Ambulance Technology and Standards Update – Part II

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National Institute of Standards and Technology (NIST)
GSA Motor Vehicle Management Value Proposition

Right Vehicle  Right Price  Great Service

and the data required to effectively and efficiently manage a fleet
Ambulance Patient Compartment Design Standards

2015 Federal Fleet Management Conference & Training
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Agenda

• Project Background
• Overview of Effort
• Impacts to Community
DHS Science and Technology

- DHS First Responder Working Group meeting Sept 2009
- **First Responder Capability Gap identified:** Standardized Construction and Design Standards in Ambulances for EMS personnel safety
- Reached out to NIST in Jan 2009 for expertise in systems engineering and human factors
EMS Need

- Inherent conflict between need to care for patient and personal safety while in moving ambulance
- High injury risk to both EMS worker and patient during accidents
- Recognized need for better patient compartment design with respect to EMS performance and safety
- Lack of data-based standards that address human performance and safety
Project Goal

Goal: Provide foundation for a uniform standard for ambulance design and construction based on scientific data.

Address
- Worker performance, ergonomics
- Worker and patient safety

Deliverables
- Input to Standards Organizations (e.g., NFPA, CAAS)
- Design Guidebook
- Demonstration Ambulance
Project Partners and Roles

• Duration: April 2011 – September 2014

• Partners:
  – **Department of Homeland Security** (DHS) **Science & Technology** (S&T) **Resilient Systems Division** (RSD) and **First Responders Group** (FRG): Sponsor
  – **BMT Designers & Planners** (D&P): Human factors design requirements, concepts for user interfaces, compartment arrangement and layout
  – **National Institute of Standards & Technology** (NIST): Requirements analysis and developing/evaluating design concepts through modeling and simulation
  – **National Institute for Occupational Safety and Health** (NIOSH): Developing and testing concepts for ambulance crashworthiness
PROJECT OVERVIEW

- User Research
- Nationwide Web Survey
- Focus Groups
- Workshop
- Requirements Analysis
- Design Concept Development & Evaluation
- Finalize Design Requirements
Requirements Gathering Process

User Research
- Literature survey
- Ride-alongs
- Interviews
- Standards gap analysis

Focus Groups
- Manufacturers
- Practitioners

Nationwide Web Survey
- 2537 EMS Workers, Trainers

Workshop
- Practitioners
- Practitioner Organizations
- Government Agencies

Issues for focus group moderator guide
Inform survey questions
Initial design requirements
Validate survey results, prioritize requirements
REQUIREMENTS ANALYSIS
Requirements Analysis

• **Design needs** - high level patient care performance and EMS/patient safety goals identified by EMS user community or through human factors engineering analyses.

• **Design requirements** - functions, capabilities, or support that will satisfy or fulfill the need. E.g., “Equipment and controls are operable by the EMS provider while seated and restrained.”

• **Design criteria** - specific elements of design that support the fulfillment of a design requirement. There may be several criteria per requirement, with each addressing a specific element of the requirement. Often standards-based.
Design Needs

• Seating
  – Easily access the monitor and controls
  – Easily access equipment, supplies, and medicines
  – Enable seat positioning to provide adequate eye contact with the patient
  – Ride and perform all tasks in “ergonomically safe” manner

• Restraint systems
  – Buckle and unbuckle easily
  – Access patient while remaining restrained
  – Access monitor, equipment, and medicine while restrained
  – Perform patient care safely while restrained

• Working environment
  – Transport and care for more than one patient
  – Allow appropriate lighting
  – Allow appropriate communication
  – Have enough power for equipment
  – Secure equipment while keeping them accessible
  – Have enough working room
  – Safe and easy access and egress
  – Avoid sharp edges and corners
Design Assumptions

- Designs are based on requirements and criteria
- Design is not “standard” and only serves the purpose of visualizing optional layouts
- One patient on cot
- Curbside & roadside seats on track
- Cables, tubing, & leads are routed along wall/ceiling
- Design does not necessarily address crashworthiness
- CPR/intubation cannot be performed while seated
- IV bag will be hung prior to transit
- Curbside workstation is the primary medic seat
- Jump bags are the primary storage for immediate care items
Conceptual Design – Helps to Validate Design Requirements
Roadside Seat
Curbside Seat
Key Human Performance Requirements

• Use the human performance requirements to drive the design.

• The EMS provider shall be able to reach the patient’s body from head to knee while in a seated and restrained position.

• The EMS provider shall be able to reach common and critical equipment/supplies from a seated and restrained position.

• The EMS provider is able to face and interact with the patient while in a seated and restrained position.
Computer Simulation Analysis

• Create virtual model of new design concepts
• Virtual human models replicate patient care tasks
• Used 5% female through 95% male mannequins
• Benefits
  – Eliminates the need to construct physical prototypes
  – Allows for the evaluation of many design concepts faster, cheaper
Modeling with Mannequins
Design Concept & Evaluation Process

- Design Requirements
- Design Concept
- Design Evaluation
- Computer Simulation
- Design Modeling
Focus Groups

Nationwide Web Survey

Workshop

Requirements Analysis

Design Concept Development & Evaluation

Finalize Design Requirements

User Research
Standards Input

• NIST had 46 items accepted (including editorial recommendations) to NFPA 1917, 2nd edition.
  – Items focused on reachability of patient, equipment, supplies and controls (e.g., HVAC)
• NIST contributed input to CAAS GVS-2015. Currently reviewing version out for public comment.
Guidebook

- Ambulance Design Guidebook covers best practices, recommendations, and ergonomics.
  - **Final, pending release by DHS**
  - Intended to be a practitioner guide and not a standard
  - Covers user-defined process, steps to take to develop design requirements and basic systems engineering
  - Also addresses some best practices or recommendations in the following areas:
    - Equipment layout and workflow
    - Lighting, noise, HVAC
    - Storage
    - Ingress/egress (patient and EMS worker)
    - Labeling
    - Communications and information technology
    - Restraints and seating
    - Surfaces and materials (incl. decontamination)
FEMA Demonstration Ambulance

- Using guidebook to design their next ambulance at one of their locations
  - Using requirements/design process
  - Using best practices included in guidebook
  - Parts of process will be filmed for NIOSH informational DVD
  - Helped NIST and D&P refine guidebook from a practitioner perspective

- Incorporating reachability and ergonomic work by NIST and D&P
  - NIST and D&P helped them come up with the requirements and potential design elements to help with their design specification

- Design will incorporate results of crashworthiness work conducted by NIOSH (i.e., SAE standards)

- FEMA will own ambulance, but will be showcased by DHS at future expos for first 6 months
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Questions?
GSA Motor Vehicle Management Resources

- GSA Fleet Drive-thru and Training
- Consolidate Your Vehicles With GSA Fleet
- Short Term Rental Program
- Dispatch Reservation Module
- Federal Fleet Management System (FedFMS)
- Car Sharing
- Alternative Fuel Vehicle Guide
- WEX Station Locator / DOE Station Locator
- 2015 FFMT Presentations