ARMSTRONG INSTITUTE
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JOHNS HOPKINS
MEDICINE

Respiratory Protective Devices: A Human Factors and Systems Engineering Perspective

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Overview

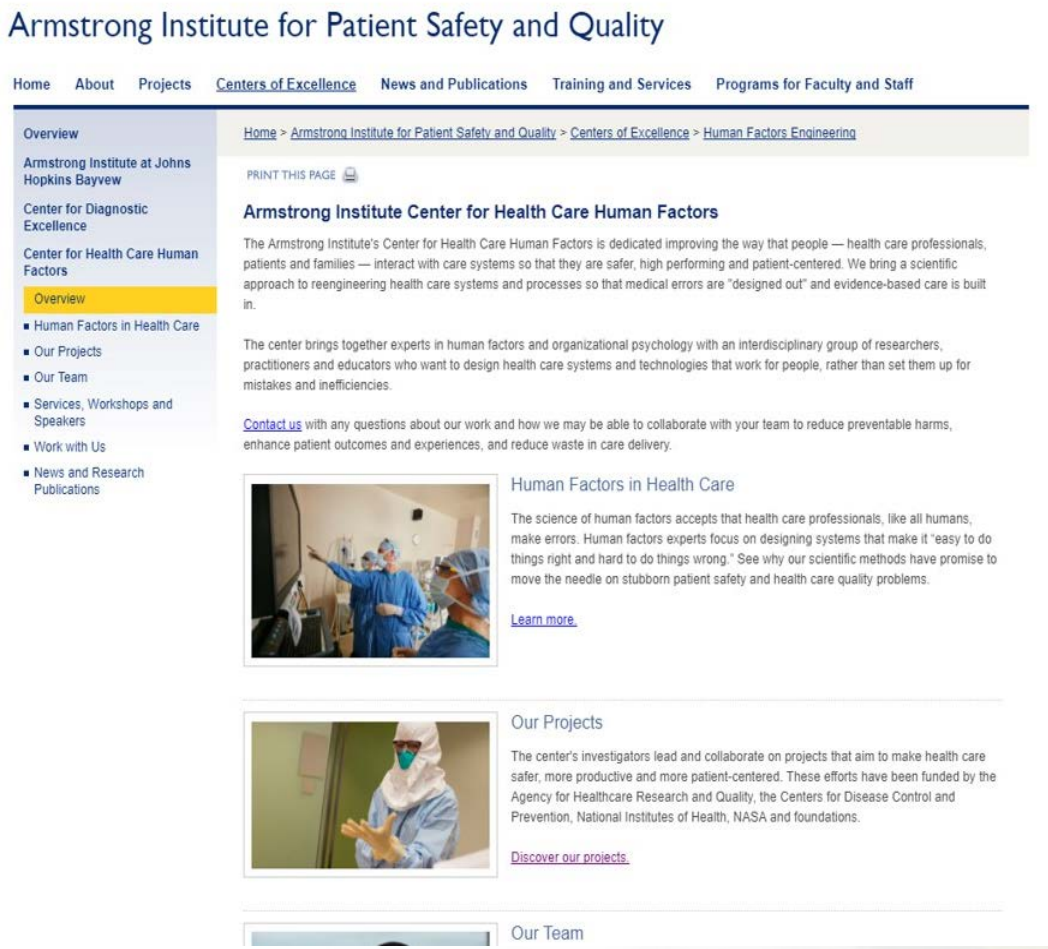
- Role of human factors engineering in respiratory protective device (RPD) design and use
- RPD as part of a larger sociotechnical safety-critical work system
- Future research considerations from a human factors engineering perspective

Human Factors and Ergonomics (HFE)

"…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.**"

International Ergonomics Association (IEA)

Center for Health Care Human Factors



www.hopkinsmedicine.org/armstrong/humanfactors

How Can Human Factors Engineering Help?*

RPD Related Issues	How HFE Can Help
• Fit to different types of individuals • Comfort, ease of use	Physical Ergonomics
• Packaging and Labeling issues • Manufacturer's instructions for use • Color & texture use in RPD • Training	Cognitive Ergonomics

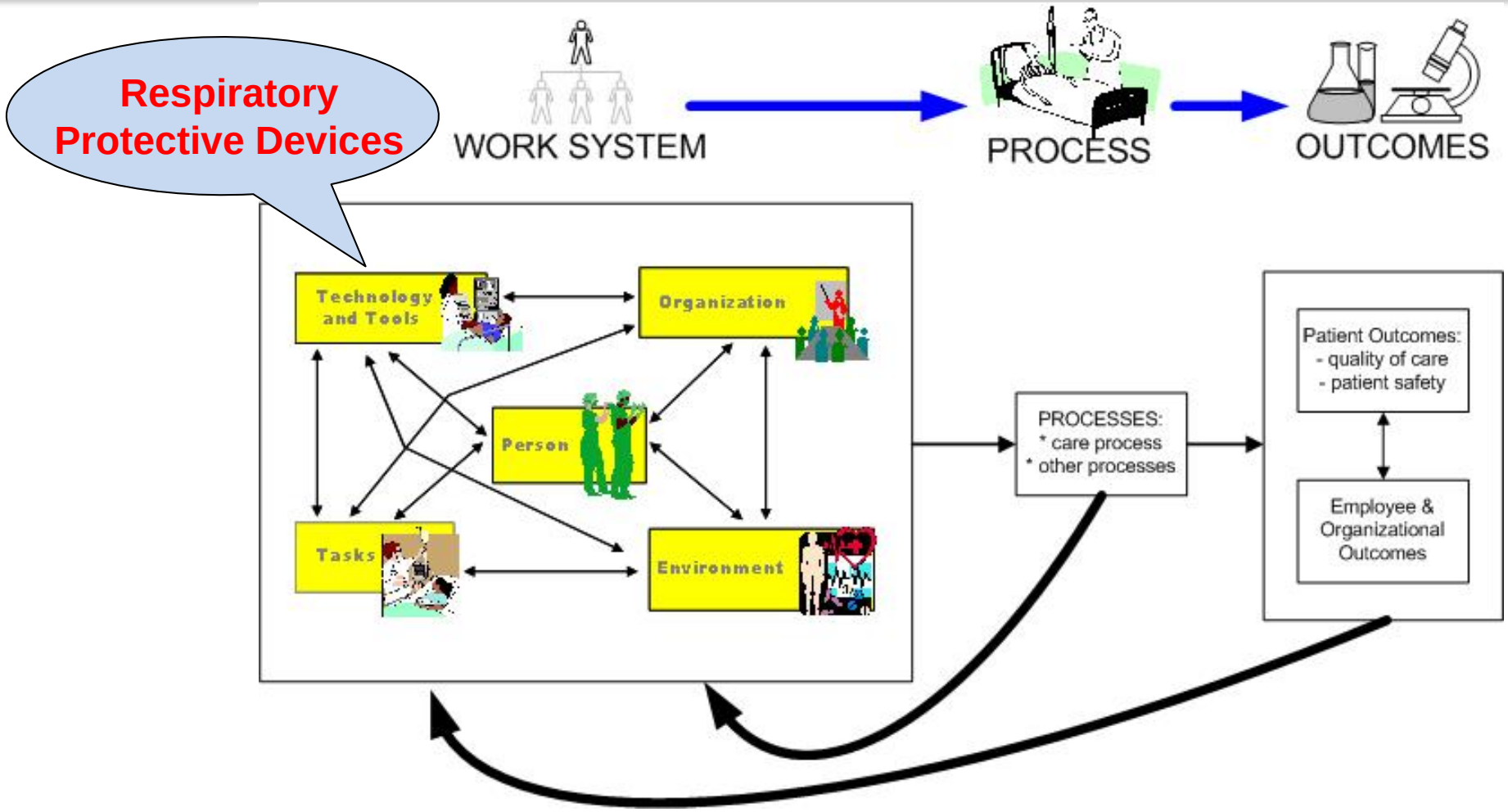
• Use within a specific context or 'work system':
  • Time pressure, safety climate, team work
  • Training, Adaptive capacity
  • Participatory ergonomics
	Macroergonomics
	(Organizational Ergonomics)

*Gurses et al. Time to accelerate integration of human factors and ergonomics in patient safety. BMJ Quality and Safety, 2011.

User Characteristics

- Physical Characteristics
  - Anthropometric differences
- Cognitive Characteristics
- Knowledge
- Skills
- Attitudes
  - Trust, mistrust, overtrust
  - Preferences
  - Different cultures
  - Comfort
  - Perceived ease of use, usefulness, feasibility/ perceived workload
- Use Behaviors

Respiratory Protective Devices as a Component of the Sociotechnical Work System



Carayon, P., Hundt, A.S., Karsh, B.-T., Gurses, A.P., Alvarado, C.J., Smith, M. and Brennan, P.F. "Work System Design for Patient Safety: The SEIPS Model", BMJ Quality & Safety, 2006.

Work and Work System Characteristics in which Respiratory Protective Devices will be Used

- Work and Task Characteristics
  - **Task- Technology Fit**
- "Safety Critical" Work or "Living" Environments
  - Highly dynamic
  - Nonlinear and unpredictable
  - Safety-prone
  - **Work-as-imagined versus work-as-done**
- Use HFE methods and approaches to study the 'work' and 'work and/or living' environments

Technologies in the Wild*

*Pennathur…Gurses. Technoloies in the Wild. Ergonomics

Many Relevant Human Factors Engineering Approaches

Conceptual Approaches

- Systems Approach
- Naturalistic Decision Making
- Distributed Cognition
- Resilience Engineering
- High Reliability
- Organizational Learning
- Implementation Science

Methodological Approaches

- Task analysis, cognitive task analysis
- Work System Analysis
  - In-depth understanding of context of use
- Human-Centered Design
- Usability Evaluation
  - Formative and summative evaluations
- Proactive Risk Analysis
  - FMEA, What-if analysis, etc
- Participatory Ergonomics/Design

Comprehensive, Interdisciplinary, Multi-dimensional Research Strategy to Improve RPD Use and Safety

- **Interdisciplinary** "Science of RPD"
- Understand needs of **different users**
  - In-depth ethnographic studies: work as imagined versus work as done
- Identify **safety risks** and any other related problems **proactively**
  - Failure modes and effects analysis, What-if analysis
- **Iteratively** develop and pilot test solutions
  - **Human-centered design**
- Tailor, implement, and disseminate
  - **Implementation science**
- **Effective Feedback Mechanisms** about RPDs
  - Learning Public Health Systems

THANK YOU!

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