The Unintended Effects of Medical Software on Clinical Decisions and Patient Safety: System Viewpoint

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Biography

Farah Elkourdi is a Ph.D. student advised by Dr. Onur Asan in Systems Engineering at Stevens Institute of Technology.
She received her B. Sc. degree in Computer Engineering and M. Sc. degree in Software Engineering. Her previous experience includes working as a software developer on various projects.
Her research interests are primarily in Software Engineering, Human-Computer Interaction, and Digital Health.

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Introduction

- Medical software refers to a type of computer program designed to aid in the diagnosis, treatment, or management of patient data and medications. [1]

- Medical software is a vital component of the healthcare system impacting patient safety.

- Medical software can enhance the quality of patient care, diminish paper workload, and reduce unnecessary medical tests. [2]

- Medical errors are a serious public health problem and the third-leading cause of death. [3]

- There are errors associated with healthcare Information Technology (IT) that can disrupt care delivery and harm patients. [4]

1. P. Schneider and M. Hines, "Classification of medical software," in Symposium on Applied Computing, Arkansas, 1990, pp. 20-27, doi: 10.1109/SOAC.1990.82134
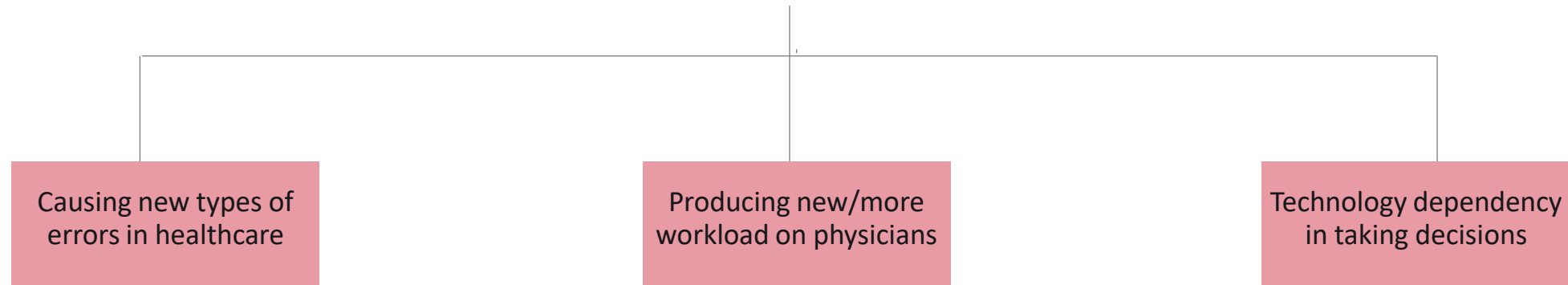2. healthit.gov, "Advantages of Electronic Health Records," healthit.gov, 8 March 2022. [Online]. Available: https://www.healthit.gov/faq/what-are-advantages-electronic-health-records. [Accessed 21 March 2023].
3. O. Ozeke, V. Ozeke, O. Coskun, and I. I. Budakoglu, "Second victims in health care: current perspectives," Advances in Medical Education and Practice, vol. 10, pp. 593–603, 2019.
4. M. O. Kim, E. Coiera, and F. Magrabi, "Problems with health information technology and their effects on care delivery and patient outcomes: a systematic review," Journal of the American Medical Informatics Association, vol. 24, no. 2, pp. 246-250, 2017.

SOME UNINTENDED CONSEQUENCES RELATED TO MEDICAL SOFTWARE

Causing new types of errors in healthcare	Producing new/more workload on physicians	Technology dependency in taking decisions

The most commonly reported software medical errors in healthcare are generated by **wrong data entry**, **a selection from dropdown menus**, and **file uploads**. [1]

1. M. O. Kim, E. Coiera, and F. Magrabi, "Problems with health information technology and their effects on care delivery and patient outcomes: a systematic review," Journal of the American Medical Informatics Association, vol. 24, no. 2, pp. 246-250, 2017.

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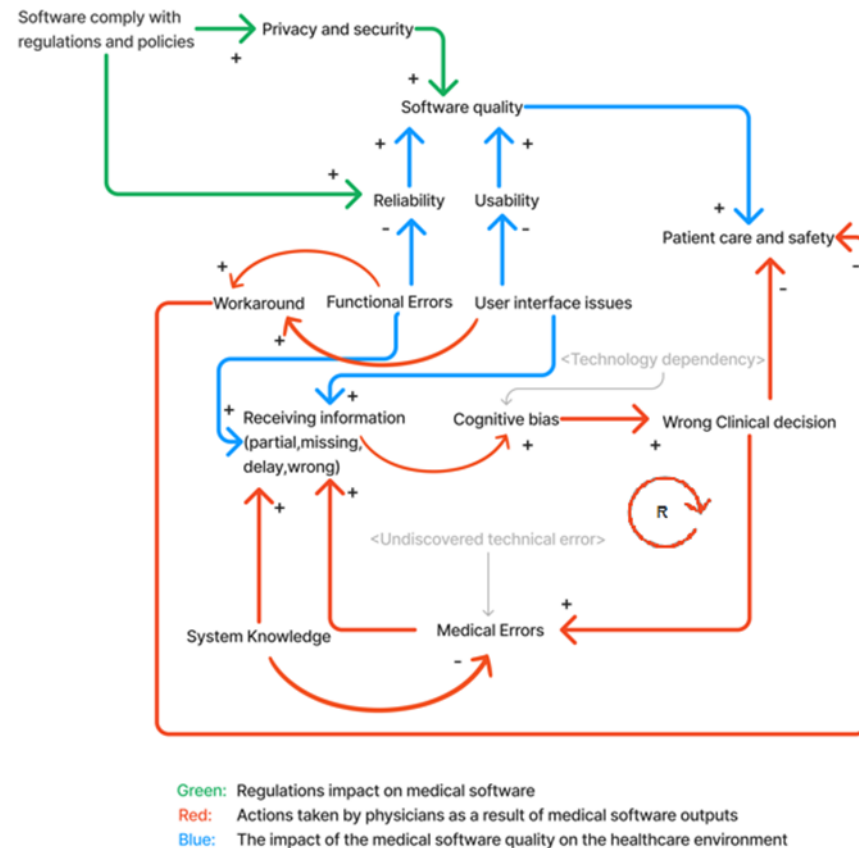# POTENTIAL SOURCES OF UNINTENDED CONSEQUENCES

Figure 1. Causal loop presents the potential sources of software medical errors

- The impact of regulations and policies on medical software is presented in green arrows in Figure 1.

- The blue arrows in Figure 1 present the impact of medical software quality on the healthcare environment.

- The red arrows in Figure 1 present physicians' actions as a result of medical software outputs.

The key objective is to eliminate the potential sources of the negative consequences to deliver a high care quality in clinical decisions and support patient safety.

Errors and poor user interfaces might interfere with receiving the information and lead to errors when making decisions. [1]
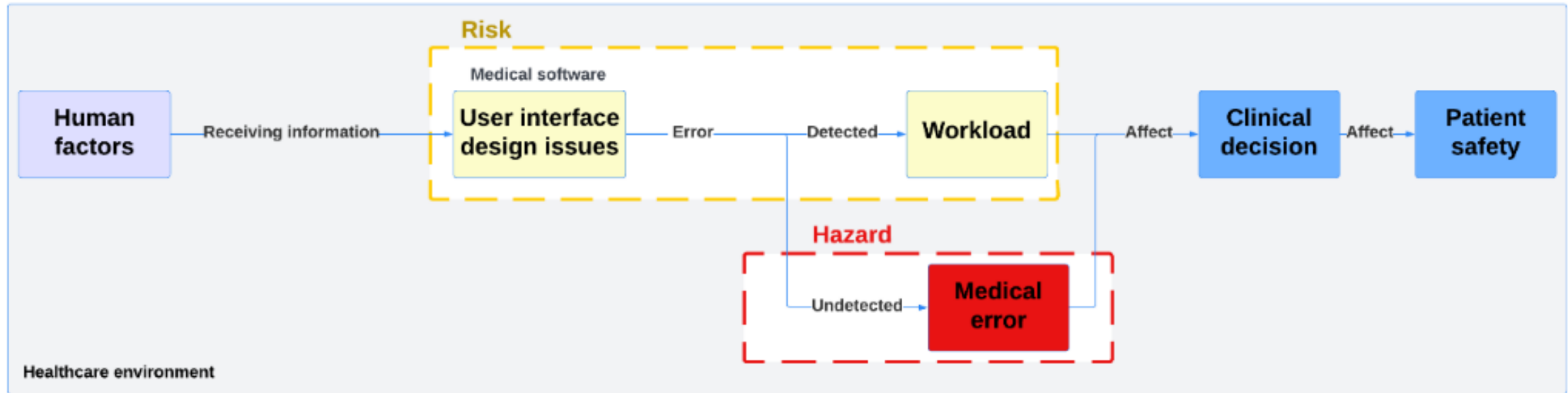

Figure 2. The impact of human factors and medical software on clinical decision and patient safety

1. M. O. Kim, E. Coiera, and F. Magrabi, "Problems with health information technology and their effects on care delivery and patient outcomes: a systematic review," Journal of the American Medical Informatics Association, vol. 24, no. 2, pp. 246-250, 2017.
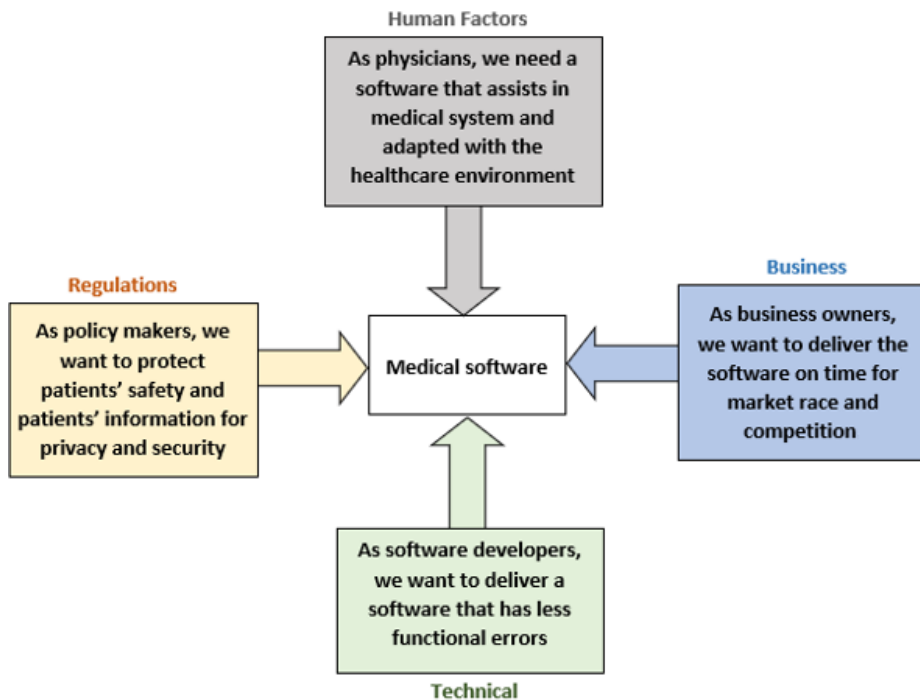
DIFFERENT PERSPECTIVES AND VALUES

Figure 3. Different perspectives of multiple stakeholders in the system

Implementing software into the healthcare system might produce possible unforeseen consequences due to the complexity of the healthcare system and the various stakeholders involved in the system:

➢ Policymakers' perspective
➢ Business perspective
➢ Technical perspective
➢ Human factor perspective

The ideal point for producing successful medical software is to maintain in the middle to observe the full picture that is balancing between all the four different aspects.

Conclusion

- The challenges rely on applying a complex system "the medical software" into another complex system "the healthcare" system.

- Identifying the potential sources of unintended consequences helps in achieving our objectives of minimizing the risks.

- The system stakeholders must collaborate and communicate effectively to ensure that the medical software is developed and implemented to prioritize patient safety and care.

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