



Ambulance Patient Compartment Design Standards

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Presentation Goals

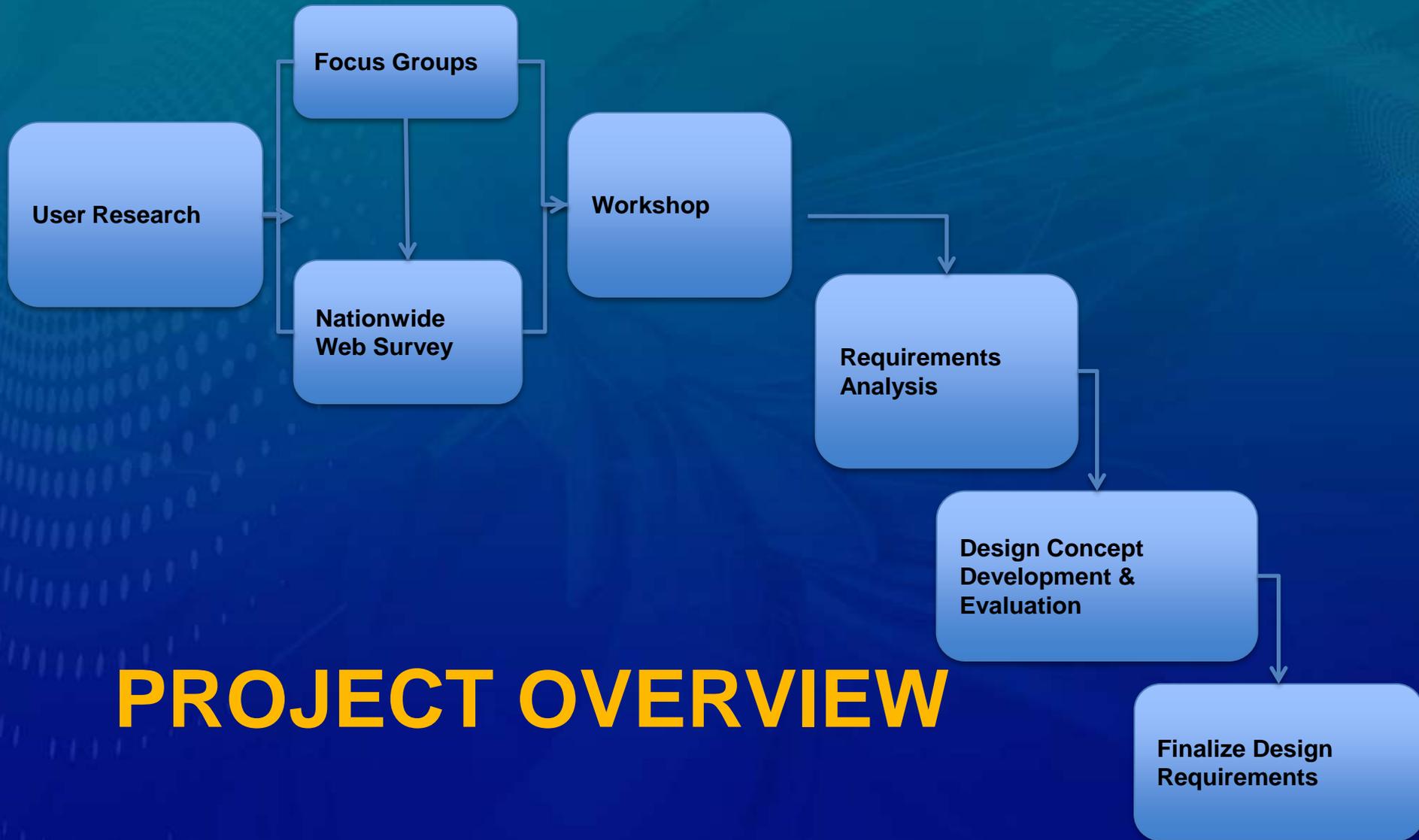
- Provide background on what we have done to date
 - Work leading up to submission to NFPA 1917
- Update on guidebook effort



Project Partners and Roles

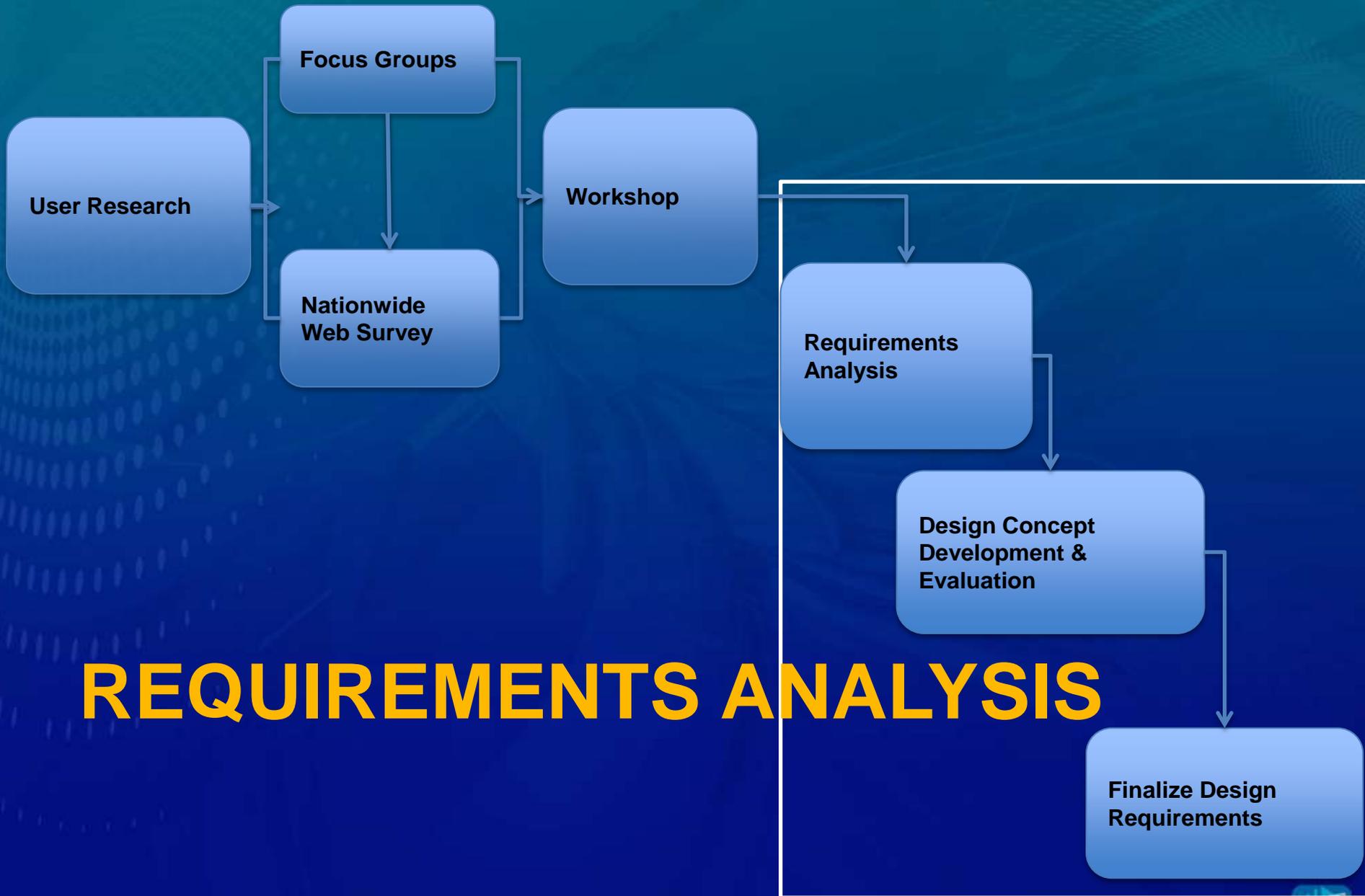
- Duration: April 2011 – September 2014
- Partners:
 - **Department of Homeland Security (DHS) Science & Technology (S&T) Resilient Systems Division (RSD) and First Responders Group (FRG):** Sponsor
 - **BMT Designers & Planners (D&P):** Human factors design requirements, concepts for user interfaces, 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





REQUIREMENTS ANALYSIS

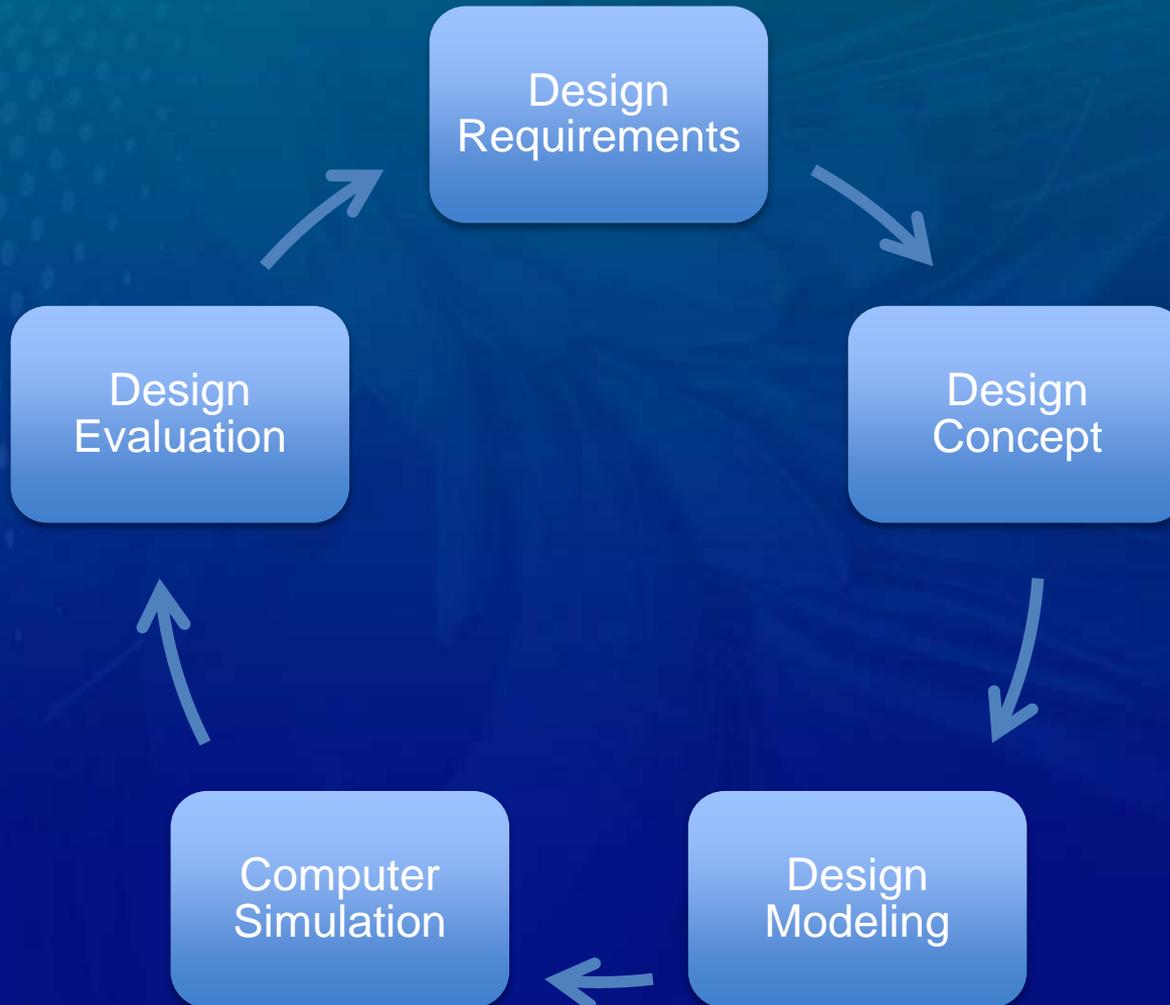


Requirements Analysis

- **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 Concept & Evaluation Process



Key Human Performance Requirements

- 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.

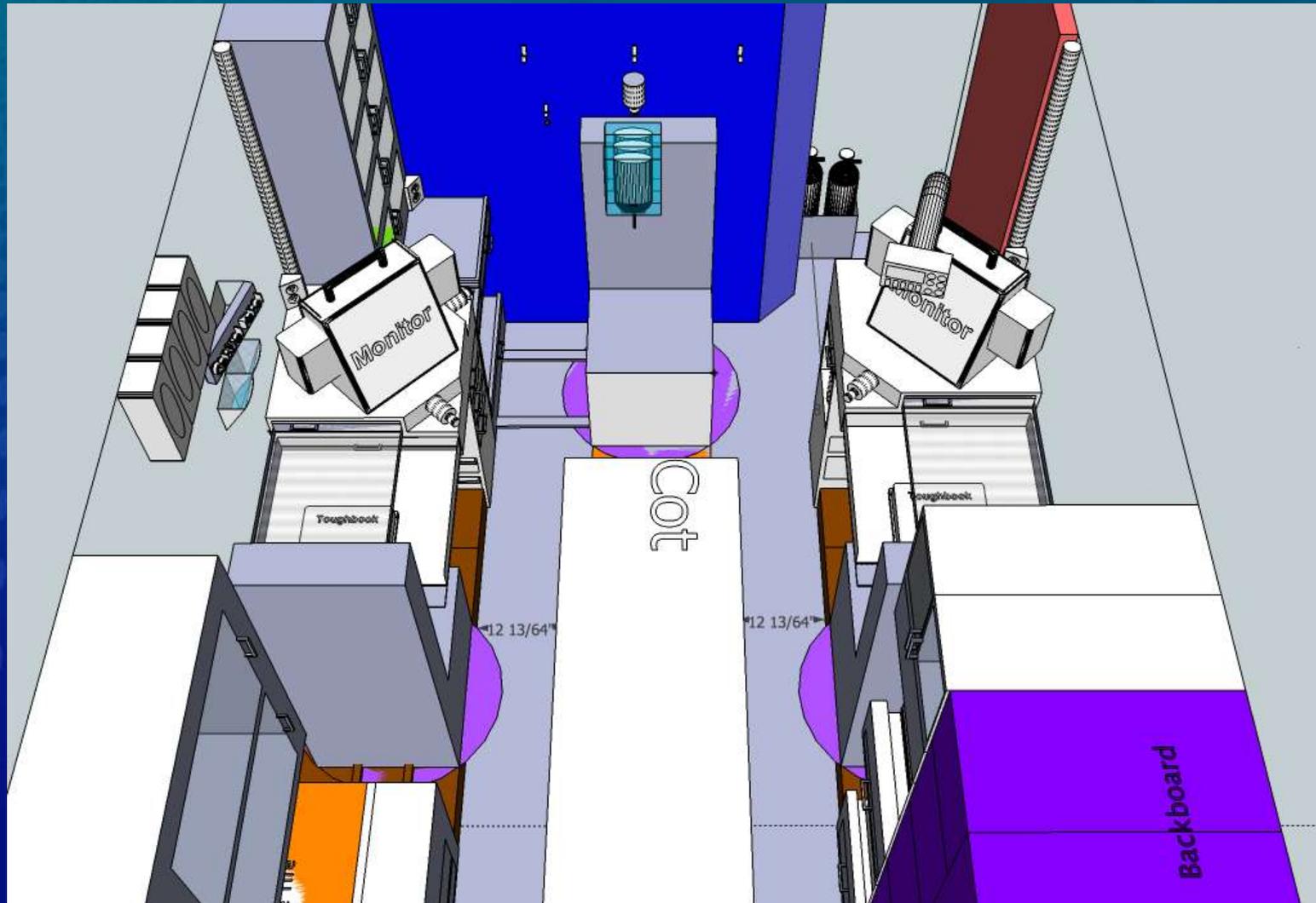


Design Assumptions

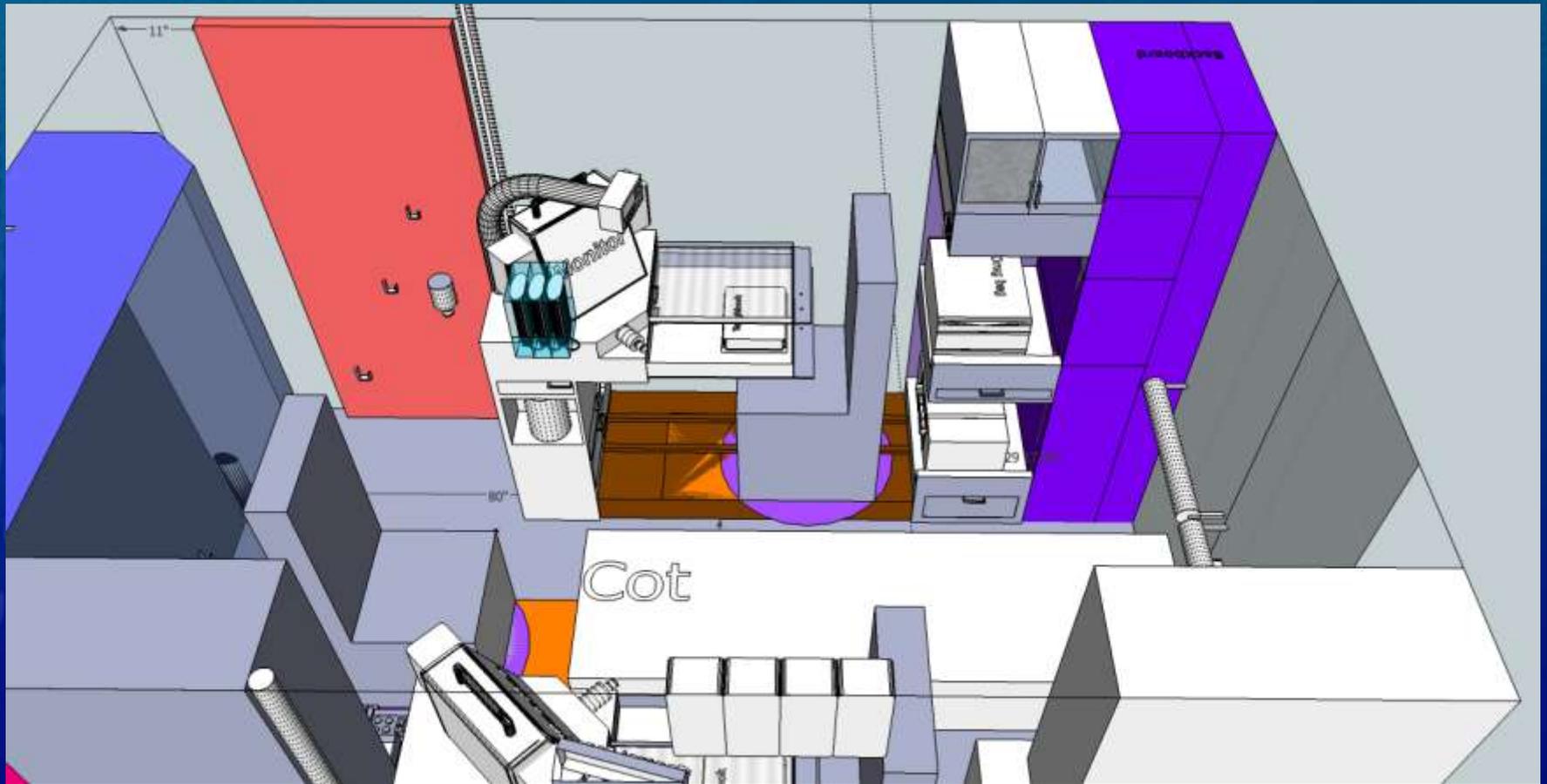
- Designs are based on requirements and criteria
- Design is not “standard” and only serves the purpose of visualizing optional layouts
- One patient on cot, one stable back boarded patient
- Curbside & roadside seats on track
- Cables, tubing, & leads are routed along wall/ceiling
- Design does not 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



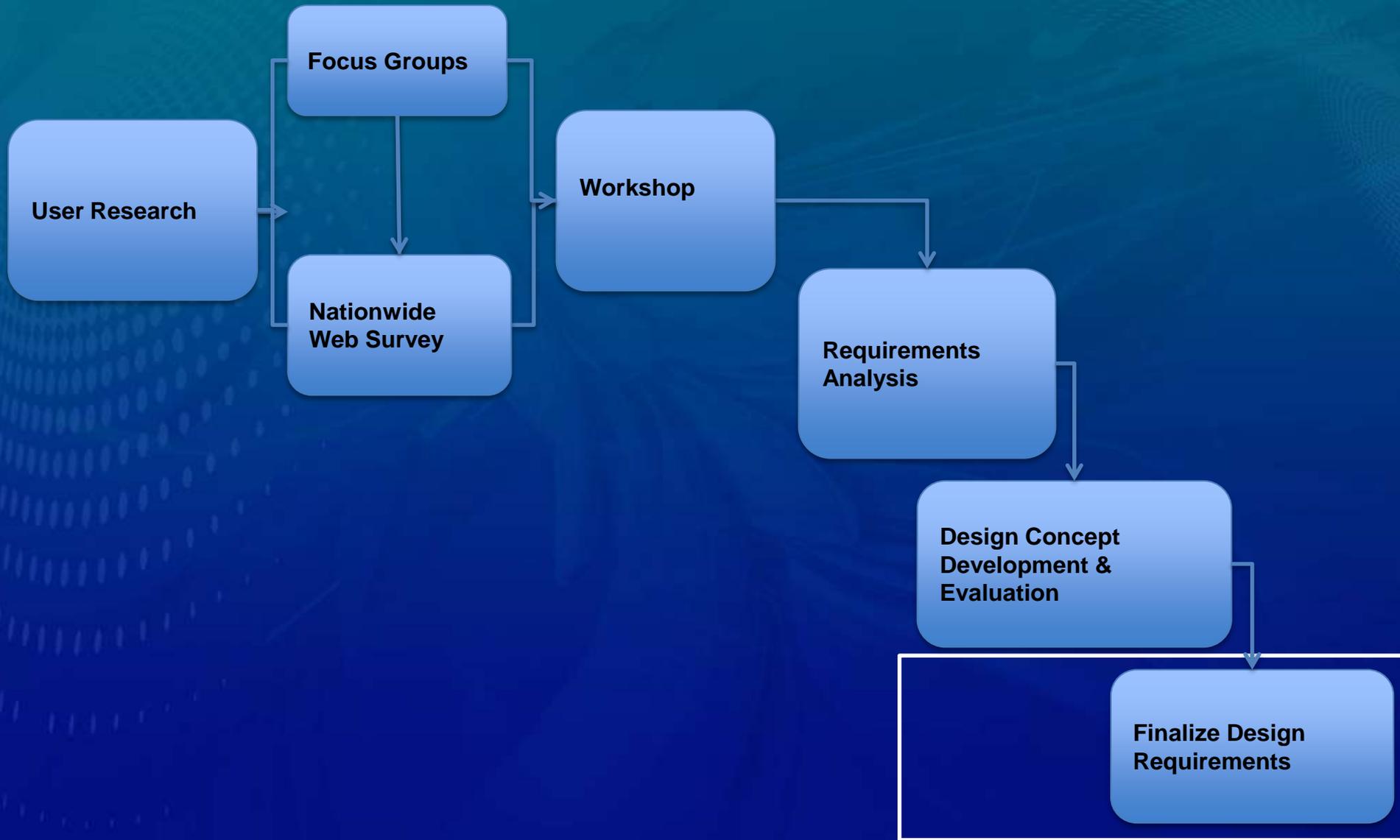
Curbside Seat



Computer Simulation Analysis

- Create virtual model of new design concepts
- Virtual human models replicate patient care tasks
- Benefits
 - Eliminates the need to construct physical prototypes
 - Allows for the evaluation of many design concepts faster, cheaper





NFPA 1917 Submission

NIST submitted 86 items for 2nd Edition of NFPA 1917 (includes 26 items for the annex) in the following areas:

- Controls and Switches
- Bumpers
- Stepping Surfaces
- Patient compartment configuration
- Access to handrails and handholds
- Patient compartment entry doors
- Floor covering
- Interior Storage
- Interior Surfaces
- Equipment Mounting
- Waste and Sharps Disposal
- Patient Compartment Seats
- Seat Belts
- Seat Adjustment
- Seat Size
- Access to Patient
- Patient Cot Retention
- Ventilation
- Oxygen System
- Patient Compartment Illumination
- Communications Equipment



Submission Examples

Many requirements based on reachability to patient and equipment for 5% female through the 95% male. Used DOD standard/specification (MIL-STD 1472G) that addresses functional reachability ranges for different size demographics.

- Interior storage cabinets, shelves, and drawers designed for storing common and critical equipment or supplies shall be within a maximum functional reach of 26.7 in. (678 mm) to the EMSPs with height as short as 59.3 in. (1506 mm) while seated and restrained. The securing mechanism of those interior storage cabinets and drawers, if provided, shall be capable of being accessed under the same reach condition.
- Where furnished, interior storage cabinets, shelves, and drawers, and their securing mechanisms shall be within a maximum standing functional reach of 26.7 in. (678 mm) and their contents shall be retrievable by EMSPs with height as short as 59.3 in. (1506 mm) while standing.
- The seat height shall be a maximum of 21 in. (533 mm), measured from the floor.
- Annex - Seating should be provided to allow the EMS provider access to either side of the patient's body from a seated and restrained position.



Submission Examples (cont.)

Additional requirements were focused on functional and safety elements that provide efficiencies in work performance.

- Each egress door shall have a failsafe method of opening and no method of locking should preclude egress.
- The interior storage design shall not allow for items greater than 31 lb. (14 kg) being stored higher than 5ft (1524 mm) from the floor and for items greater than 44 lb. (20 kg) being not being stored higher than 3ft (914 mm) from the floor.
- Workspace surfaces (i.e. countertops) shall have a mechanism to keep items from falling off the surface.
- Cot guidance and securing mechanism shall incorporate a universal locking and mounting system that is able to secure cots of all models and from all vendors.
- Air vents shall be located where they will not be obscured by interior storage cabinet doors, other equipment storage, and seats.



Continuing Activities

- Ambulance Design Guidebook (currently in development) covers best practices, recommendations, and ergonomics.
 - 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)
 - Design process
- Support NIOSH on Safety Demonstration Ambulance



Guidebook Review

- We'll be seeking input from the EMS community on the guidebook.
 - First draft tentatively scheduled to be completed December 2013
 - Feedback will be collected and guidebook will be revised
 - Intent is for guidebook to be released before next edition of NFPA 1917
 - If schedule allows, guidebook will be used in conjunction with the NIOSH Safety Demonstration Ambulance development



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Questions?

