat
 - Forward and rear facing seating
 - A laterally sliding stretcher platform
 - Equipment stored on the curbside wall

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Safety concepts out there now

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

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Core aspects

- Ambulance transport safety "is part of a system"
- Patient safety...and provider and public safety too!
- New developments and safety initiatives
- Need for measurement for safer performance
- Creating a 'culture of safety' thru awareness, training, design, technology and incentive.

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Goals

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

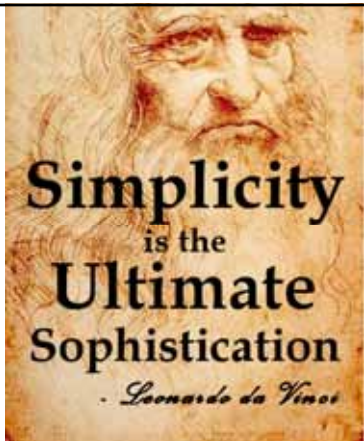
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Innovation

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Clever innovation can be very simple, yet cost efficient



Malaysian Ambulances

- Modern automotive vans
- No disruption of vehicle integrity
- Clever and data driven interior layout
- Structured system of policy

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<http://www.rettmobil.org/index.php/en/>

RETTmobil 2014

RETTmobil 2014 is a European initiative for emergency services and rescue services. It is a platform for sharing information and experiences between emergency services and rescue services across Europe.

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Sharing new approaches and technologies

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Patient Transferring Slides



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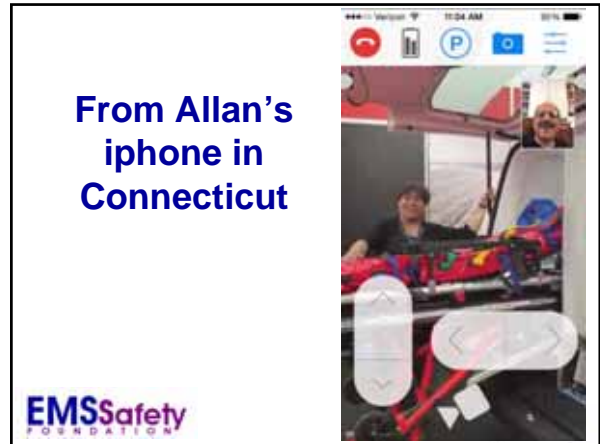
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Clever knowledge transfer, a game changer from Dlouhy in Europe



The old expensive and not versatile

and the new...

Rapidly and game changing technology and cheaper, better, very versatile



**Ambulance Safety Innovation
Design Module 1.0
www.INDEMO.info
the future concepts you can
have right now!!!
*Better, safer and cheaper***



Based on technically sound scientific principles

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Big Data and Mobile Health

U.S. Department of Health & Human Services
NIH National Institutes of Health
 Office of Behavioral and Social Sciences Research

METHODOLOGY
 Community Based Participatory Research
 Systems Science

Big Data Opportunities and Challenges in Mobile Health (KDD 2014)

Workshop Agenda
 Workshop Agents

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HIMSS 16

Conference & Exhibition
 FEB 29 - MAR 4, 2016 | LAS VEGAS

TRANSFORMING HEALTH THROUGH IT

HIE Applications in Emergency Medical Services Settings
 March 2, 2016

Rich Lewis, EMS Review Chair, South Metro Fire Rescue
 Dr. Mark Prather, CEO, Dispatch Health and Board Member, CCARMS

dispatch
 HEALTH

#HIMSS16
 www.HIMSSconference.org

Chief Rick Lewis – South Metro Fire Rescue

Agenda

- Review patient care and operations inefficiencies
- Introduce the CORHIO health information exchange
- Discuss how EMS is using HIE for clinical decision-making, quality improvement programs, staff training and changes to 9-1-1 protocols
- Review results: cost savings and new models of emergency care
- Answer your questions

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Wearable tech..

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<http://www.visimobile.com/visi-product-info/>



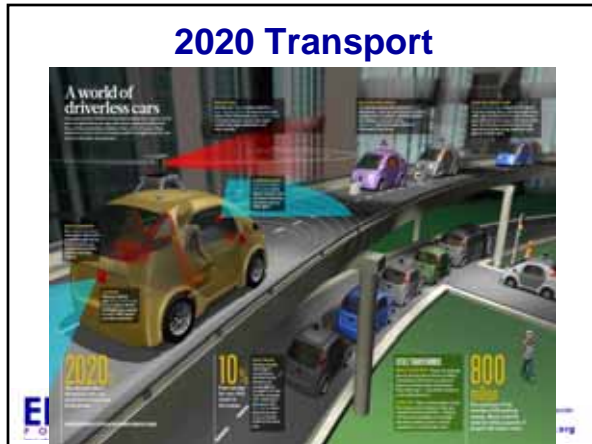
Clever fleet management tools

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2020 Transport



Unique regional traffic flow challenges

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Regional connected/ autonomous vehicle challenges



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AI and EMS Dispatch



www.EMSSafetyFoundation.org

www.iRescu.info



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Virtual Reality - EMS Education



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SAE: Future Vehicles



Connect with the leading technical authorities from government, industry, and academia LEARN MORE



SAE 2015 Government/ Industry Meeting

January 21-23, 2015
Marriott Marquis Convention Center
Washington, DC, USA

Future vehicles: integrating safety, environment and the Technology

Understanding how technology, regulations and legislation will affect the design of light and heavy-duty vehicles in terms of safety, environment and energy consumption is essential to vehicle development. This forum will provide opportunities for technical authorities from government, industry and academia who are leading advanced automotive technology, regulations and pending legislation to address issues that will influence future decision making for those within the industry. *Stacy Mott*

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The ambulance response vehicle of the future?




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And even now AED Drones!

Ambulance Drone Delivers Defibrillator by Air (VIDEO)



Automatic external defibrillators (AEDs) are like a common sight at airports and sports arenas, but they're not always easy to bring ubiquitous. Aed Infront, a graduate industrial design student at TU Delft University in Holland, developed a drone with a built-in defibrillator that can quickly fly exactly to where it's needed.



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Unmanned Ambulance drones



FlyPulse
ambulance

FlyPulse
@FlyPulseNL

Developed drone systems for medical emergencies

© 2014 Techlab
Hilversum - Veld College
Tilburg - Ponsse
Candice - Rob-Info

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Manned Drones





designboom

agol's drone ambulance quickens emergency responses

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eHang passenger drone



? The ambulance of the future

First passenger drone makes its debut at CES

Chinese entrepreneur brings their one-person craft, which is controlled by satellite and capable of flying through, to the world's technology convention



Passenger drone unveiled by eHang at CES

A Chinese company unveiled a world first on Wednesday by unveiling a drone capable of carrying a human passenger.

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Urban Aeronautics – vertical take off drone



startup Urban Aeronautics is developing an unmanned flying ambulance called the "AirMule" that combines the in-and-out agility of a helicopter with the ability to perform rescue in dense urban environments that are difficult to maneuver through in a rotor-based vehicle.

E In a post last month, Gizmodo's Andrew Tanenholz described the vehicle's capabilities.

The Urban Aeronautics "AirMule."

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AirMule drone ambulance makes maiden flight

Autonomous ambulance that took its first controlled flight is found to be capable of landing in areas that helicopters can't, and will be able to assist two people



A drone ambulance designed to assist two people has taken autonomously to the air for the first time.

The vehicle, which can take off and land vertically, is designed for conditions where landing a helicopter is unfeasible – such as on a rooftop. The drone, made by Israeli company TerraTech Robotics, has been tested multiple times, but is designed to carry up to a single person in a cabin.

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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

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What do we know works...

- Tiered dispatch
- Vehicle Operations Safety Policies
- Forward and rear facing seating
- Laterally sliding stretcher
- Securing equipment
- Validate/Integrate disruptive technologies
- Fleet management electronic technical devices
- Safety awareness
- Cultural change

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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

Conclusion

- 1) Safety must be inherent to operational process design
- 2) Engagement of appropriate interdisciplinary expertise in systems design, transport safety human factors 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.