MedStar Health
National Center for
Human Factors in Healthcare

Human Factors in Machine Learning and Artificial Intelligence

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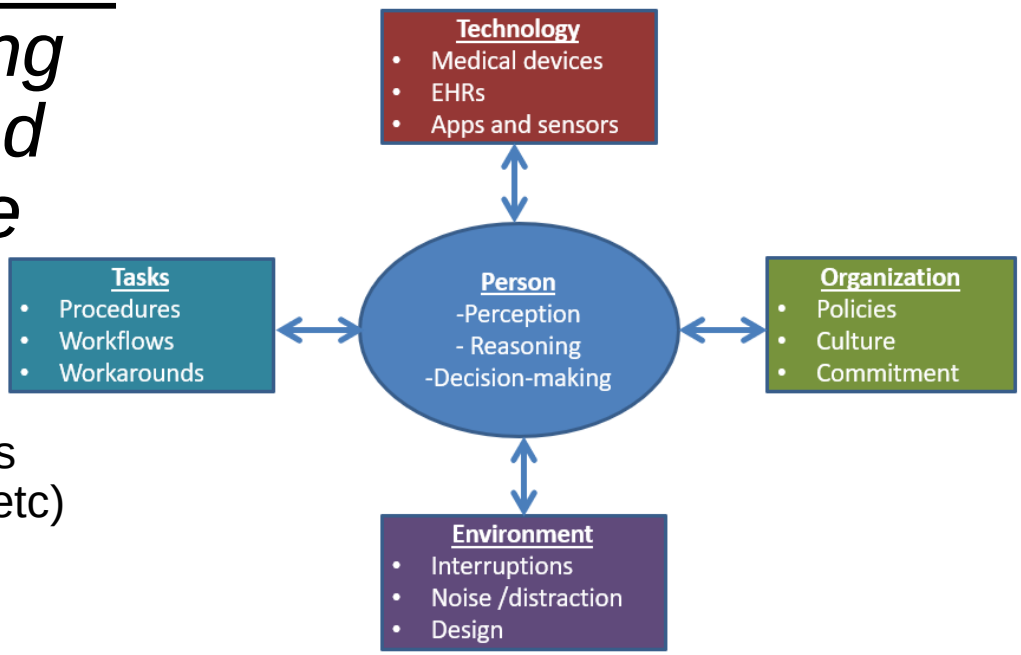
What is Human Factors?

- Multidisciplinary science that focuses on studying human capabilities and *designing technology, systems, and processes to meet these capabilities* for safety, efficiency, & quality
  - Used extensively in other industries (aviation, transportation, defense, etc)



- Must understand context of use and system factors

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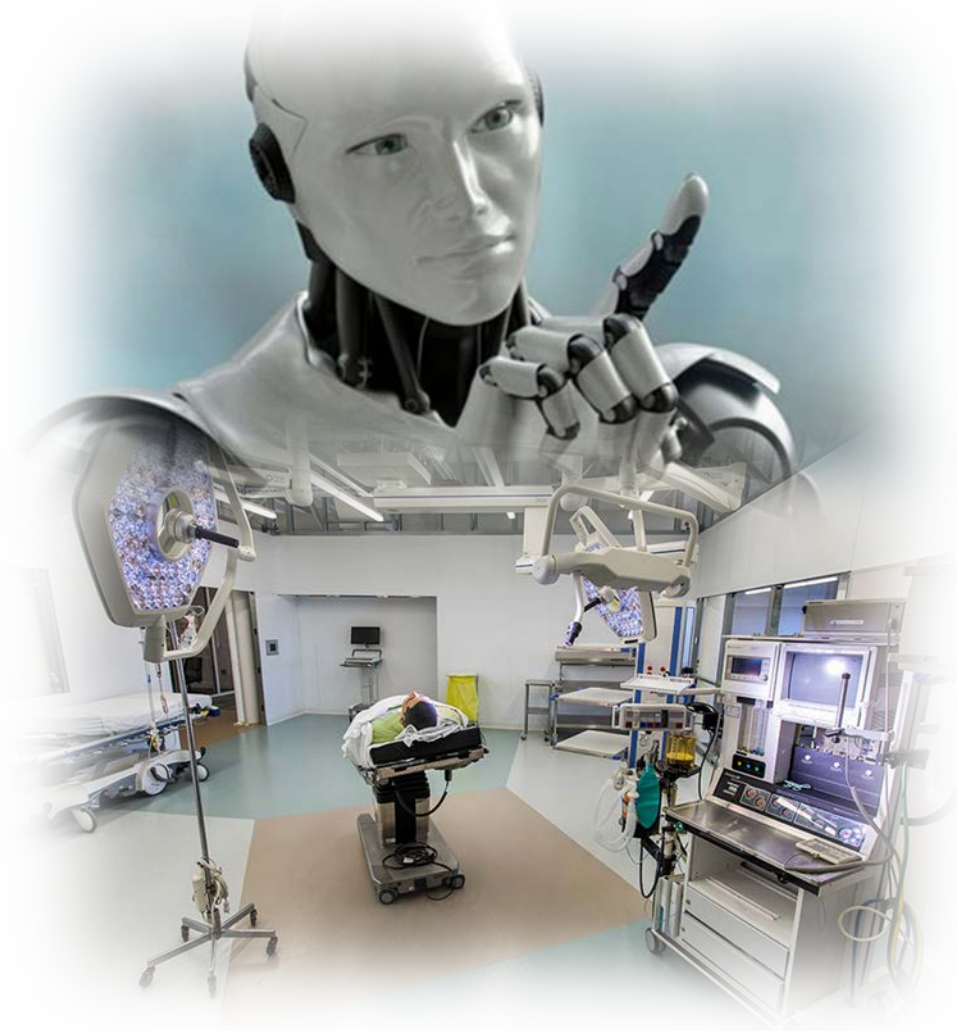
The Central Tenant of Human Factors

"We don't redesign humans.

We redesign the system within which humans work."



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The ML/AI Reality Gap

ML/AI Development & Imagined Use

Typical

- **12 hou**
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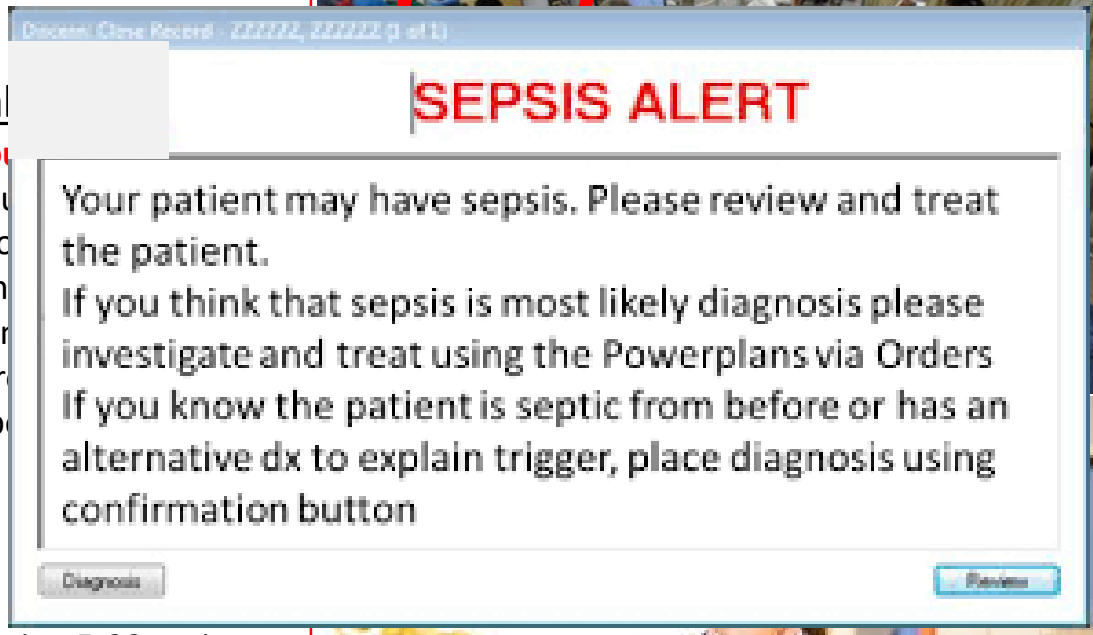
- Managing 5-20 patients

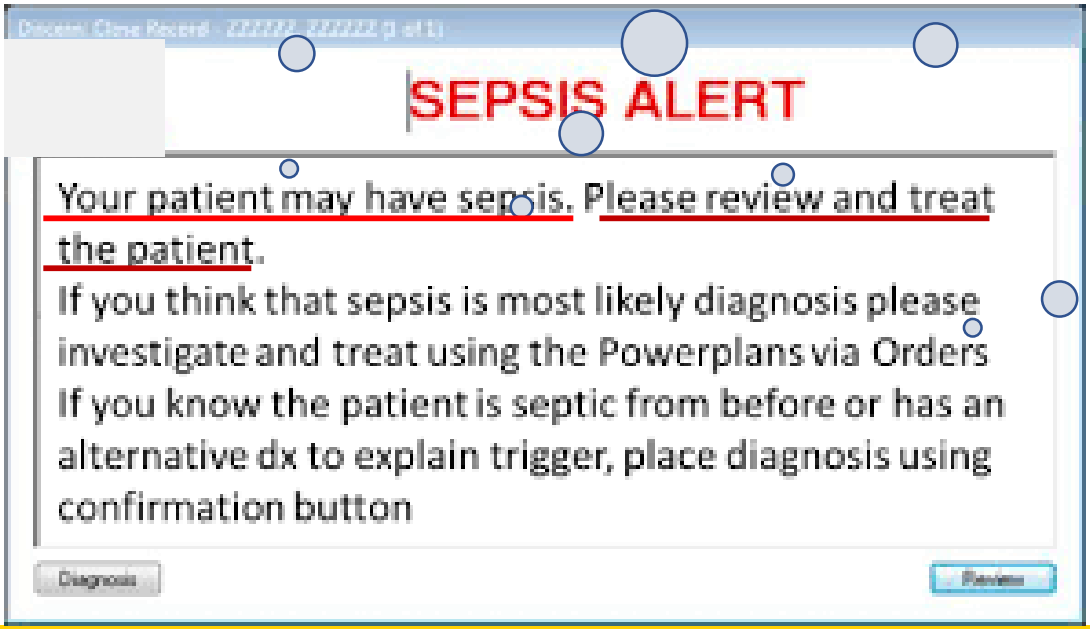
ML/AI in Real Life



Why does the model think this?

How confident is the model? Can I do something to increase confidence?

What should I be doing that I am not already doing?



Why are you asking me to do all of this?

User-Centered Design

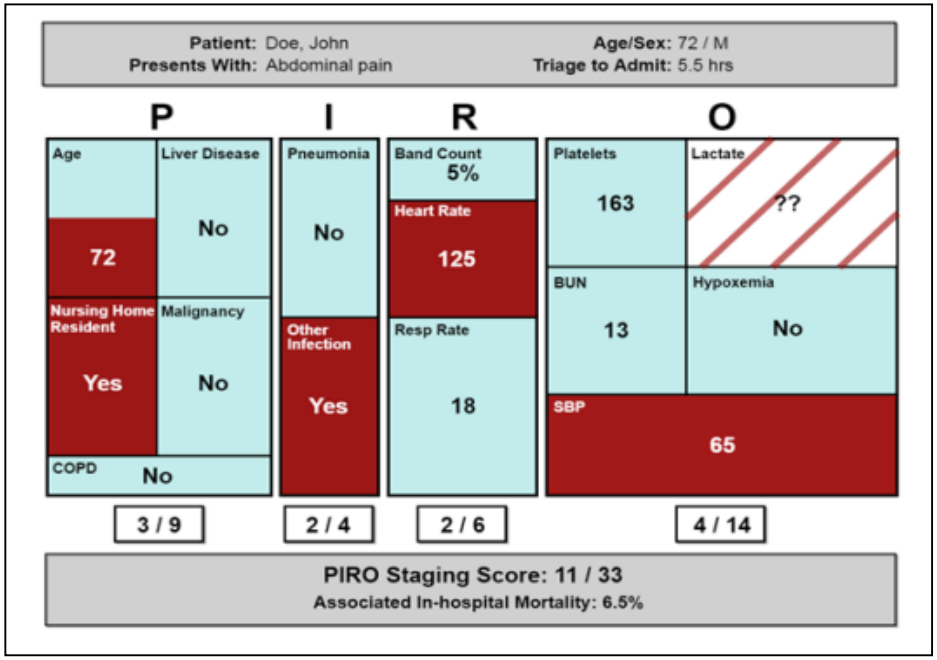
Four Life Cycle Phases of Artificial Intelligence Model Deployment Incorporating Human Factors Elements and User-centered Design

Life Cycle Phase	Description	Example User-Centered Design Methods and Techniques
Design	The intended user of the AI should be involved early and continuously during this stage to ensure their needs are considered.	Observe the clinical environment Identify needs through interviews and focus groups Develop user personas
Development	Rapid and iterative prototyping of an AI model to maintain desired performance characteristics through testing with intended end-users.	Conduct iterative user testing Perform cognitive walkthrough Perform final (summative) usability testing
Implementation	Technical integration, testing and deployment, educational sessions for users, and consideration of interaction with other clinical systems, tools, and work processes.	Redesign existing workflows and processes to integrate new technology Conduct pilot test Refine based on user feedback
Long-term use	AI models should be continually monitored and validated to maintain desired performance and to detect safety events. Models may be retrained and additionally re-evaluated for modification of human factors elements.	Monitor user interaction data Provide a mechanism to report safety issues Monitor performance outcomes

Filice, R. W., & Ratwani, R. M. (2020). The Case for User-Centered Artificial Intelligence in Radiology.

Critical Human Factors Aspects

- **Workflow Matters**
  - Assistance at the right time
  - Assist the right people (not always the physician)
  - Make it easy
- **Answer the "Why?"**
  - Don't just predict, inform
  - Reasoning/decision-making
- **Confidence is Key**
  - Represent confidence
  - Optimize based on feedback



Schubel, L., Mosby, D. L., Blumenthal, J., Capan, M., Arnold, R., Kowalski, R., ... & Littlejohn, R. (2020). Informatics and interaction: Applying human factors principles to optimize the design of clinical decision support for sepsis. *Health Informatics Journal*, *26*(1), 642-651.

Thank You

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