

**TRB EMS Subcommittee ANB10(5)**

# **EMS Safety Summit 2012**

## **Safety Systems, Strategies and Solutions**

**Bridging Ergonomics, Operational Task Analysis and Automotive Safety**

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# Bridging Ergonomics Operational Task Analysis and Automotive Safety

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# Bridging Ergonomics Operational Task Analysis and Automotive Safety

- **Definitions**
- **Automotive Safety Technology**
- **The Ambulance Challenge**
  - **Bridging the Gap**
  - **Opportunities**



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# ERGONOMICS

- **Ergonomics** is the study of designing equipment and devices that fit the human body, its movements, and its cognitive abilities.

The International Ergonomics Association defines ergonomics as follows:



- Ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance.
- Ergonomics is employed to fulfill the two goals of **health and productivity**
- It is relevant in the design of such things as safe furniture and easy-to-use interfaces to machines and equipment. Proper ergonomic design is necessary to prevent repetitive strain injuries, which can develop over time and can lead to long-term disability.

# AUTOMOTIVE SAFETY

"Active safety" is used to refer to technology assisting in the prevention of a crash

"Passive safety" refers to technology of the vehicle (primarily airbags, seatbelts and the physical structure of the vehicle) that help to protect occupants during a crash



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# ACTIVE SAFETY

AVOIDS THIS:



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# ACTIVE SAFETY PREVENTS THIS:



# SAFETY TECHNOLOGY

## Active Safety Technology

- ESC: Electronic Stability Control / Rollover Prevention
- Antiskid Brakes maintain control while braking
- Brake Assist Systems prevent or reduce the severity of collision.
- Adaptive cruise control maintain a safe distance from the vehicle in front
- Lane departure warning systems alert the driver of an unintended departure from the intended lane of travel
- Tire pressure monitoring systems
- Traction control systems restore traction if driven wheels begin to spin
- Infrared night vision systems
- Adaptive headlamps
- Reverse backup sensors, which alert drivers to difficult-to-see objects in their path when reversing
- Backup camera

**Electronic Stability Control (ESC):**  
Maintains vehicle control

**Advanced Head Restraints:**  
Reduce potential head/neck injuries in crashes

**Advanced Frontal Air Bags:**  
Protect in frontal crashes, shielding the driver's and front passenger's head, neck, and chest

**Lane Departure Warning (LDW):** Monitors lane markings on the road and cautions driver of unintentional lane drift

**Side Air Bags and Curtains:**  
Protect in side crashes shielding a passenger's head, neck, chest, and pelvis

**Safety Belt Load Limiter and Safety Belt Pretensioner:**  
Absorb crash energy and tighten belts to restrain occupants

**Forward Collision Warning (FCW):**  
Detects vehicles ahead, cautioning drivers of impending collisions

## Pre-crash Safety Technology

- Seat Belt pre-Tensioner
- Automatic Braking



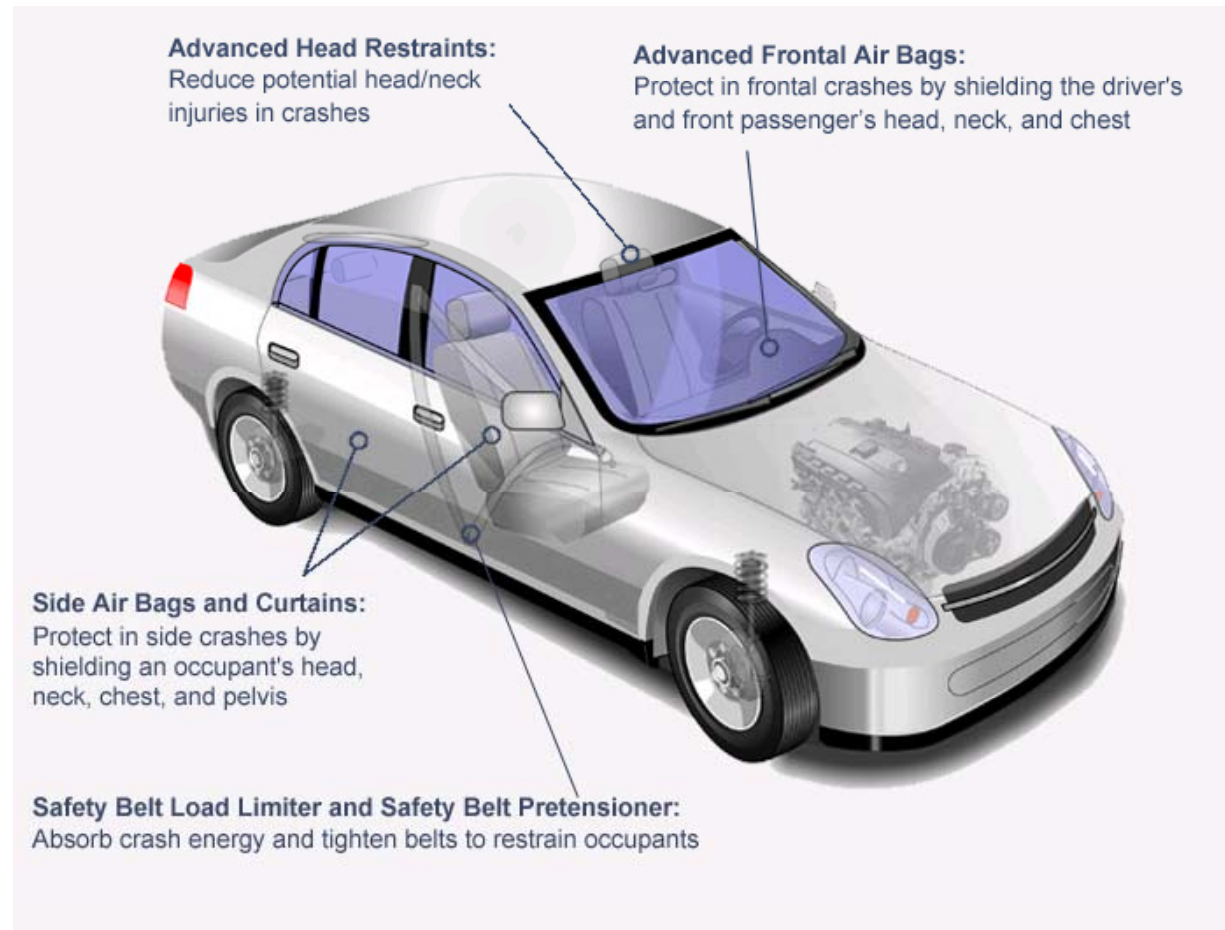
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# SAFETY TECHNOLOGY

## Passive Safety Technology

- Seatbelts
- Airbags
- Laminated windshields.
- Passenger Compartment Safety Cell
- Vehicle Crumple zones
- Side impact protection beams
- Collapsible steering columns
- Door Latch and Hinge Systems
- Pedestrian protection systems
- Impact Friendly Interior Surfaces
- Cargo Restraints



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# DESIGN for SAFETY

Well Defined Occupant Positions

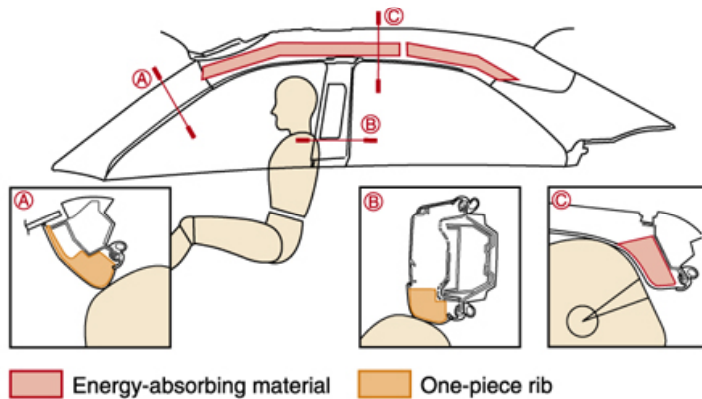
Highly Refined Interior and Vehicle Design

High Volume Manufacturing

50,000 – 200,000+ Vehicles

High Capital Investment

Testing and Certification Processes



Courtesy Toyota

## HEAD INJURY CRITERIA

$$HIC = \left[ \frac{1}{(t_2 - t_1)} \int_{t_1}^{t_2} a dt \right]^{2.5} (t_2 - t_1)$$

# The Ambulance Challenge

- Small Manufacturers
- Minimal Research Funding
- Working Environment
- High Stress Situations
- Many possible Tasks
- Equipment and Materials on Board

# AMBULANCE DESIGN

Emergency Room on Wheels

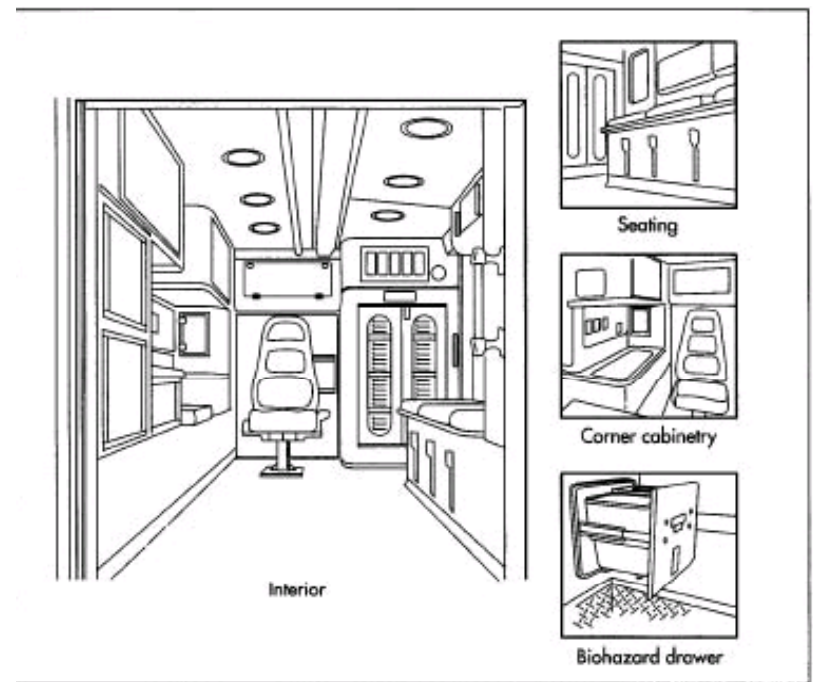
Large Variation of Medical Incidents

Large Variation in Occupants

Low Volume Manufacturing

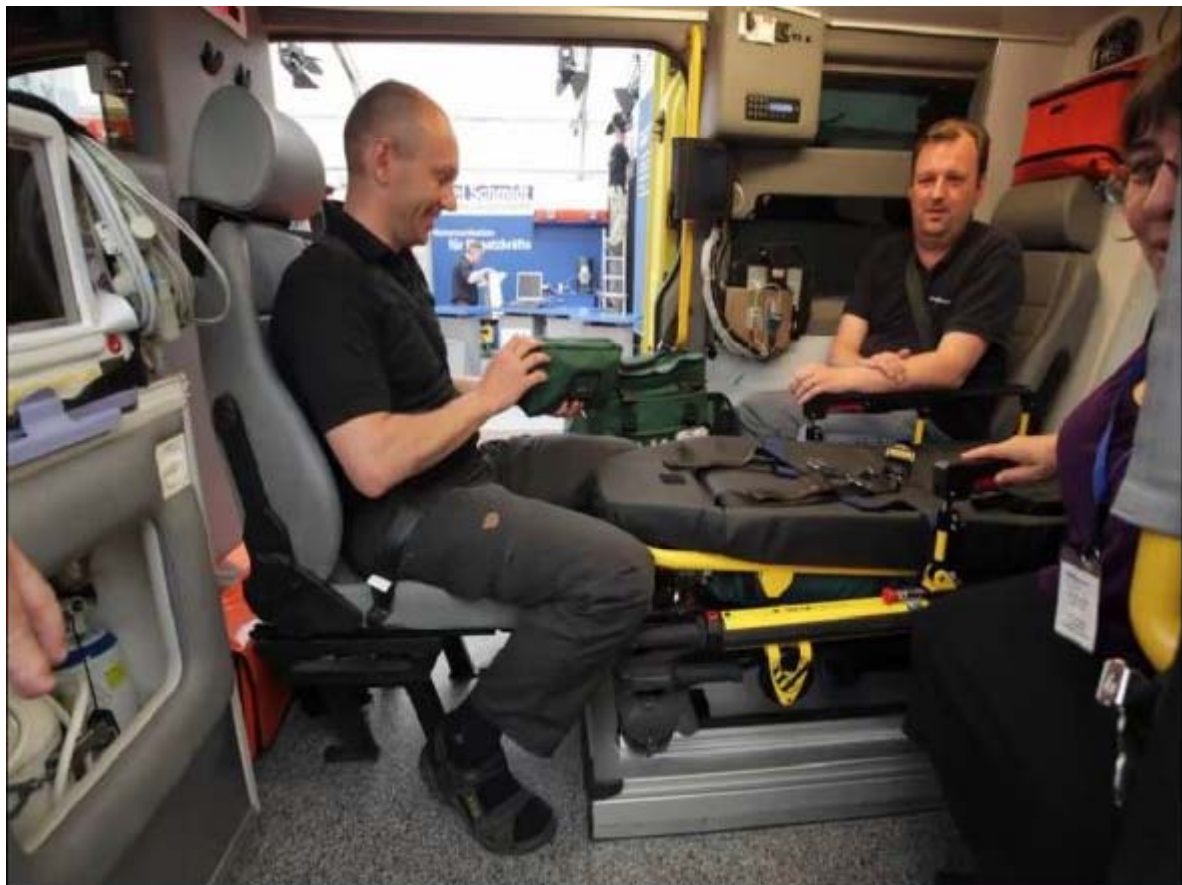
50 - 500 vehicles

Low Capital Investment



# AMBULANCE DESIGN CHALLENGE

Seated and Restrained, But can you get the job done?



Courtesy of AmbulanceRanger

# BRIDGING the GAP

## BASIC PRINCIPLES: ERGONOMICS

## BASIC PRINCIPLES: AUTO SAFETY

Maintain Health (Safety) and Productivity

- Bio Metric Range of Customers
- Seated when traveling

Prevent Accidents, Minimize Consequences

- Bio Metric Range of Customers
- Seated when traveling

- Task Analysis / Performance
  - Provide resources required
  - Appropriate reach / motion
  - Appropriate strength
  - Maintain task forces below injury levels
    - Repetitive events

- Passive Safety
  - Restrain occupants in seats
  - Maintain seat integrity
  - Maintain passenger compartment Integrity
  - Minimize deceleration forces
    - Provide crush zones
  - Provide friendly surfaces at impact zones
  - Maintain force levels below injury levels
    - Singular events



# OPPORTUNITIES

- Attendant / Patient / Gurney Relationship
- Operator Support Systems
- Interior and Equipment Storage Systems
- Operating Factors

# •Attendant and Patient/Gurney Relationship



Attendant may not be able to get close to patient

No room for attendant's legs below gurney

Attendant must face forward and work sideways

Attendant restraint may suffer



# Operator Support Systems



Bio-Impact friendly hand grips

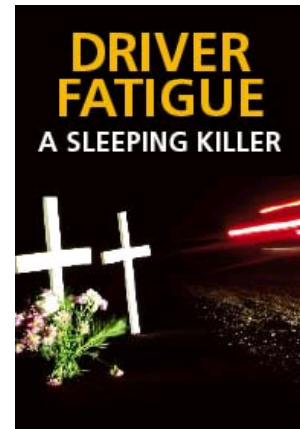
# Interior and Storage Systems



Interiors designed for Ergonomics and  
Bio-Impacts

# Operating Factors

- Operator Fatigue leads to Accidents
  - Work Rules allow long shifts



- “Lights and Siren” Attitude leads to Accidents
  - Philosophy, Training, Policy, Enforcement



**QUESTIONS?**

**THANK YOU!**