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 and the plan for the future

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Learning Objectives

- Define Human Factors (HF)
- Discuss how HF can be used to impact safety challenges in healthcare
- Understand HF return on investment

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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

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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**




An Alternative Approach:
Human Factors Engineering

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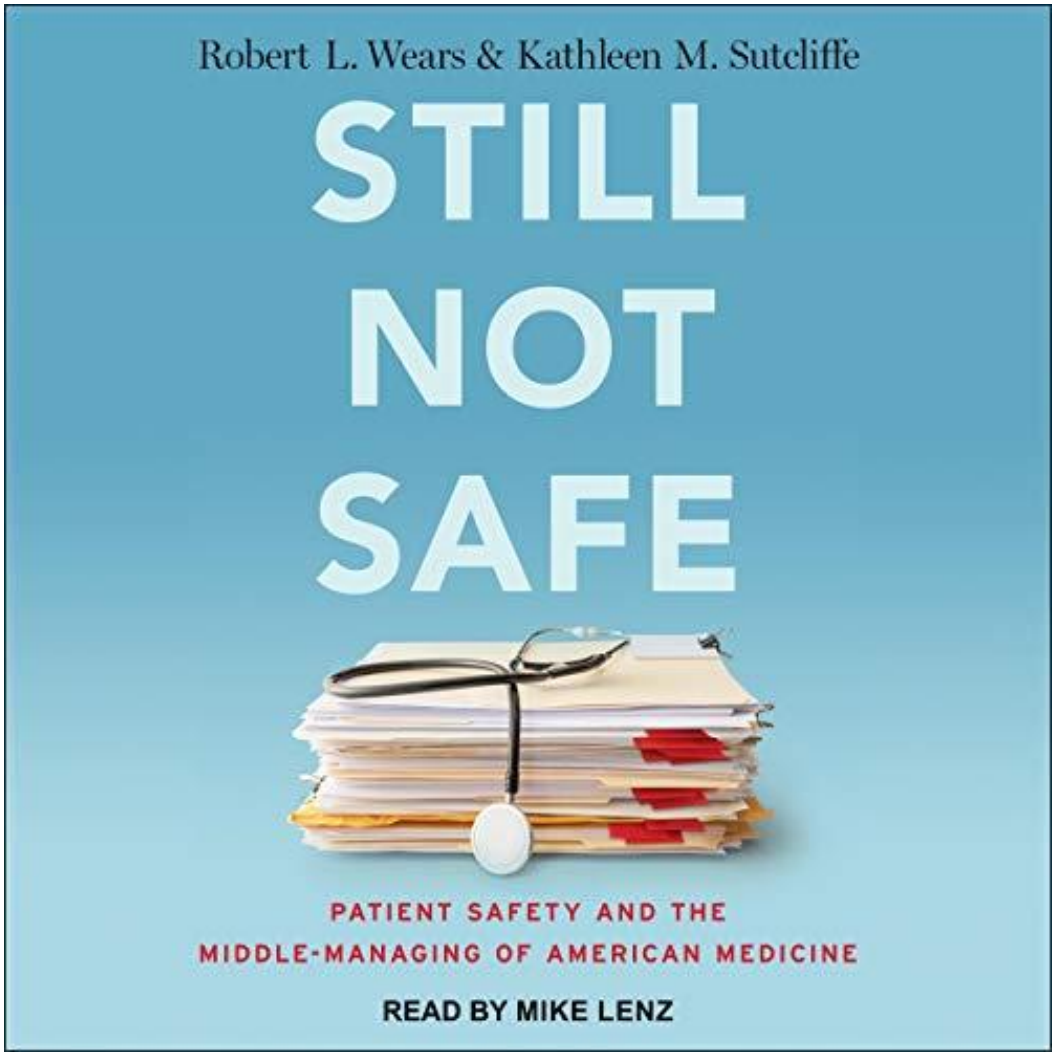
24 years later…



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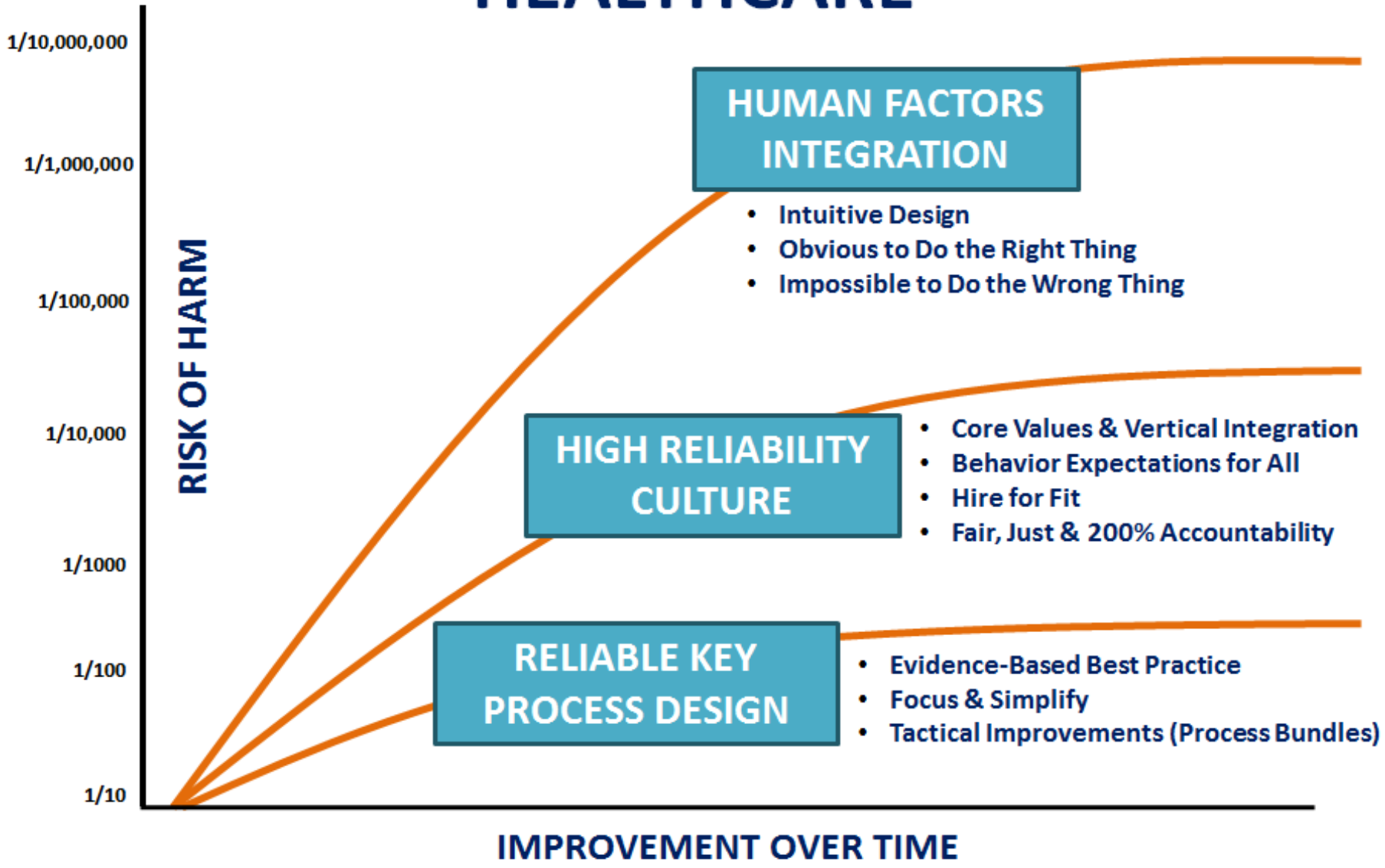
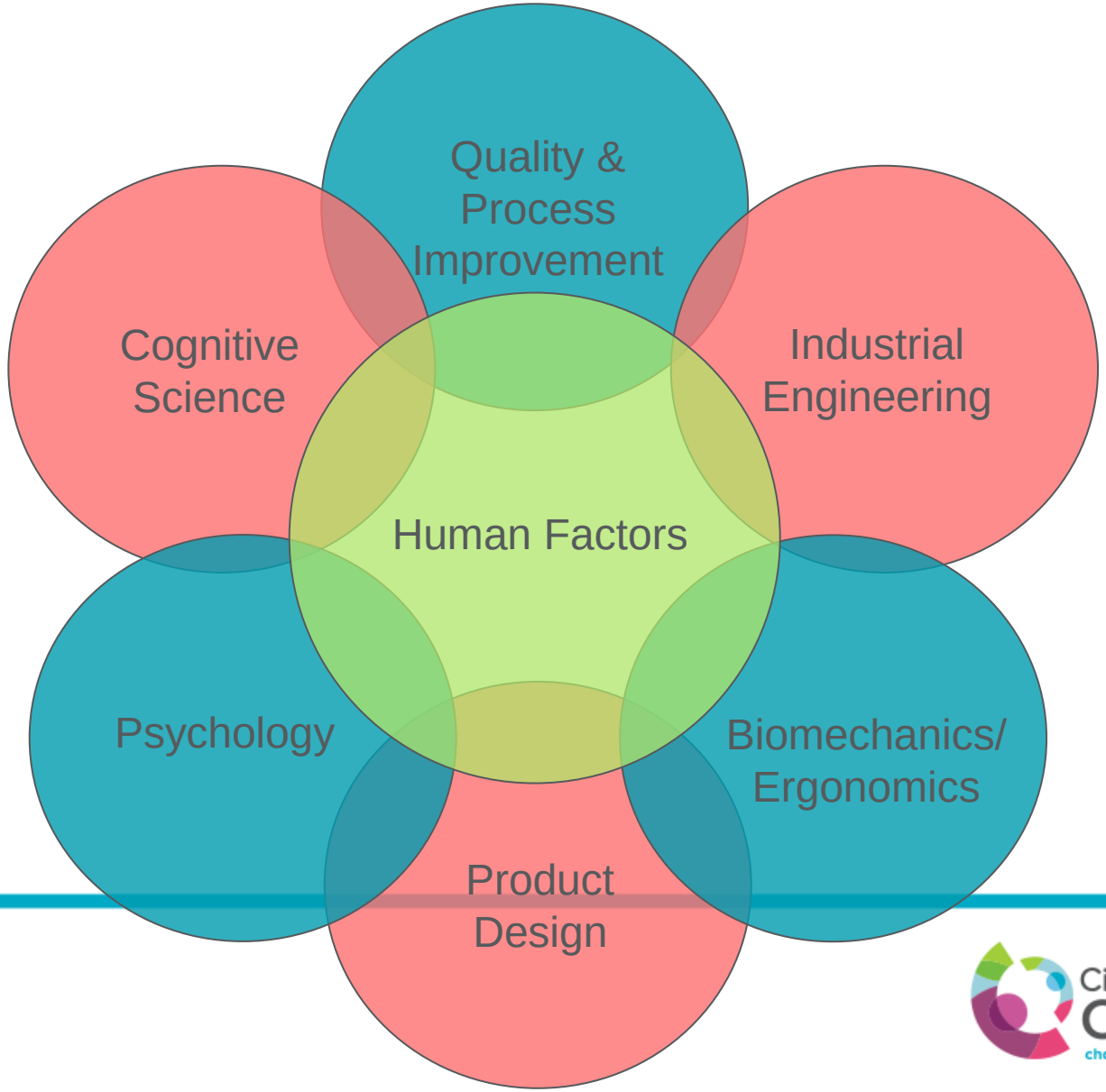
ELIMINATING SERIOUS HARM IN HEALTHCARE



What is Human Factors?



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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!

What is Human Factors

- A science
- An expertise
- Not all the same

How are the Goals Achieved?

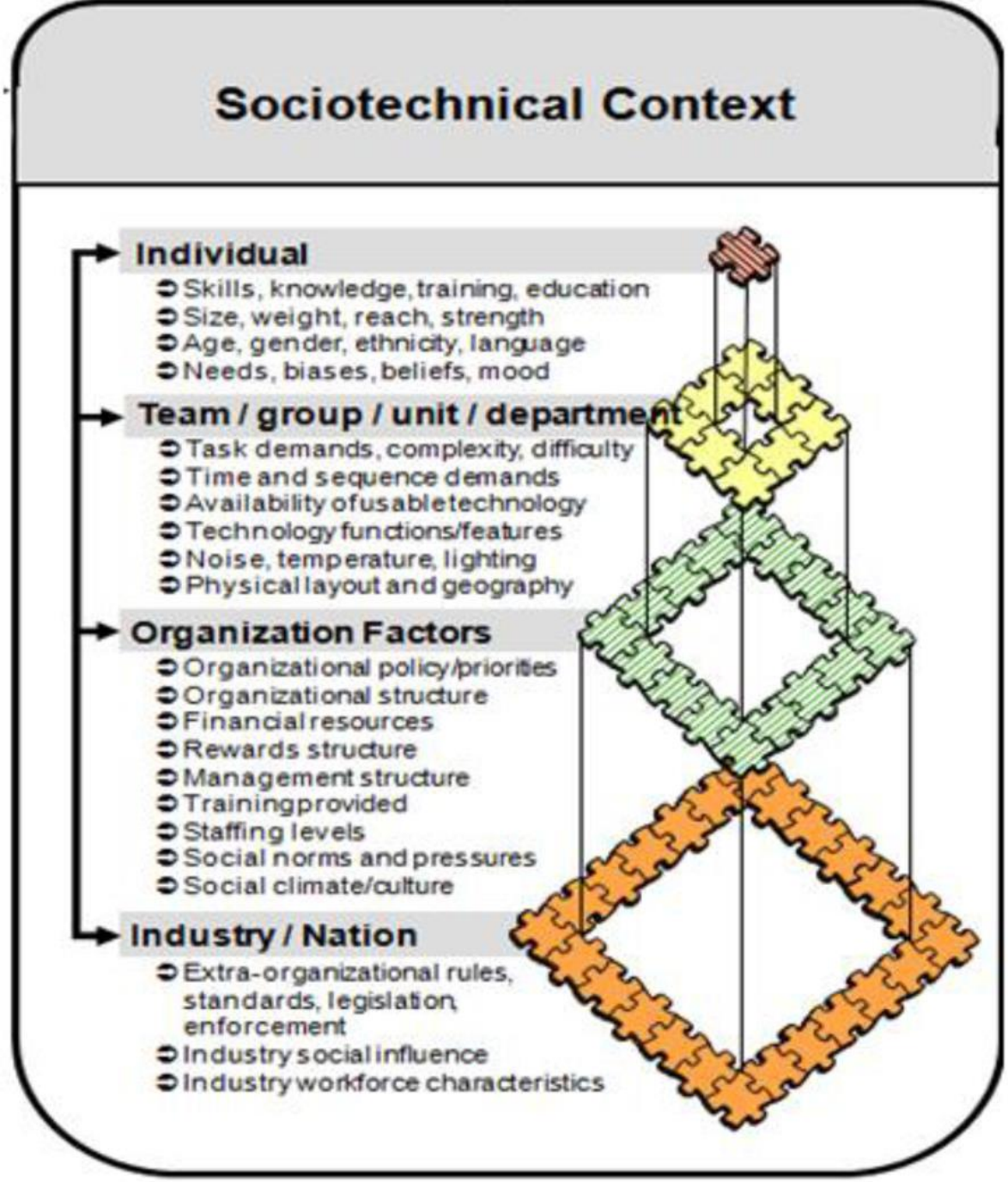
Individual approach

- 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)

Sociotechnical Context



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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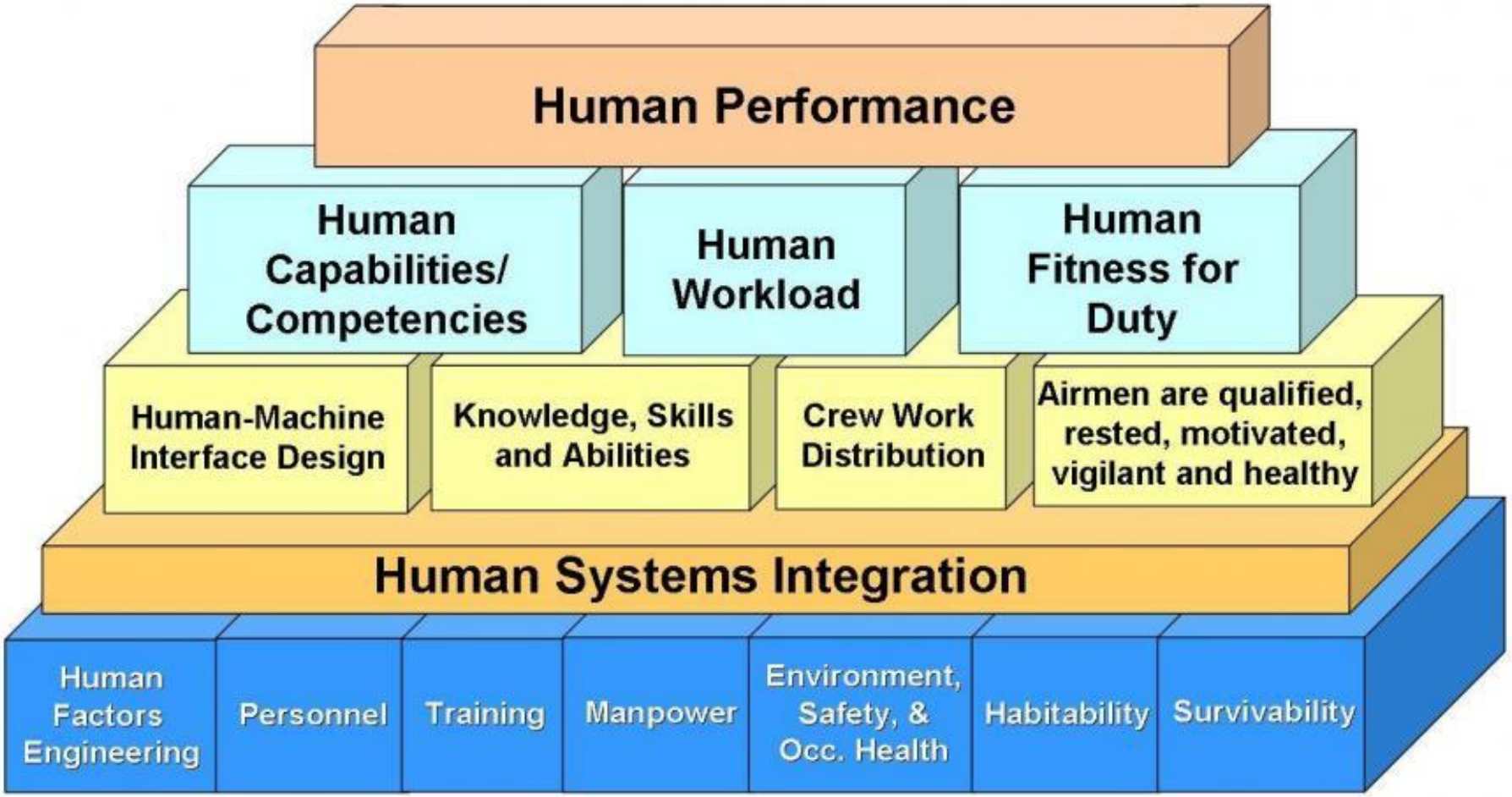
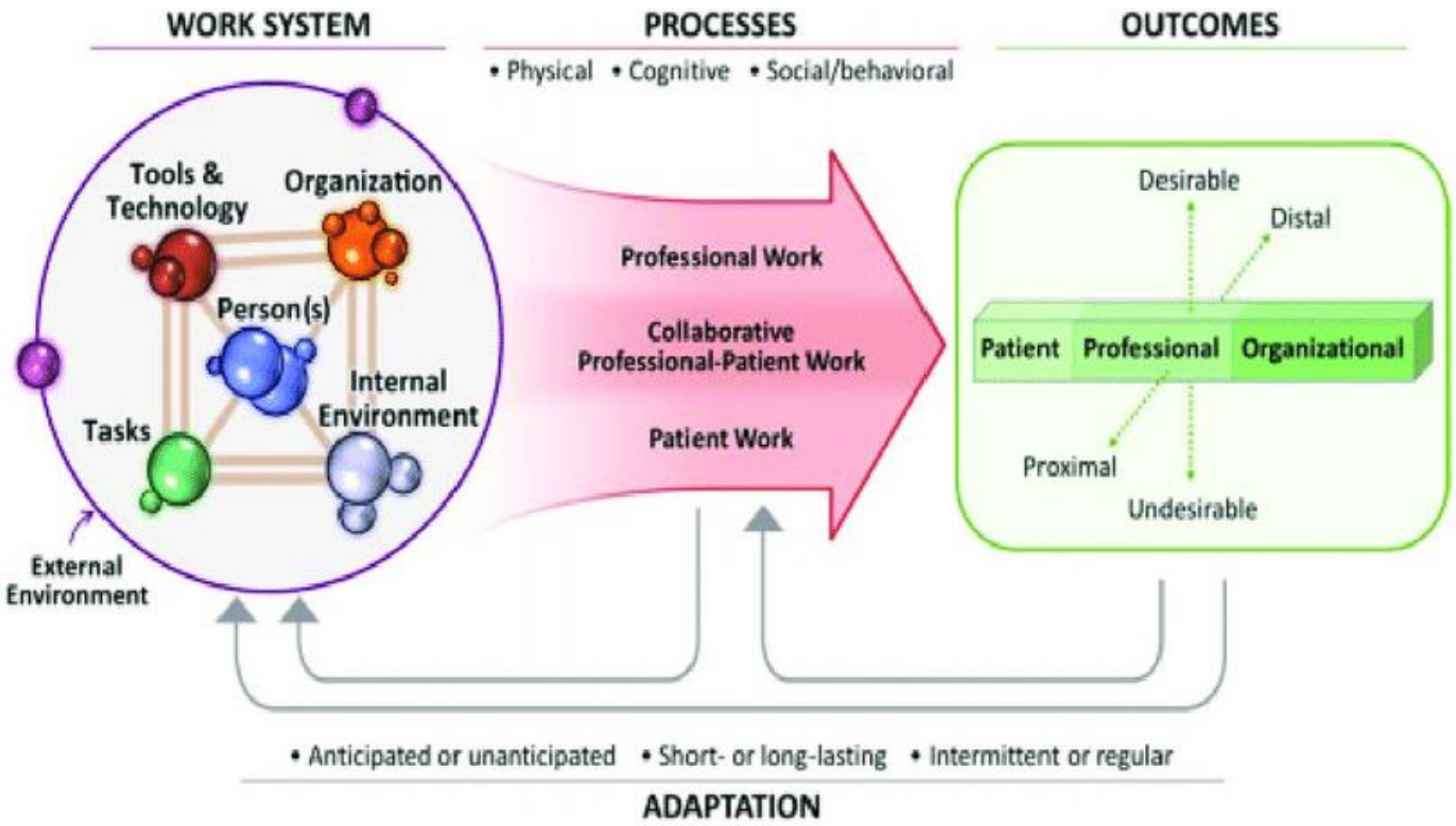
Human Performance Pyramid



Through the HF Lens



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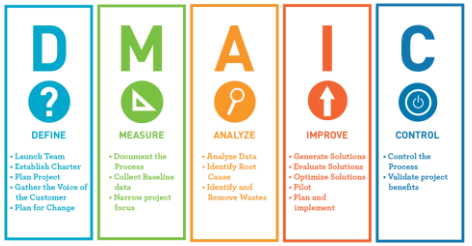
Lean

-reduce waste

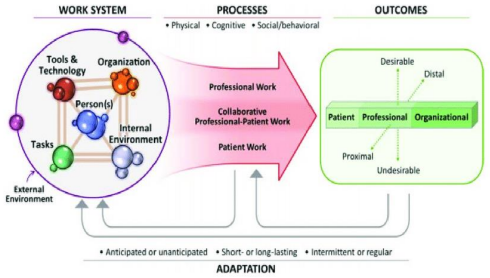
Six Sigma

-reduce deviation



Human Factors

-understand human limitations



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Detailing the differences between Human Factors, Quality Improvement, and Lean Six Sigma

	Human Factors	Quality Improvement	Lean Six Sigma
Define:	A scientific discipline and applied field that studies how people interact with deices, products, and systems	A framework used to systematically improve care. by standardizing processes and structure to reduce variation, achieve predictable results.	A method that provides tools to improve the capability of their business processes.
Goal:	To reduce human error, increase productivity and system availability, enhance safety, health, comfort with a specific focus on the interaction between the human and their environment.	To improve patient outcomes	To systematically remove operational waste and reduce process variation with a focus on efficiency.
Methods:	Psychology, sociology, engineering, biomechanics, industrial design, physiology, anthropometry, interaction design, visual design, user experience, and user interface.	Commonly use Six Sigma methods, Total quality management, continuous improvement model, or Plan, Do, Study, Act.	The Toyota and US Motorola Companies: DMAIC (Define, Measure, Analyze, Improve, Control), Plan, Do, Study, Act.
Common tools	System Models and Frameworks Hazard and Operability Analysis, System and hierarchical task analysis Cognitive decision-making, situational awareness, and mental models Physical interaction and usability testing, link analysis and anthropometric analysis	Run Chart, process maps, and fishbone diagrams, 5 Whys, FMEA, Regression Analysis	Run Chart, process maps, and fishbone diagrams. Voice of the customer, Value Stream Mapping, Pareto Charting, Process Capability

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

Moving to higher reliability

- Engineer out the problem

Education
Memos and emails
Checklists

Redesign

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Practical Examples

HOW DOES THIS WORK?

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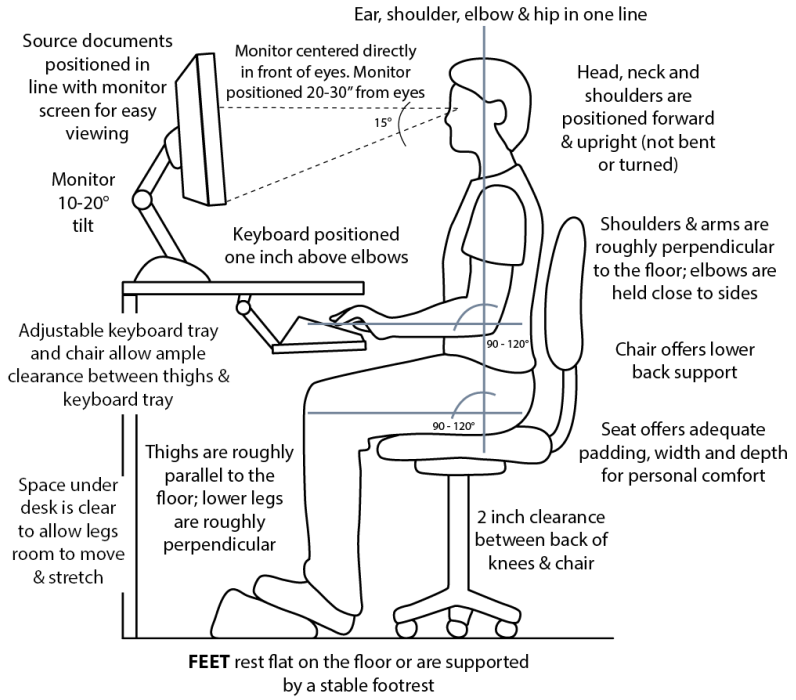
Physical/Micro Ergonomics



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Designs in Everyday Life

Solution: If the connector could be inserted either way and work

http://www.baddesigns.com

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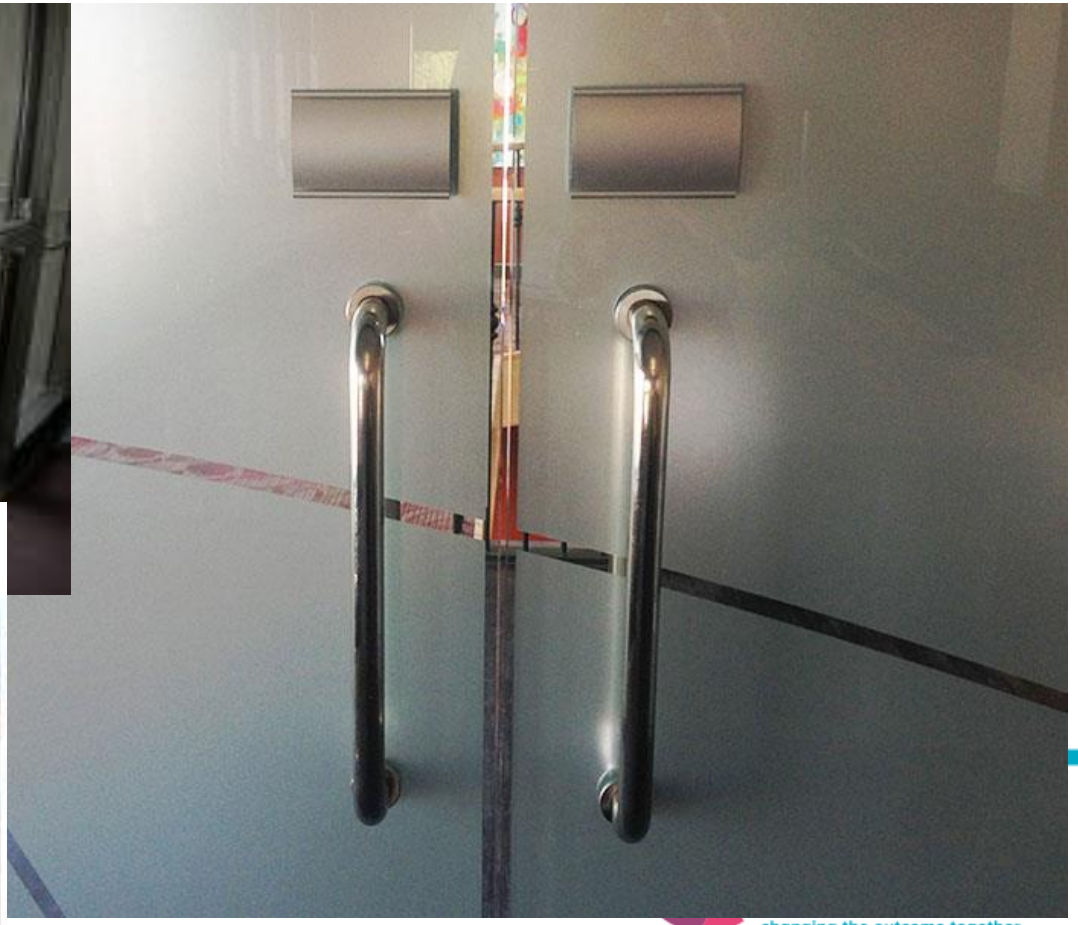
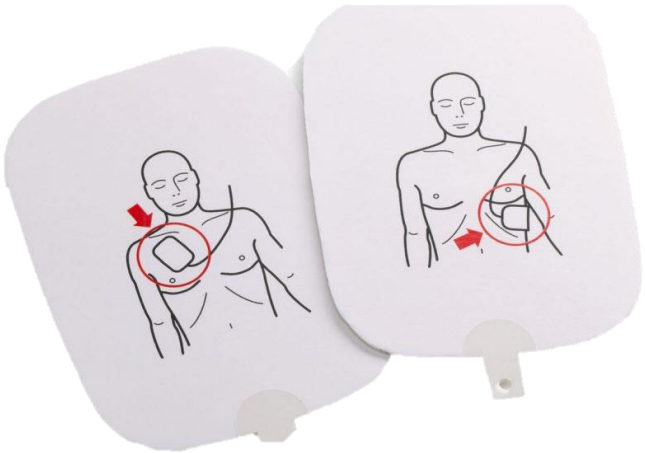
Designs in Everyday Life

Designing for Affordance



Good Design saves lives



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LIFEPAK 20e
DEFIBRILLATOR / MONITOR
Recommended
Adult VF Dose: 200-300-360J
HR 80
200J
21:23:53
SpO2 99
II x1
SpO2
1 ON
2 ENERGY SELECT
3 CHARGE
AED MODE
ANALYZE
LEAD
SIZE
SYNC
PACER
RATE
CURRENT
PAUSE
ALARMS
OPTIONS
PRINT
CODE SUMMARY
EVENT
Speed Dial
AC Mains
Service
ECG
SpO2
Masimo SET
Masimo
WARNING Hazardous electrical output. For use only by

Audience Participation….

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

Ready…..?

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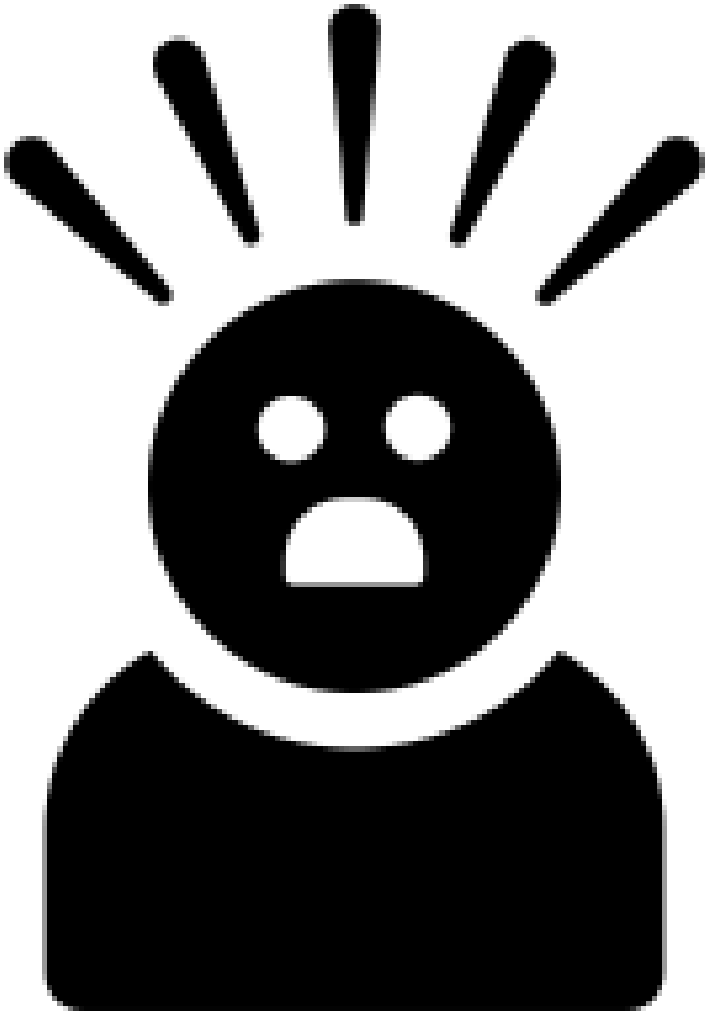
Healthcare Display #1

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	-	125.0
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

Distraction!



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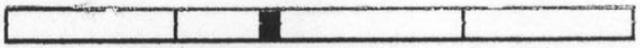
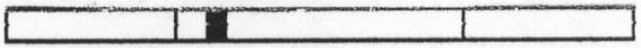
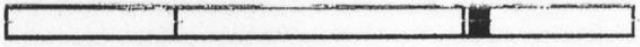
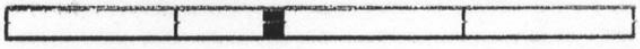
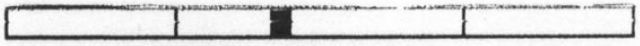
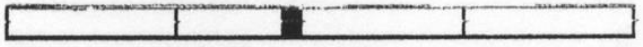
Okay, try again.

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
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 - 125.0	
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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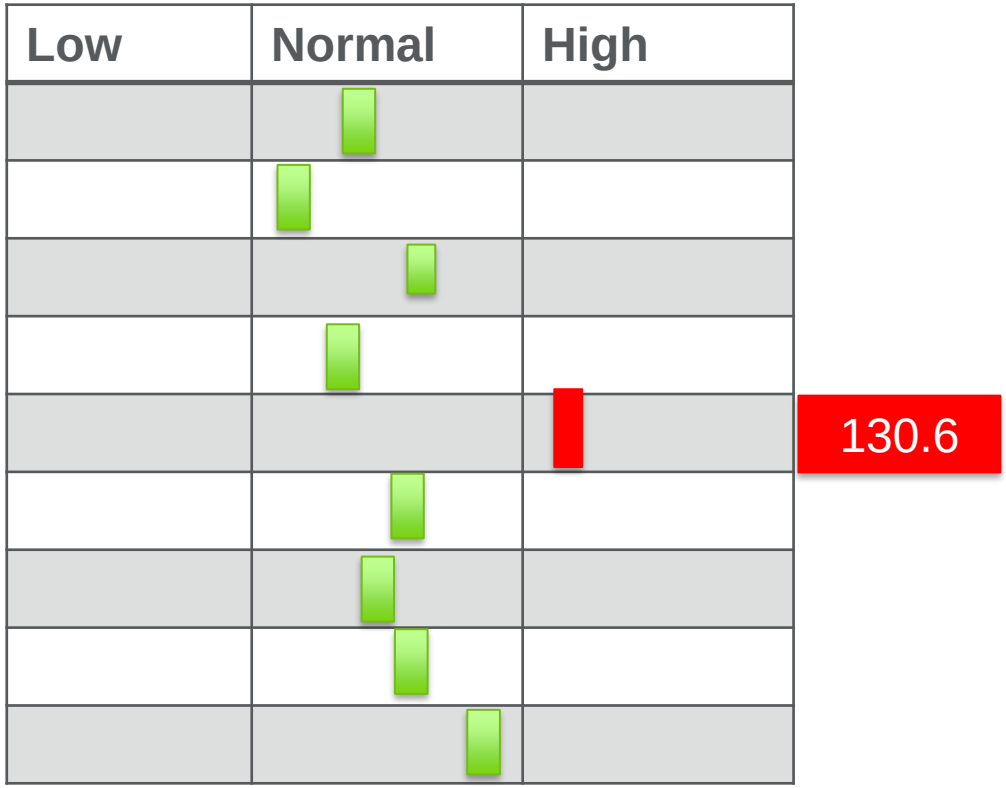
Healthcare Display #3

Test	Results
ALKP	85 U/L
ALT	23 U/L
BUN	16.6 mg/dl
CREA	0.77 mg/dl
GLU	**130.6 mg/dl**
TP	6.21 g/dl
NA	149.9 mmol/l
K	4.44 mmol/l
CL	116.9 mmol/l



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SPOT

SPOT

SPOT

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WHAT CAN I DO?

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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 taken into account the system of use

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

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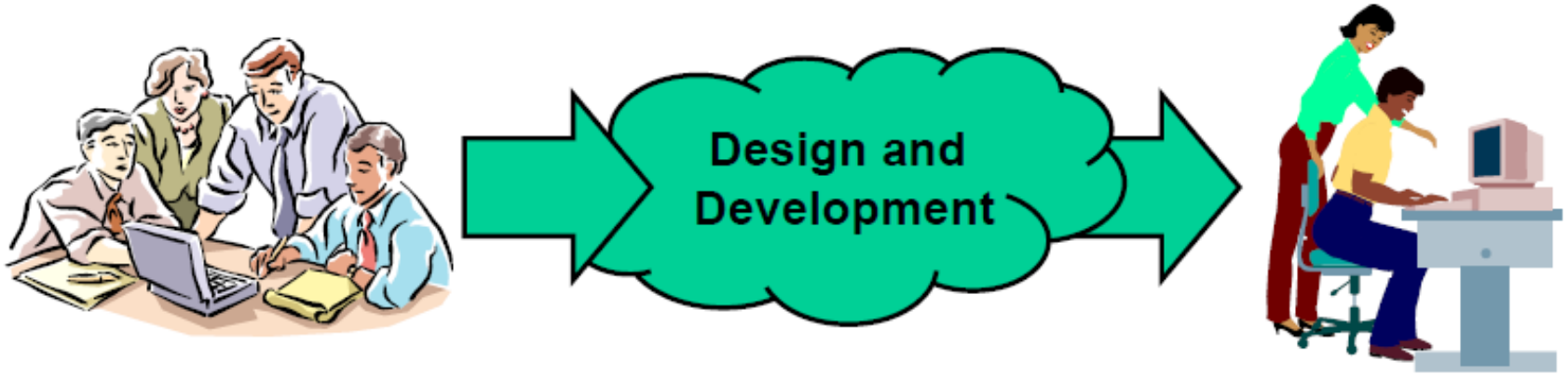
Human Factors Design Process

Start with the user(s)

End with the user(s)



- What users need
- What users know
- How users work
- User limitations

- Objective user testing
- Subjective user evaluation
- Post-deployment analysis
- Postmortem review

Slide courtesy of Philip Kortum

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DEVLOPING HF RESOURCES

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Decentralized

- Similar to Project Manager, Quality Improvement, Lean Six Sigma
- Can float where needed

Breadth

Ambulatory	Value Analysis	Periop	NICU	CICU	TCC	Information Services	Telehealth

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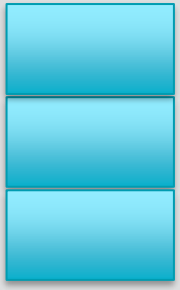
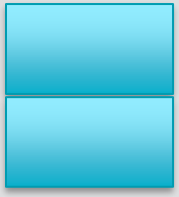
Depth

Ambulatory	Value Analysis	Periop	NICU	CICU	TCC	Information Services	Telehealth
							

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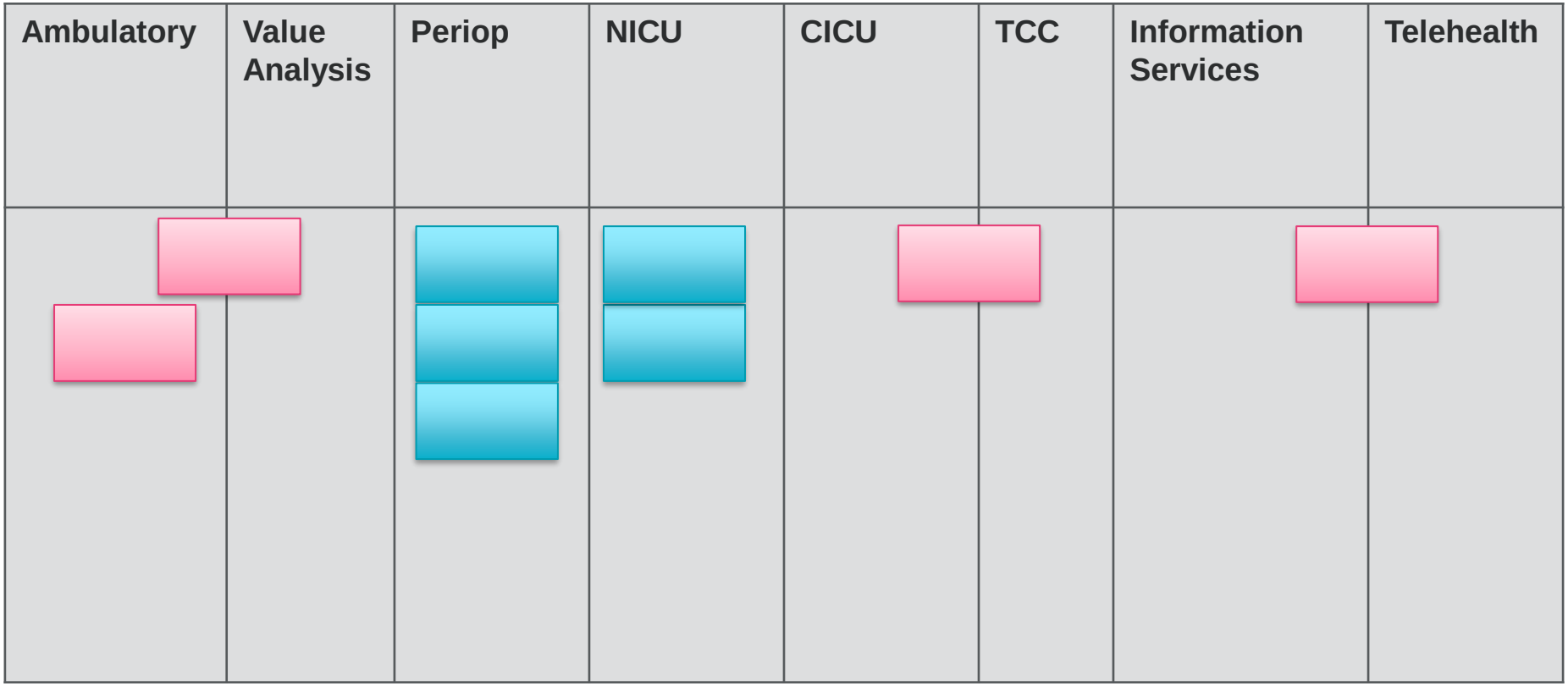
Breadth and Depth



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Return on Investment

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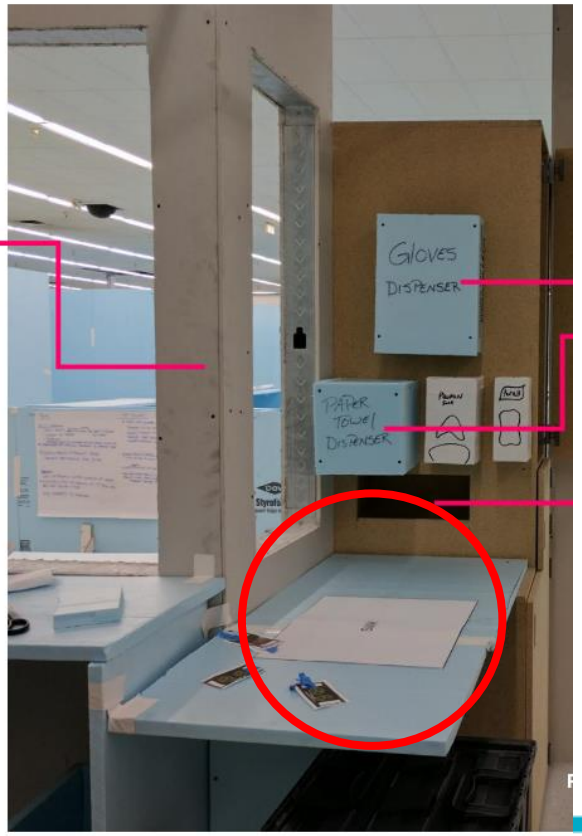
Critical Care Building Workspace Design



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Savings:

Item	Cost	Saved
Moved door (x120)	$500	60,000
Moved sink (x120)	$800	96,000
Adjusted lighting (x120)	$1700	204,000
New tiling (x120)	$1850	222,000
Cabinet removal (x4)	$20,000	80,000
	Saved:	$662, 000

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Code Cart Re-design

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Code Cart Re-design

Items delivered to bedside	Original Code Cart Times[1]	Redesigned Code Cart Times[1]	P
All items (total time)	139.9±41.9	113.8±33.4	0.11
Bag/Mask	43.9±31.5	30.1±14.4	0.21
Intraosseous equipment	46.36±22.9	23.87±6.6	0.003
Epinephrine	92.17±46.76	95.74±34.63	0.76
IV Push/Pull System	99.7±46.9	74.43±35	0.15

Average 30 secs

$96,000

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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!

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Resources

Human Factors and Ergonomics Society

Human Factors Transforming Healthcare

Thank You!

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