



Human Factors Engineering for EHR Design in Oncology Care

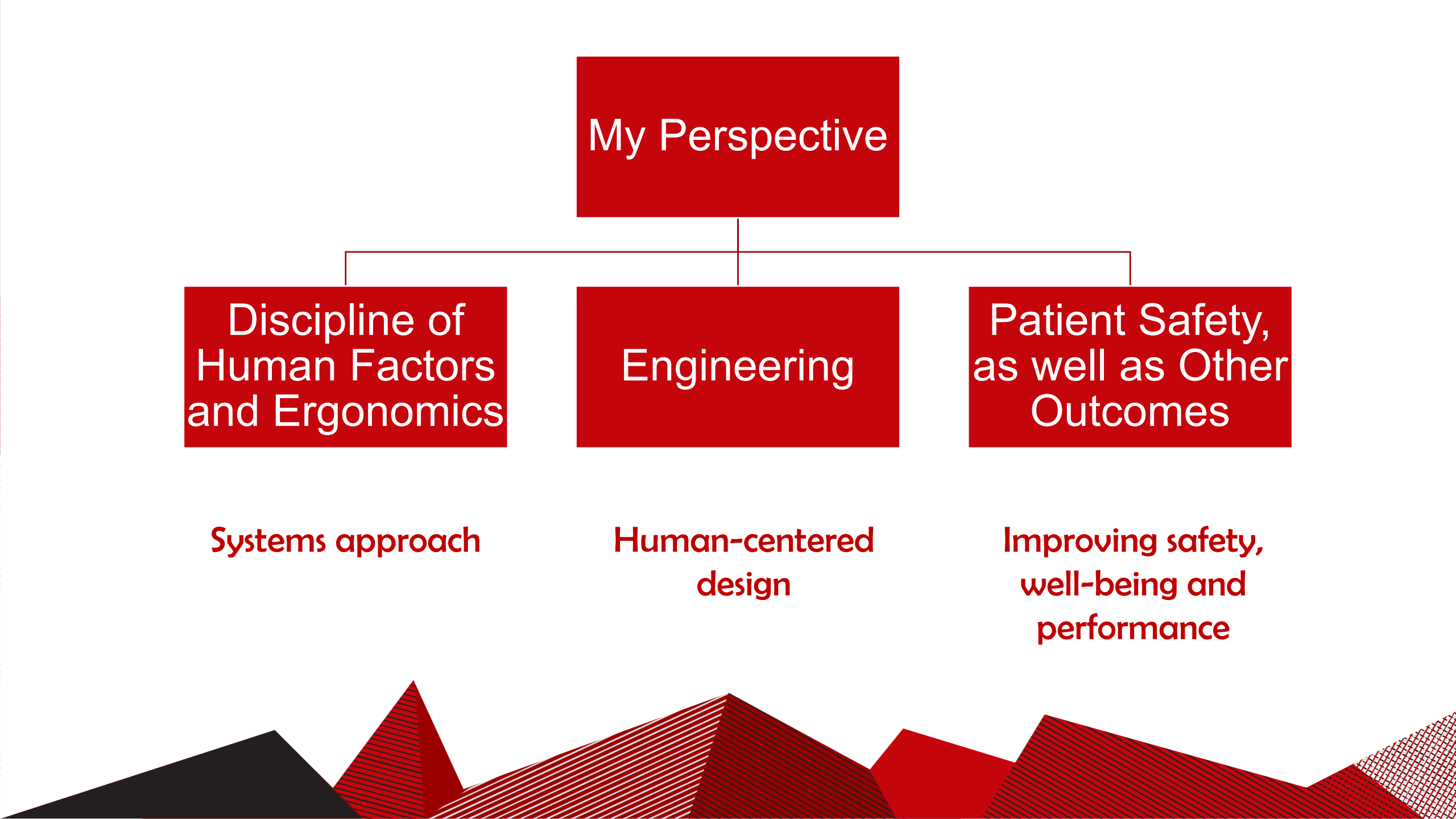
A Patient Journey Perspective

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February 28, 2022

My Perspective



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graph TD; A[My Perspective] --> B[Discipline of Human Factors and Ergonomics]; A --> C[Engineering]; A --> D[Patient Safety, as well as Other Outcomes]; B --- E[Systems approach]; C --- F[Human-centered design]; D --- G[Improving safety, well-being and performance];
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Discipline of
Human Factors
and Ergonomics

Systems approach

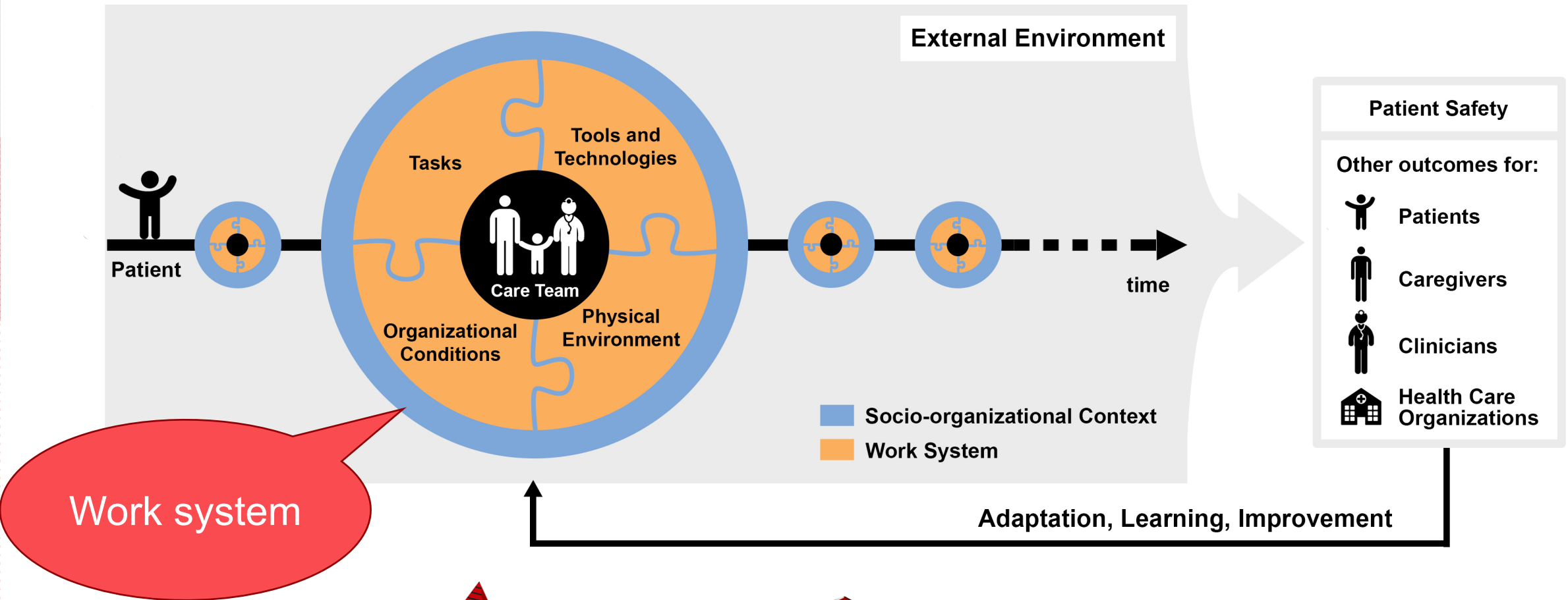
Engineering

**Human-centered
design**

Patient Safety,
as well as Other
Outcomes

**Improving safety,
well-being and
performance**

SEIPS 3.0 Model of the Patient Journey



Design of medication drawer in code cart (Rousek & Hallbeck, 2011)

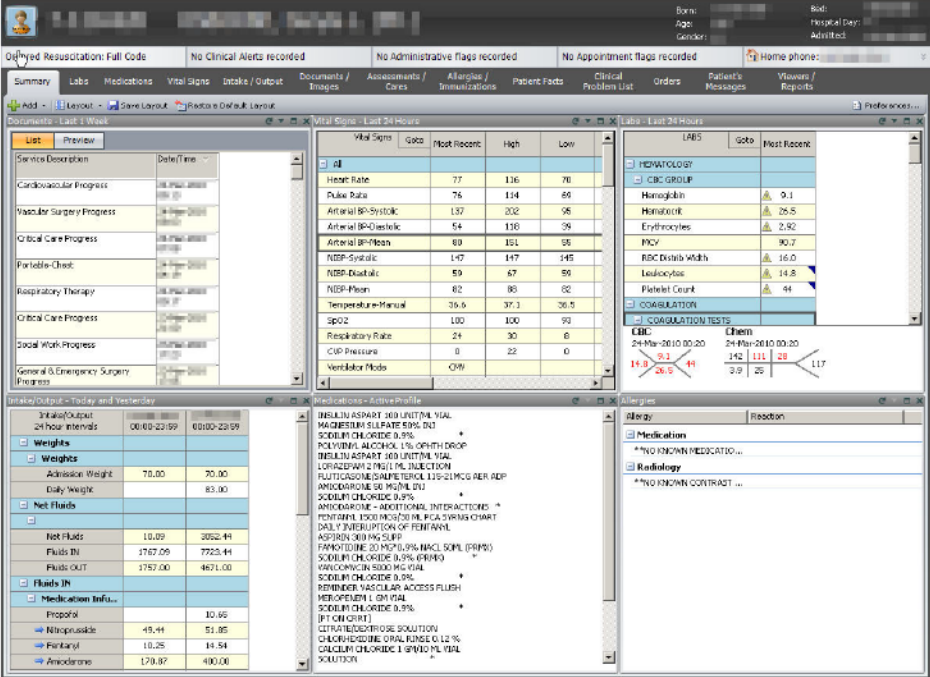


Fig. 1 Standard EMR. Synthesis offers a summary view of a single patient's electronic medical data. This interface offers access to laboratory, radiological, physiological, documents and demographic patient information.

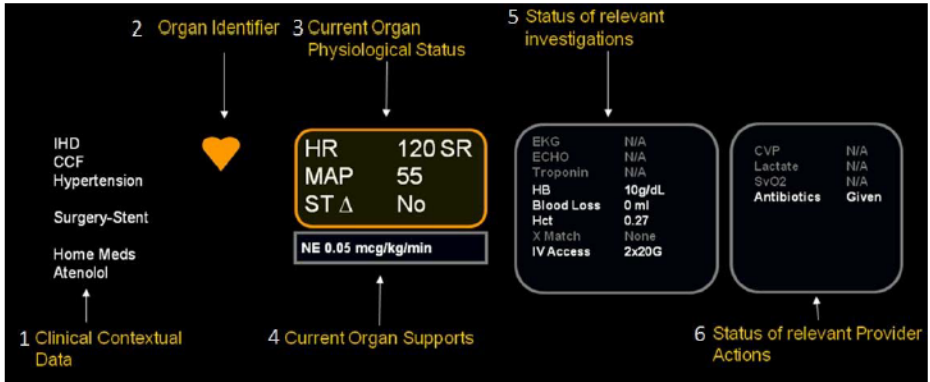
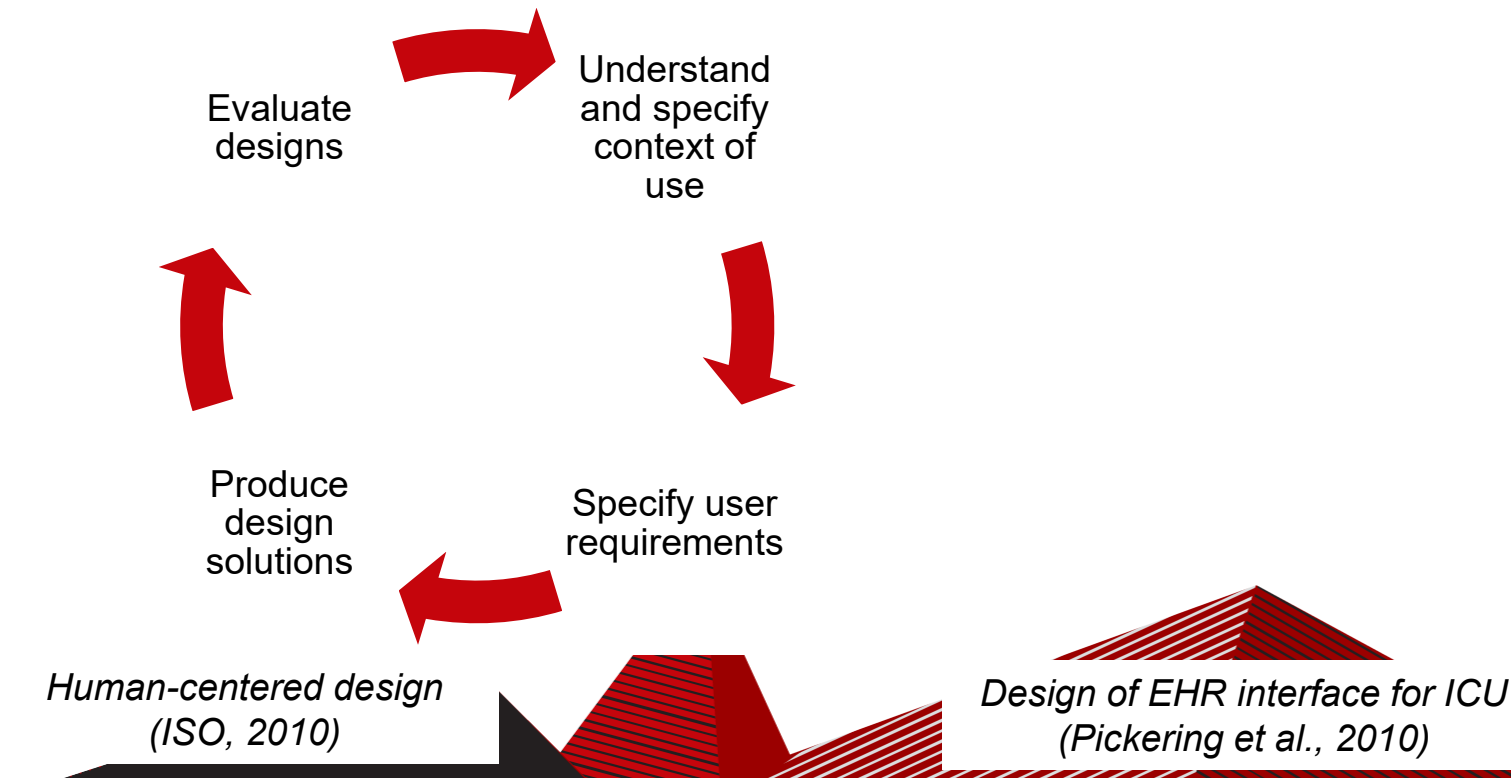
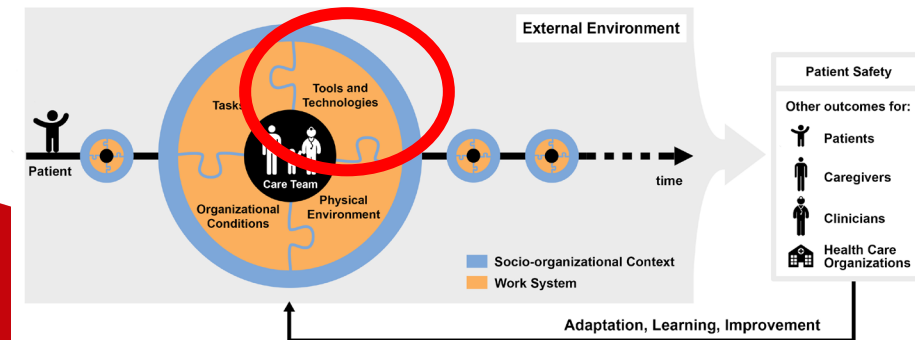


Fig. 2 The display of data within a systems based information package (in this case the cardiovascular system) is illustrated. The organization of data elements was determined by considering how experts incorporate information into decision making mental models. Reading from left to right the key organizational elements are; clinical context pulled from the patient problem list, procedure, medications and consults lists; system identifying icon with color coded status (red – urgent intervention, orange – abnormal physiology or investigation, green – normal physiology and investigations); physiological status displays current values for key physiological variables – color coding follows organ identifier; Organ Supports, displays the critical care interventions which are supporting the current physiological status; investigations displays the status and, when available, the result of high value system based investigations; provider actions are tracked in this status panel – the content of this panel varies with context e.g. Sepsis v Bleed.

How do we design **better EHR technologies**?

- *HFE methods and design principles*
- Usability:
 - Usability heuristics (Zhang et al., 2003; Scapin & Bastien, 1997)
 - Usability evaluation (Kortum, 2016)
- Designing **technologies that support the work**:
 - User-centered design, human-centered design
 - Understanding the **actual** work of clinicians, patients, ...
 - Designing **with**



How do we design EHR technologies that **fit the workflow**?

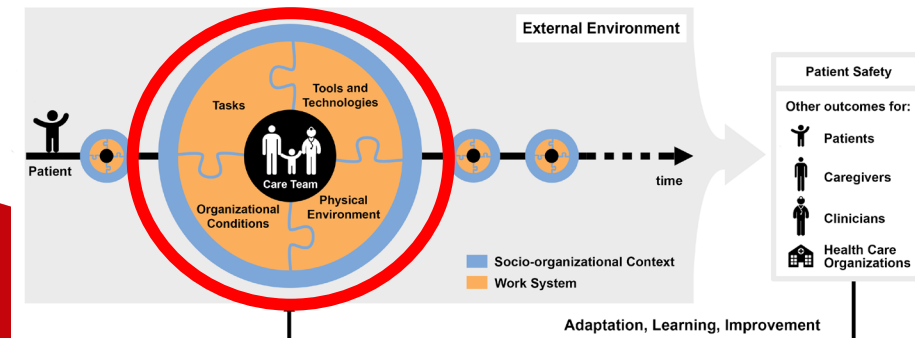
- Workflow integration of EHR
 - Burnout and stress of clinicians and patients
 - Communication between clinicians and patients

*“... EHRs hindered effective patient documentation and were prone to error”
(Lafferty et al., 2020)*

“EHR responsibilities caused moderate to excessive stress at work for 66.9% of physicians” (Gajra et al., 2020)

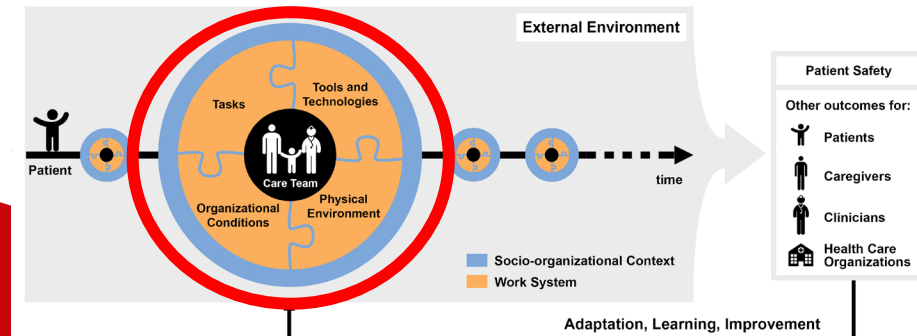
Increase of burnout among oncology PAs between 2015 and 2019 (Tetzlaff et al., 2022)

“...strategies that can mitigate the negative effects of the ERC [examination room computer] use on physician-patient communication” (Haider et al., 2018)



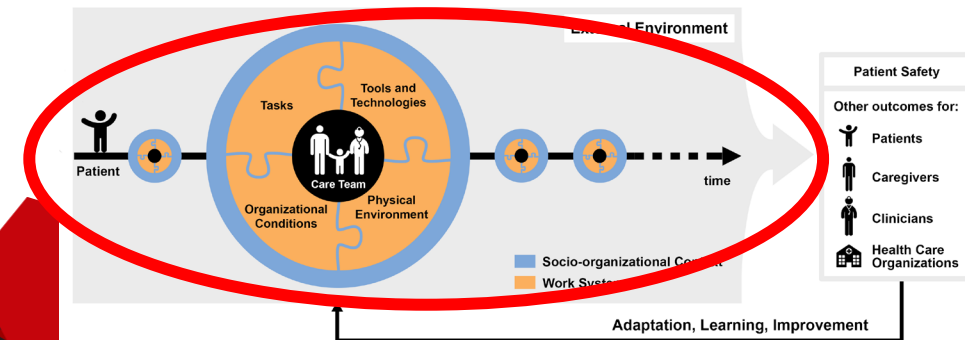
How do we design EHR technologies that **fit the workflow**?

- Workflow integration of EHR:
 - Does the technology support the **tasks** performed by clinicians and patients?
 - How does the technology fit with **temporal flow** of tasks? [sequential, delay,...]
 - How does the technology fit with the **physical environment**?
 - How does **organization** support the implementation and use of the technology?
 - How are the various **technologies** integrated with each other?

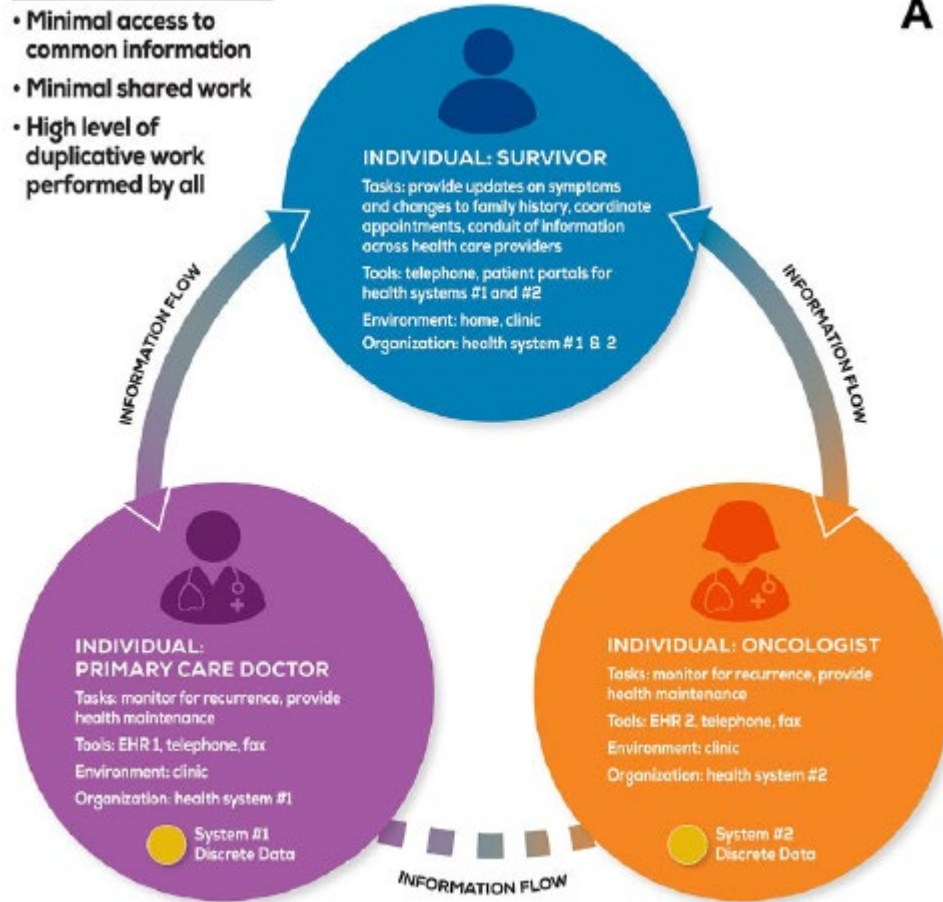


How do we design EHR technologies that support the patient journey?

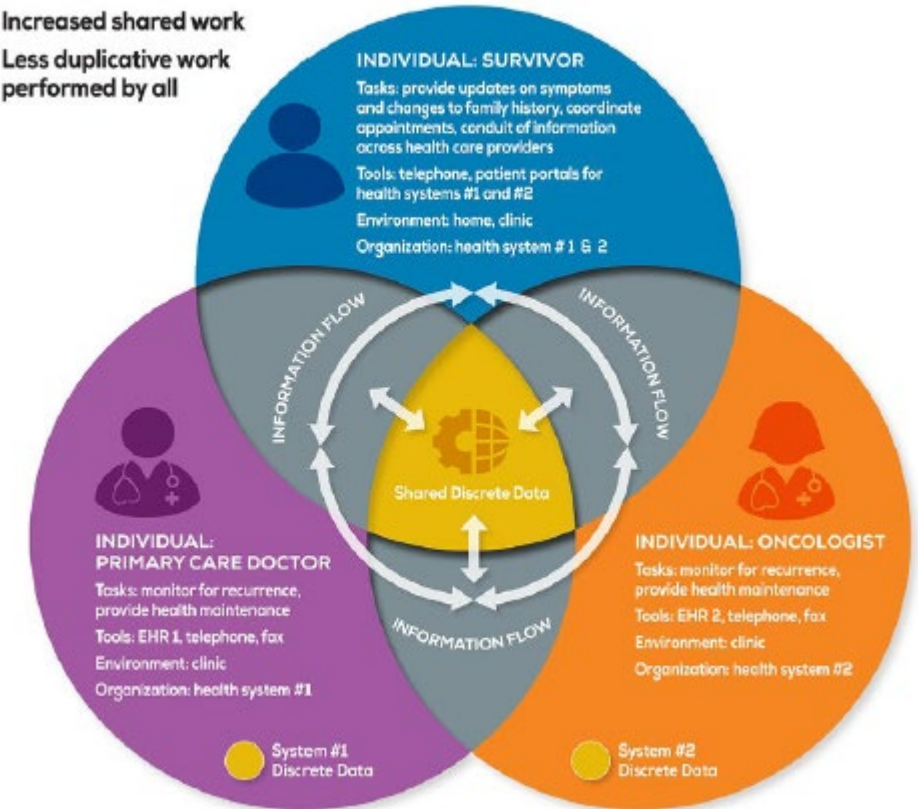
- Design of EHR technologies for **fluid teams** that are distributed...
 - over time
 - over space
 - over organizations
- Care coordination and interfaces:
 - “... lack of effective displays of a complex treatment as a whole” (Lichtner & Baysari, 2021)
 - “... a variety of visualization displays over different time horizons” (Lichtner et al., 2020)



- Minimal access to common information
- Minimal shared work
- High level of duplicative work performed by all



- Access to common discrete information
- Increased shared work
- Less duplicative work performed by all



Opportunities for EHR Innovation

1. HFE is a scientific discipline

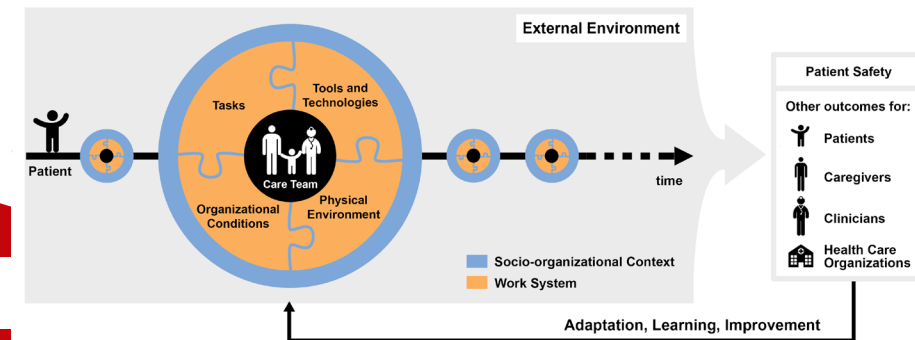
- Professional associations: HFE Society, International Ergonomics Association
- HFE has methods and design principles.

2. Participation of stakeholders:

- Designing **with** [in addition to designing for]
- Supporting the **actual** work

3. Design is tough; hard to get it right; continuous design process:

- **Learning**, feedback loops (Carayon & Salwei, 2021)





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References

- Baysari, M. T., B. A. van Dort, M. Prgomet, W. Y. Zheng, M. Z. Raban, L. Dalla-Pozza, C. McCullagh and J. Westbrook (2020). "The efficiency–thoroughness trade-off after implementation of electronic medication management: a qualitative study in paediatric oncology." International Journal for Quality in Health Care **32**(8): 511-516.
- Carayon, P. and M. E. Salwei (2021). "Moving toward a sociotechnical systems approach to continuous health information technology design: The path forward for improving electronic health record usability and reducing clinician burnout." Journal of the American Medical Informatics Association **28**(5): 1026-1028.
- Carayon, P., A. Wooldridge, P. Hoonakker, A. S. Hundt and M. M. Kelly (2020). "SEIPS 3.0: Human-centered design of the patient journey for patient safety." Applied Ergonomics **84**.
- Gajra, A., B. Bapat, Y. Jeune-Smith, C. Nabhan, A. J. Klink, D. Liassou, S. Mehta and B. Feinberg (2020). "Frequency and causes of burnout in US community oncologists in the era of Electronic Health Records." JCO Oncology Practice **16**(4): e357-e365.
- Haider, A., K. Tanco, M. Epner, A. Azhar, J. Williams, D. D. Liu and E. Bruera (2018). "Physicians' compassion, communication skills, and professionalism with and without physicians' use of an examination room computer: A randomized clinical trial." JAMA Oncology **4**(6): 879-881.
- International Organization for Standardization (2010). ISO 9241-210 Ergonomics of Human-System interaction - Part 210: Human-Centred Design for Interactive Systems. Geneva, Switzerland, ISO.
- Kortum, P. T. (2016). Usability Assessment: How to Measure the Usability of Products, Services, and Systems. Santa Monica, CA, The Human Factors and Ergonomics Society.
- Lafferty, M., M. Manojlovich, J. J. Griggs, N. Wright, M. Harrod and C. R. Friesse (2021). "Clinicians report barriers and facilitators to high-quality ambulatory oncology care." Cancer Nursing **44**(5): E303-E310.
- Lichtner, V. and M. Baysari (2021). "Electronic display of a patient treatment over time: A perspective on clinicians' burn-out." BMJ Health Care Informatics **28**(1).
- Lichtner, V., B. D. Franklin, L. Dalla-Pozza and J. I. Westbrook (2020). "Electronic ordering and the management of treatment interdependencies: A qualitative study of paediatric chemotherapy." BMC Medical Informatics and Decision Making **20**(1): 193.
- Pickering, B. W., V. Herasevich, A. Ahmed and O. Gajic (2010). "Novel representation of clinical information in the ICU: Developing user interfaces which reduce information overload." Applied Clinical Informatics **1**(2): 116-131.
- Rousek, J. B. and M. S. Hallbeck (2011). "Improving medication management through the redesign of the hospital code cart medication drawer." Human Factors **53**(6): 626-636.
- Scapin, D. L. and J. M. C. Bastien (1997). "Ergonomic criteria for evaluating the ergonomic quality of interactive systems." Behaviour & Information Technology **16**(4): 220-231.
- Tetzlaff, E. D., H. M. Hylton, K. J. Ruth, Z. Hasse and M. J. Hall (2022). "Changes in burnout among oncology physician assistants between 2015 and 2019." JCO Oncology Practice **18**(1): e47-e59.
- Tevaarwerk, A. J., J. R. Klemp, G. J. van Londen, B. W. Hesse and M. E. Sesto (2018). "Moving beyond static survivorship care plans: A systems engineering approach to population health management for cancer survivors." Cancer.
- Zhang, J., T. R. Johnson, V. L. Patel, D. L. Paige and T. Kubose (2003). "Using usability heuristics to evaluate patient safety of medical devices." Journal of Biomedical Informatics **36**: 23-30.