

Respiratory Protective Devices: A Human Factors and Systems Engineering Perspective

Ayse P. Gurses, PhD, MS, MPH

Professor

Director, Center for Health Care Human Factors bit.ly/healthcarehumanfactors

Armstrong Institute for Patient Safety and Quality, Malone Center for Engineering in Healthcare

Johns Hopkins University Schools of Medicine, Bloomberg Public Health, Whiting Engineering

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

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Armstrong Institute Center for Health Care Human Factors

The Armstrong Institute's Center for Health Care Human Factors is dedicated improving the way that people — health care professionals, patients and families — interact with care systems so that they are safer, high performing and patient-centered. We bring a scientific approach to reengineering health care systems and processes so that medical errors are "designed out" and evidence-based care is built in.

The center brings together experts in human factors and organizational psychology with an interdisciplinary group of researchers, practitioners and educators who want to design health care systems and technologies that work for people, rather than set them up for mistakes and inefficiencies.

[Contact us](#) with any questions about our work and how we may be able to collaborate with your team to reduce preventable harms, enhance patient outcomes and experiences, and reduce waste in care delivery.


Human Factors in Health Care



The science of human factors accepts that health care professionals, like all humans, make errors. Human factors experts focus on designing systems that make it "easy to do things right and hard to do things wrong." See why our scientific methods have promise to move the needle on stubborn patient safety and health care quality problems.

[Learn more.](#)

Our Projects



The center's investigators lead and collaborate on projects that aim to make health care safer, more productive and more patient-centered. These efforts have been funded by the Agency for Healthcare Research and Quality, the Centers for Disease Control and Prevention, National Institutes of Health, NASA and foundations.

[Discover our projects.](#)

Our Team

www.hopkinsmedicine.org/armstrong/humanfactors

How Can Human Factors Engineering Help?*

RPD Related Issues	How HFE Can Help
<ul style="list-style-type: none">• Fit to different types of individuals• Comfort, ease of use	Physical Ergonomics
<ul style="list-style-type: none">• Packaging and Labeling issues• Manufacturer's instructions for use• Color & texture use in RPD• Training	Cognitive Ergonomics
<ul style="list-style-type: none">• Use within a specific context or 'work system':<ul style="list-style-type: none">• Time pressure, safety climate, team work• Training, Adaptive capacity• Participatory ergonomics	Macroergonomics (Organizational Ergonomics)

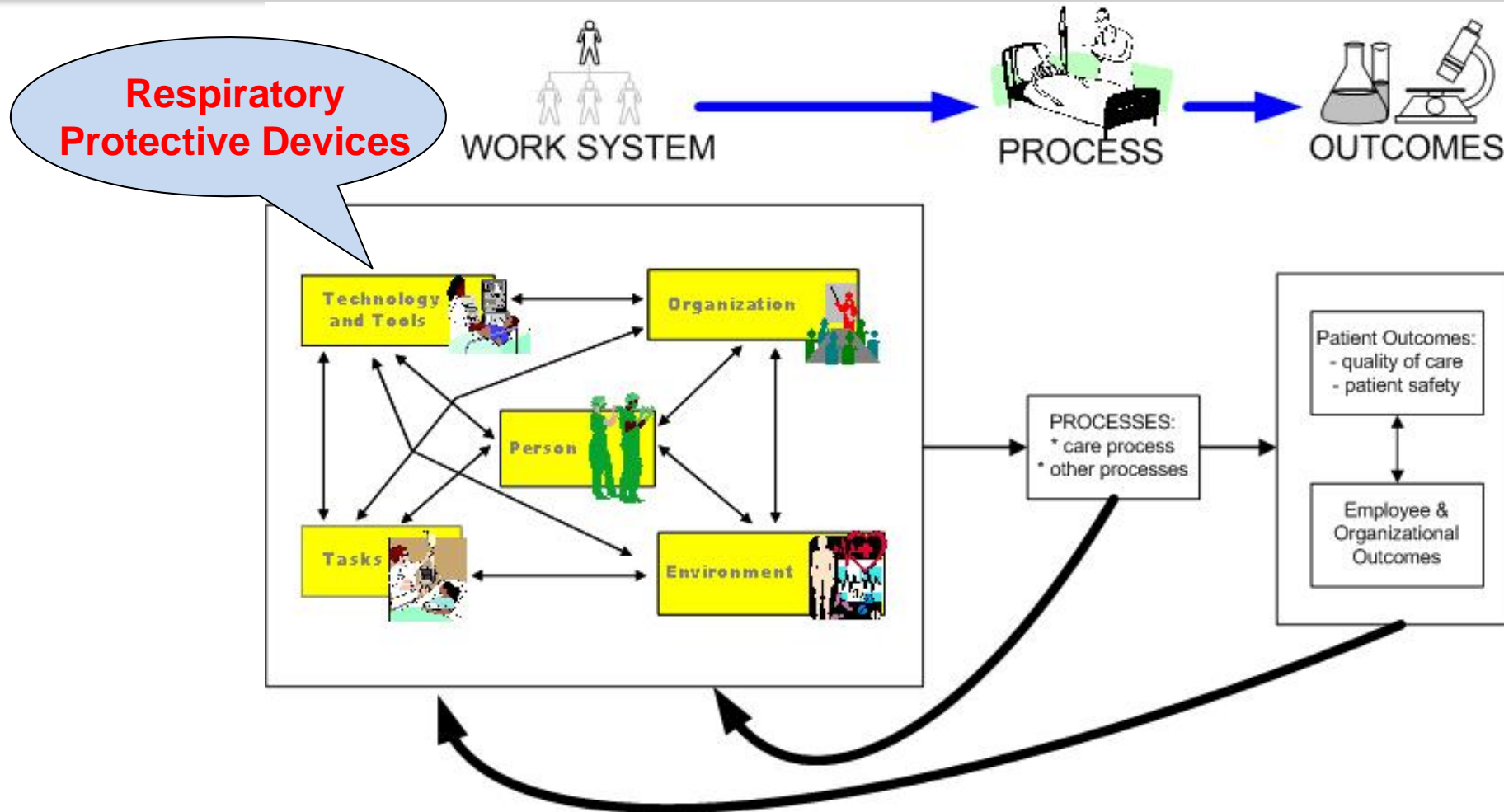
*Gurses et al. Time to accelerate integration of human factors and ergonomics in patient safety. BMJ Quality and Safety, 2011.

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



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*



How **NOT** to Wear a Mask



“The Escape Hatch”



“The Earring”



“The Sniffer”



“The Stache”



“The Nose Plug”



“The Neckbeard”

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!

agurses1@jhmi.edu

Twitter: @AysePGurses

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