

Armstrong Institute for Patient Safety and Quality

Enhancing Safety in Health Care: A Human Factors and Systems Engineering Approach

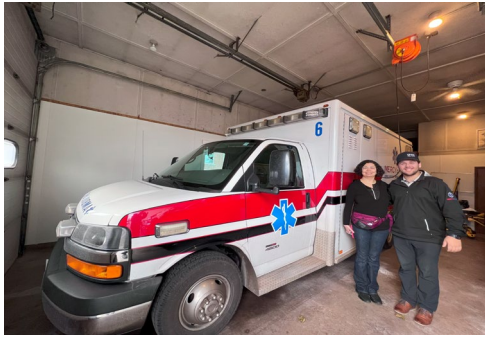
Ayse P. Gurses, PhD, MS, MPH

Director, Armstrong Institute Center for Health Care Human Factors

Professor, Schools of Medicine, Bloomberg Public Health, Whiting Engineering

Johns Hopkins University

Human Factors and Systems Engineering Across the Care Continuum



EMS

ED

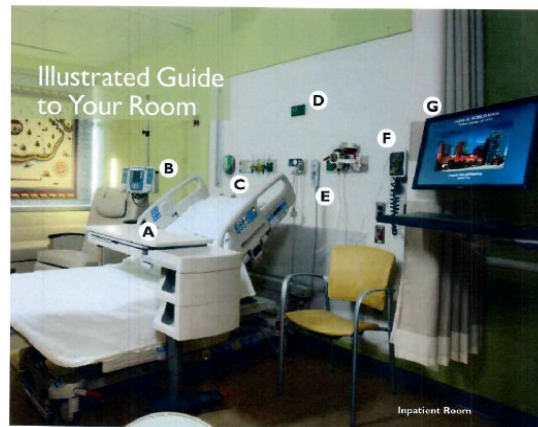
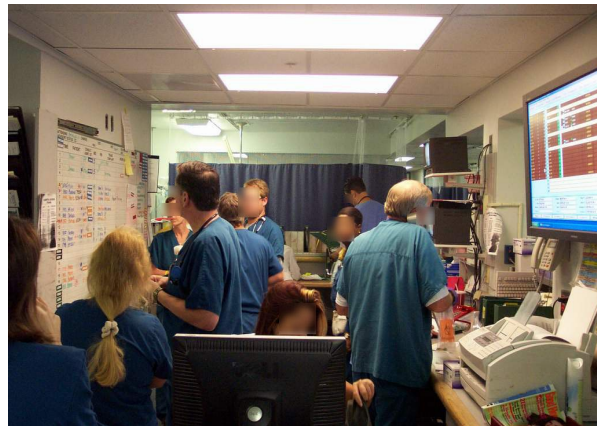
Operating Room

Inpatient

Ambulatory

Home
Care

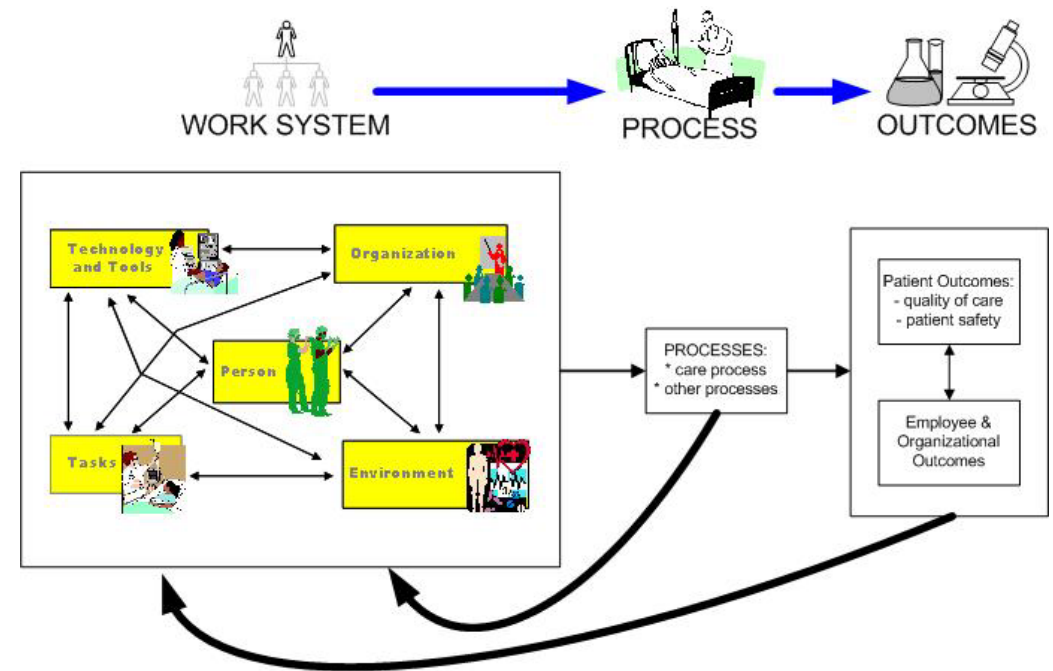
Long Term
Care



Enhancing Health Care Safety: Approach

- Patient/ Family Caregiver Safety AND Health Care Worker Well-Being
- Human-Systems Integration across the care continuum
- Conceptual Approaches (not comprehensive)
 - SEIPS, sociotechnical systems theory
 - Distributed Cognition, Multi-Team Systems
 - Naturalistic Decision Making
 - Safety I & Safety II
 - High Reliability Organizing
 - Technology Acceptance Model
 - Etc.
- Field studies, mixed methods, cognitive task analysis, participatory ergonomics, human centered design, ETC.

Systems Engineering Initiative for Patient Safety (SEIPS)



(Carayon,...Gurses... 2006)

Ex #1. The 2014 Ebola Outbreak*

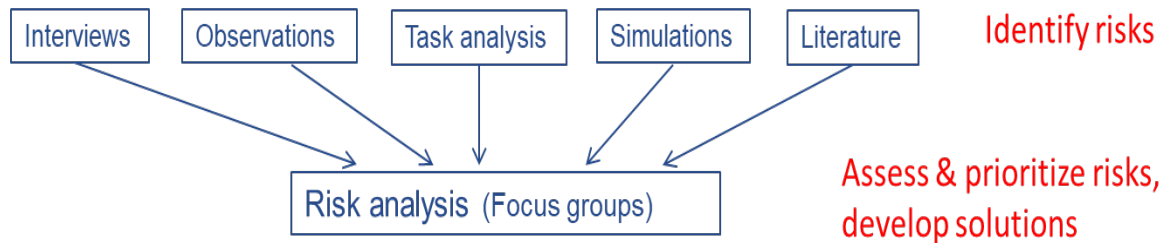
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PROJECT A. *Training Development for Ebola Personal Protective Equipment (PPE) Use*

- CDC developing new guidelines in anticipation of the outbreak
- We collaborated with CDC to develop an HFE-based risk analysis informed training

- SEIPS
- System ambiguity framework
- Team work science

I. Proactive risk assessment



II. Participatory and iterative approach to intervention design

III. Multi-method evaluation (including HFE-specific measures)

Gurses et al, 2018

PROJECT B. *A Comprehensive Risk Assessment of Ebola PPE Doffing and Multi-Component Intervention Development*

- 103 potential failure modes identified (FMEA)
- 55 failure modes prioritized

Multi-component intervention

- PPE selection
- Technical aspects of PPE removal
- Role clarity,
- Mirror (Physical environment)
- Encouraging speaking-up, mutual support



Significant reduction in PPE contamination

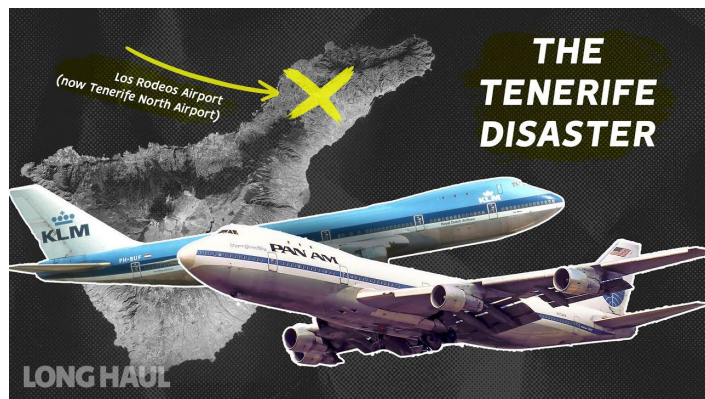
*Funded by CDC

Gurses et al, 2019; Andonian et al, 2019

Ex #2. Team Cognition and Importance for Safety

Team cognition

- Planning, decision making, problem solving, sensemaking, coordinating



Care is frequently delivered in:

- Multi-team systems (MTS)
- Fluid teams.
- Distributed teams

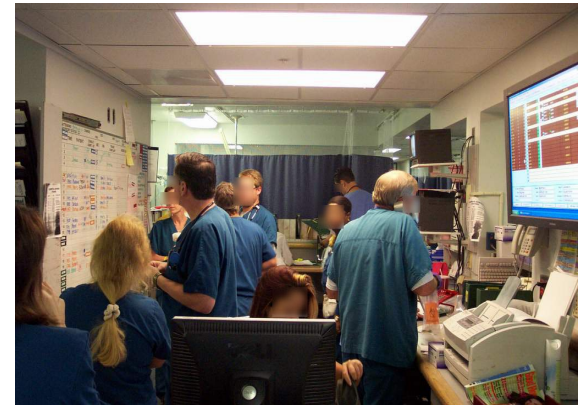


Photo by Bob Wears

How to design 'work system(s)'
to support team cognition?



Ex #2. Supporting Multi-Team Cognition for Safety



Role-Location Matrix:
58 total roles for 7 locations

Peds ED Trauma Narrator

	Consult Needed: Yes (burn patient)
Focused Assessment	Focused Assessment - Focused Assessment: Begin Focused Assessment Neurological - Neuro (WDL): Within Defined Limits Glasgow Coma Scale (1-5 years) - Eye Opening: Spontaneous ; Best Auditory/Visual Stimuli Response: Appropriate words or phrases ; Best Motor Response: Obeys ; Glasgow Coma Scale Score: 15 HEENT - HEENT (WDL): Within Defined Limits Respiratory - Respiratory (WDL): Within Defined Limits Cardiovascular - Cardiac (WDL): Within Defined Limits Integumentary - Integumentary (WDL): Exceptions to WDL ; Skin Integrity: Other (Comment) (open and intact blisters noted to chin, neck, chest and right axillae and right upper arm) Musculoskeletal - Musculoskeletal (WDL): Within Defined Limits Gastrointestinal - Gastrointestinal (WDL): Within Defined Limits (last ate at 10pm) Genitourinary - Genitourinary (WDL): Within Defined Limits Psychosocial - Psychosocial (WDL): Within Defined Limits
Immunizations	Child Immunization Status - Childhood Immunization Status: Up to Date
Assign Attending	assigned as Attending
Assign Physician	
First Physician Assigned	
Humpty Dumpty Fall Risk	Humpty Dumpty Fall Risk - Age: Less than 3 years ; Gender: Male ; Diagnosis: Other Diagnosis ; Cognitive Impairments: Forgets limitations ; Environmental Factors: Patient Placed in Bed ; Response to Surgery/Sedation/Anesthesia: More than 48 hours/None ; Medication Usage: Other Medications/None ; Total Risk Score: 13 High Fall Risk Interventions - High Fall Risk Interventions: Assess need for increased supervision
Orders Acknowledged	New - Initiate Patient Triage, Assessment and Non Prescriber Initiated Protocol Orders
Safety/Orientation	Safety/Orientation - Arrival: Brought to room on stretcher by EMS ; Preparation: Patient placed on stretcher ; Bed: Low/locked position; Side rails up x 1 ; Call Light: Call light is within reach of family member ; Person oriented to room and educated on fall risk ; Father ; Additional Risk Factors: Developmental ; Fall Risk Interventions: Education on increased fall risk and prevention
Head to Toe	Patient ID/Risk band - Patient ID/Risk Band: Patient ID band on/verified Neurological - Neuro (WDL): Within Defined Limits (Pt sleeping, easily arousable.) Glasgow Coma Scale (1-5 years) - Eye Opening: Spontaneous ; Best Auditory/Visual Stimuli Response: Appropriate words or phrases ; Best Motor Response: Obeys ; Glasgow Coma Scale Score: 15 HEENT - HEENT (WDL): Within Defined Limits Respiratory - Respiratory (WDL): Within Defined Limits ; Respiratory Pattern/Effort: Normal ; Bilateral Breath Sounds: Clear Cardiovascular - Cardiac (WDL): Within Defined Limits (2+ bilateral radial pulses. Afebrile.) ; Capillary Refill: LUE less than 3 seconds; RUE less than 3 seconds Integumentary - Integumentary (WDL): Exceptions to WDL ; Skin Integrity: Other (Comment) (Open burn to bilateral

Situational Awareness to Manage Complexity

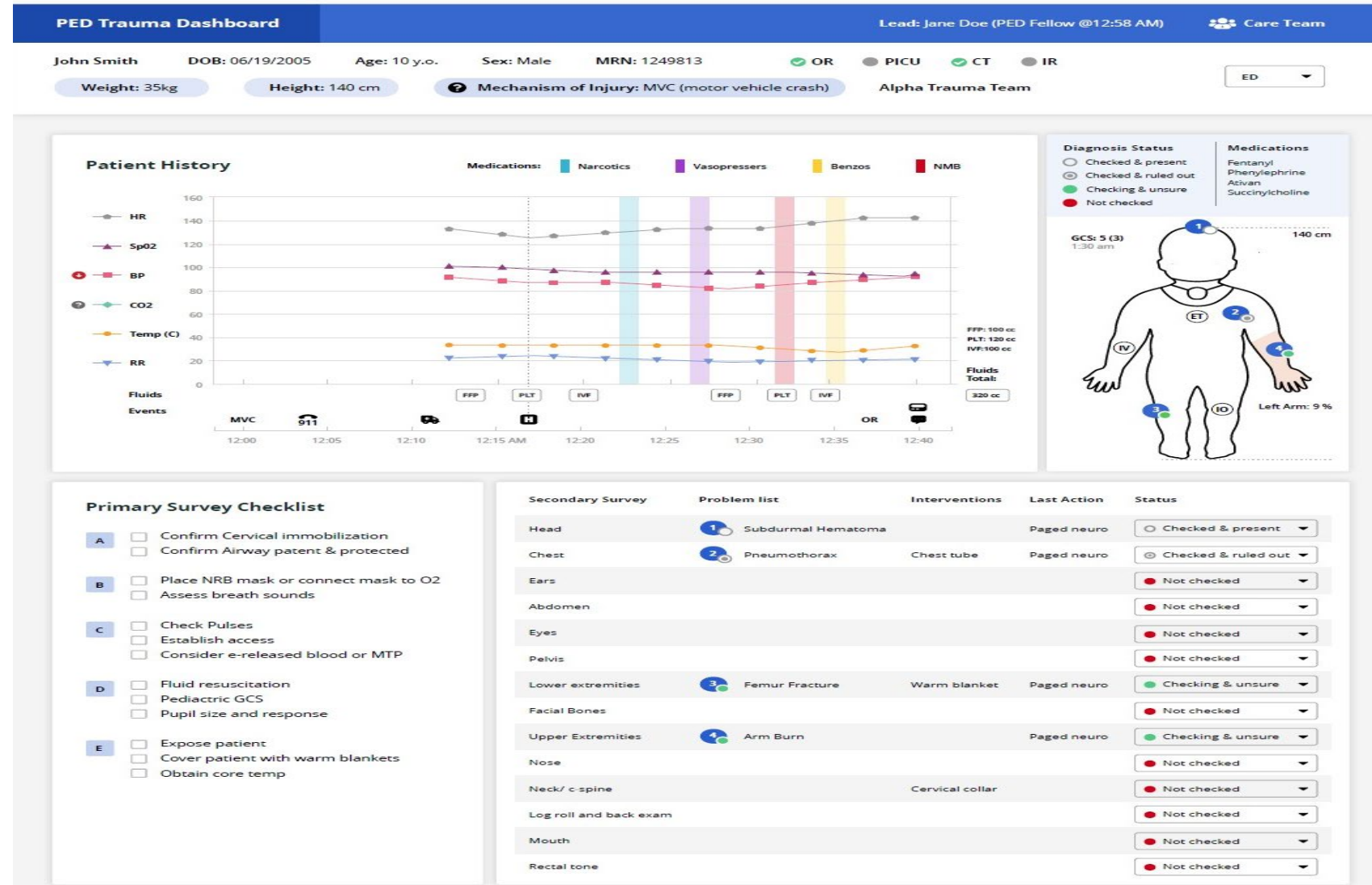
Ex #2. Designing Peds Trauma Dashboard: A Human-Centered and Participatory Approach*

Case 1: Large display
in ED trauma bay



Case 2: Remote access
from OR or PICU

Case 3: Mobile
access



Ex #3. Safety I AND Safety II: Why?

Studying ‘Diagnostic Errors’ vs Diagnostic Processes

A multi-site field study in 5 EDs:*

- 1 urban, academic, large
- 1 suburban, community, medium
- 3 rural, community, small

Supporting ‘expertise’
of care professionals & patients/families
is central to diagnostic safety.**

Aspects of Diagnostic Work***	“Work as Imagined” (Presumed Work)	“Work as Done” (Diagnostic Work as Actually Occurs)
Uniformity of ED services/resources	- All EDs/hospitals are equally equipped and resourced to accurately diagnosis and treat any condition at any time.	-Wide variation: “Geography becomes destiny.” - Under-resourced and rural EDs often must transfer patients out to other EDs/hospital
Follow-up & feedback	- Follow-up& feedback is readily available	- Can be exceptionally difficult and tend to occur through informal networks and HCW strategies.

*Funded by AHRQ R01 (PI: Gurses), ** Newsome....Gurses, JCEM, 2024- under review, ***Gurses et al, 2024, manuscript in preparation.

THANK YOU
agurses1@jhmi.edu