

Human Factors in Healthcare Safety

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Agenda

- What is Human Factors (HF)?
- Why is HF Important in Healthcare and Safety?
- Practical Examples
- How Cincinnati Children's Integrated HF




Learning Outcomes

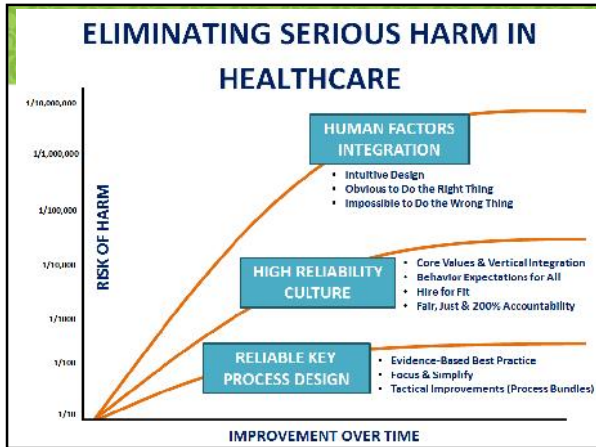
- Discuss the benefits of human factors in healthcare
- Discuss how human factors can be used to impact safety challenges in healthcare



A Call from the Institute of Medicine

- In 1999, IOM released report *To Err is Human: Building a Safer Health System* released in 1999
- Highlighted serious errors that occur daily in hospitals
- Catalyst for including Human Factors in healthcare
- Led to many human factors engineering design efforts to reduce:
 - Error rates in hospitals
 - Consequences of errors






Our Learnings...

The flowchart consists of three boxes connected by arrows:

- Blue box:** The road to high quality & safe patient care runs through the performance of you and your staff
- Green box:** So... if your technology is bad, your workflows don't work. Or if the physical space doesn't work, your performance will be impacted.
- Light green box:** If your performance suffers, your patients suffer.



Common Thinking and Pitfalls

- **Errors are personal failings**
 - When something bad happens, someone must be at fault
 - If we try harder we won't have the error
- **Policies create safety**
- And recently... **Technology will save us!**



An Alternative Approach:
Human Factors Engineering




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What is Human Factors?

❖ Human factors is the **systematic application** of relevant information about those **HUMAN** capabilities, limitations, characteristics, behavior, and motivation to the design of **THINGS (PRODUCTS)**, **PROCEDURES (PROCESSES)** people use and the **ENVIRONMENT (PLACES)** in which they use them.

<p>Science</p> <ul style="list-style-type: none"> • Discovers and applies information about human behavior, abilities, limitations, and other characteristics to... • ... the design of tools, machines, systems, tasks, jobs, and environments... • ... for productive, safe, comfortable, and effective human use <p><small>~Sanders and McCormick (1993)</small></p>	<p>Practice</p> <ul style="list-style-type: none"> • Designing the fit between people and: <ul style="list-style-type: none"> • Products • Equipment • Places/Facilities • Processes/Procedures • Environments
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OPTIMIZATION of HUMAN PERFORMANCE
(OBJECTIVE & SUBJECTIVE)




Human Factors is also known as...

- Human factors engineering (HFE)
- Human factors psychology
- Human engineering
- Engineering psychology
- Cognitive engineering
- Usability Engineering
- Ergonomics



- I will use the terms: Human Factors, Human Factors Engineering, HFE



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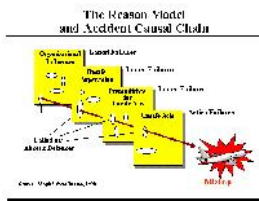
What Human Factors IS NOT...

- **Not just applying checklists and guidelines** – *Although helpful in many circumstances for standardization, etc.*
- **Not designing for oneself** (how you believe it should be - *Although I'm sure we all have great ideas.*
- **Not just common sense or aesthetics** – *Although there is nothing wrong with doing a sanity check and making something "look nice"*



Why Should We Care About Human Factors?

- Dr. James Reason says:
 - Fallibility is part of the human condition
 - We can't change the human condition
 - We can change the conditions under which people work



Human Factors Topics of Study

- Usability
- Mental workload
- Situation awareness
- Human-automation interaction
- Alerts
- Lifting
- Training
- Teamwork and team training
- Information processing
- Naturalistic decision making
- Handoffs
- Interruptions/distractions
- Violations
- Human error
- Safety



What Are the Objectives?

- **Reduce** errors, fatigue, stress and injuries at work, while at the same time...
- **Improve** productivity, ease of use, safety, comfort, acceptance, job satisfaction, and quality of life

Or simply –
improve safety, quality, efficiency, and productivity
all at the same time!



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Who Requires HFE in their Designs?

- US Federal Aviation Administration
- Department of Defense
- Department of Transportation
- Nuclear Regulatory Commission
- Department of Energy
- National Aviation and Space Administration
- **FDA – Medical Device Testing**



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Human Factors in Healthcare

- Usability of Products/Technology
 - Design of medical devices and Health IT
- Human Error
 - Understanding the nature of human error (Swiss Cheese Model)
- Clinician Performance
 - Physical and cognitive obstacles
 - Social/behavioral performance
- System Resilience
 - Ability to adapt




How Does This Work?

Practical Examples



Example #1 – Designs in Everyday Life

Plugging in a USB connector



- USB connectors are practically universal on computers today
- We use them everyday to connect a mouse, keyboards, flash drives
- **Design problem:**
 - When trying to plug the USB connector in, I frequently turn it the wrong way and I am not alone.
 - Challenging to tell just by looking which way it plugs in
- **Small problem, big impact:**
 - There are more than a billion of these connectors in use today. Even if a billion people make this mistake only once and only lose a second correcting the mistake, the lost time adds up to 31 years.
- **Solution:**
 - If the connector could be inserted either way and work, this problem would be solved. (i.e., MiniUSB)

<http://www.baddesigns.com>



Example #2 – Designs in Everyday Life

Designing for Affordance



Audience Participation....

Raise your hand (virtually) when you know HOW MANY of the lab results are out of range!!

Ready.....?




Healthcare Display #1

Species : Adult Canine
Patient : SYDNEY
Client : SUE B

Test	Results	Reference	Range
ALKP	= 85 U/L	23	- 212
ALT	= 23 U/L	10	- 100
BUN	= 16.6 mg/dl	7.0	- 27.0
CREA	= 0.77 mg/dl	0.50	- 1.80
GLU	= 130.6 mg/dl	77.0	- 126.0
TP	= 6.21 g/dl	5.20	- 8.20
Na	= 149.9 mmol/l	144.0	- 160.0
K	= 4.44 mmol/l	3.50	- 5.80
Cl	= 116.9 mmol/l	109.0	- 122.0


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Okay, try again.

Raise your hand (virtually) when you know HOW MANY results are out of range

Ready.....?



Healthcare Display #2

Test	Results	Reference Range	Indicator		
			LOW	NORMAL	HIGH
ALP	= 85 U/L	23 - 212	[Progress bar: ~40% filled]		
ALT	= 23 U/L	10 - 100	[Progress bar: ~20% filled]		
BUN	= 16.6 mg/dl	7.0 - 27.0	[Progress bar: ~60% filled]		
CRCA	= 0.77 mg/dl	0.50 - 1.80	[Progress bar: ~40% filled]		
GLU	= 130.6 mg/dl	77.0 - 125.0	[Progress bar: ~90% filled]		
TP	= 6.21 g/dl	5.20 - 8.20	[Progress bar: ~40% filled]		
Na	= 149.9 mmol/l	144.0 - 160.0	[Progress bar: ~90% filled]		
K	= 4.44 mmol/l	3.50 - 5.80	[Progress bar: ~40% filled]		
Cl	= 116.9 mmol/l	109.0 - 122.0	[Progress bar: ~40% filled]		

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Which Would You Choose?

Display #1

- Cognitively challenging because you needed to mentally find the lab value, and then interpret whether or not the value was in range
- Each comparison was an opportunity for error
- Time consuming

Display #2

- Allows you to easily find what is different
- Direct perception display to answer the cognitive challenge I posed to you

Both displays can be found in healthcare and affect accuracy (quality/safety) and response time (productivity)

However, only one was good!

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How are the Goals Achieved?

Individual approach

- Focus: Individuals
- Focused on individuals for forgetfulness, inattention, or carelessness, poor production
- Methods: poster campaigns, policy/procedure, individual correction
- Targets: Individuals


System Approach

- Focus: Conditions of work
- Building defenses to avert errors/poor productivity or mitigate their effects
- Methods: creating better systems
- Targets: System (team, tasks, organization)

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What Does Human Factors Focus on to Meet Objectives?

- **Identification** of performance: what are people actually doing?
- **Analysis** of the interaction between human performance and work systems
- **Design** of work systems to support/extend performance & eliminate/reduce performance obstacles



Human Factors Tools and Methods

- Failure Mode Effects Analysis (FMEA)
- Root Cause Analysis (RCA)
- Usability testing
- Work system analysis
- Energy expenditure
- Lifting and movement limits
- Technology design & implementation guidelines
- Mental model mapping
- Cognitive task analysis
- Visual, auditory, and tactile guidelines
- Alarm/ Warning guidelines
- Work process guidelines
- Software design
- Workstation guidelines



Human Factors at Cincinnati Children's



- 2 years in...and still learning!
- Top down/bottom up approach
- Integrated team member
- Brought in at the beginning





CLABSI Prevention Standards

Optimized Workflow – Dressing Change

The diagram illustrates a complex workflow for a dressing change. It features several interconnected steps and paths, highlighted with red starburst callouts: 'Multiple Workflows' (top right), 'Varied Practice' (left), 'Inefficient Hand Hygiene' (center), and 'Complex' (right). The workflow includes steps for hand hygiene, gowning, and dressing application. The Cincinnati Children's logo is at the bottom right.

Barcode Medication Administration (BCMA)

Equipment Usability

This collage illustrates various usability issues with BCMA equipment. It includes three main sections: 'Barcode Placement/Inconsistency' with two images showing barcodes that are partially covered or on a crease; 'Equipment Oriented Differently' with two images showing equipment at different angles; and 'Multiple Equipment Types' with two images showing different models of equipment. A text box notes: 'Equipment has different standards of operations, indicators, etc.' The Cincinnati Children's logo and the number '29' are at the bottom.

Medication Drawers/Nurse Server




Workspace Design

- Medication /drawers
 - How has technology helped and hurt?
 - How easy is it to get the wrong med/supplies?
 - How easy is to stock the med in the wrong area/bin?
 - Does packaging make it easy to pick the wrong item?

The image shows an open medication drawer with several red and blue containers, some with labels, and some with syringes. The Cincinnati Children's logo is at the bottom right.

Safe Patient Handling (SPH) Equipment Usability, Teamwork


- Understanding challenges and barriers with current SPH equipment
- Design challenges with current equipment (room size, layout)
- Behavior/culture aspects with handling patients
 - Do what we've always done
 - Pressures to do things quickly
 - Caregiver/Patient's First



Critical Care Building Workspace Design



What Can You Do?



Use "HFE Thinking"

- Systems (e.g., machines or hospitals) need to be designed for people, and to work with people
- Systems must be designed to accommodate the range of users
- How systems are designed will influence human behavior and therefore system performance
- Design needs to be evidence-based, not "common sense" or designer driven
- All design must take into account the system of use



Sanders MM, McCormick EJ. *Human Factors in Engineering & Design*, 7th ed. McGraw-Hill; New York: 1993.



Something to Ponder...

- What is more controllable, People or Systems?

We can't solve these problems by just FIXing people, we have to FIX the systems we interact with!



Thank You!



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