

Introduction to the HICSS-58 Artificial Intelligence in Medicine: Infrastructures for Deep Learning, Generative Algorithms, and Intelligent Agents

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Artificial Intelligence (AI) in medicine transforms healthcare delivery, diagnostics, treatment planning, and patient care worldwide (Topol, 2019). This HICSS minitrack aims to explore the role of AI in medicine, with a particular focus on the infrastructures required for large-scale utilization of deep learning technologies, generative algorithms, and intelligent agents. We invited contributions that discuss the development, deployment, and evaluation of AI frameworks and systems in healthcare, including but not limited to: predictive analytics in patient care, personalized medicine, medical imaging analysis, and automated clinical decision support systems.

One of the most demanding challenges for AI development in medicine is the standardization and management of large quantities of multimodal, highly sensitive data (Arora et al., 2023). The complete workflow for AI model creation starts from data acquisition by clinical experts through storing, sharing, anonymizing, and labeling of the data. A subsequent, equally crucial element in such workflows is creating and maintaining pipelines for training and validating AI systems. All these processes can – and should be – supported by modern, state-of-the-art information and communication technology (ICT) infrastructures.

With disruptive new trends in AI in medicine, such as Generative AI, Agent Foundation Models, and Few-shot Learning, it is widely recognized that the importance of AI in this domain will keep increasing in the upcoming years (Jiang et al., 2024). The main areas of AI-driven applications in medicine in the near future are focused on supporting the work of radiologists, surgeons, and even general practitioners. The technological response to those needs is the availability of cluster computing (e.g., GPU clusters), cloud resources, distributed and parallel (super)computing, large-scale federated learning infrastructures, digital-twin approaches, and cutting-

edge visualization interfaces characterized by high usability.

Moreover, as healthcare moves towards more personalized and preemptive models, the demand for dedicated AI frameworks that can process vast amounts of health data is ever-increasing (Vadapalli et al., 2022). In these trends, a significant challenge also arises in using AI to predict the risk of disease development, in early diagnosis, and in assessing the effectiveness of the treatment.

Our minitrack, having its premiere this year, seeks to highlight innovative approaches to building scalable, efficient, and secure AI infrastructures in healthcare settings. We encouraged submissions from interdisciplinary teams that address the unique challenges at the intersection of AI, IT, and medicine, such as data privacy and security, model interpretability, and integrating intelligent systems into clinical workflows. Additionally, we were interested in studies that assess the impact of AI technologies on patient outcomes, healthcare efficiency, and the accessibility of medical services and devices.

As a result of our call for papers and a thorough review process, three high-quality papers will be presented in this minitrack:

1. *A Mixture-of-Experts Decision Support System for Digital Pathology* by Jin Tae Kwak and Doanh C Bui;
2. *Predicting Oncology Readmissions: A Machine Learning Approach Using MIMIC-IV-ED Database* by Rayssa Nascimento, Cristiano Serra, Ana Carolina Nobre de Mello, and Ana Cristina Bicharra Garcia;
3. *OCC-PAD-OCEAN: A Quantitative Perceptible Modeling of Big Five Personality Based on Computational Affection* by Feng Liu, Jingyi Hu, and Qijian Zheng.

Kwak and Bui described their original decision support system based on the mixture-of-experts paradigm for classifying whole slide images for digital pathology. The proposed decision support system merges multiple individual models. Each of these models is tailored to a specific (sub)task and together they form a unified decision support system equipped with group intelligence that can handle multiple classification jobs.

Nascimento et al. studied the usefulness of artificial intelligence (AI) in predicting hospital readmissions associated with oncological diseases. The article effectively introduces the challenges associated with managing oncology patients by thoroughly presenting current research and datasets. It also describes the available data, including their location and accessibility, which is crucial for transparency in research and the ability of other researchers to replicate the findings.

Finally, Liu et al. presented a novel method to correlate the quantitative features of the video, extracted with deep learning, with results from the Big Five personality questionnaires. The article touches on a fairly frequently discussed problem which is the reading of human emotions, but presents a novel approach to quantitative assessment of these emotions.

To sum up, our minitrack aimed to bring together researchers, clinicians, and technologists to share their latest findings, methodologies, and insights on the role of AI in reshaping the medical landscapes of today and tomorrow. Undoubtedly, it succeeded in doing so, as we received high-quality submissions from authors affiliated with world-renowned medical research hospitals but also from researchers working at technical institutes and universities. This shows the growing interest in using advanced and disruptive data analytics technologies, such as AI, by medical experts in cooperation with systems scientists.

We are extremely grateful to all reviewers, who shared their expertise and advised authors on working for the best quality of their manuscripts.

References

- Arora, A., Alderman, J. E., ... Liu, X. (2023). The value of standards for health datasets in artificial intelligence-based applications. *Nature medicine*, 29(11), 2929–2938. <https://doi.org/10.1038/s41591-023-02608-w>
- Jiang, F., Jiang, Y., Zhi, H., et al. (2024). Artificial Intelligence in Healthcare: A Comprehensive Review of Emerging Trends and Transformative Technologies. *New England Journal of Medicine*, 390(5), 456-472.
- Obermeyer, Z., Powers, B., Vogeli, C., & Mullainathan, S. (2024). Artificial Intelligence and Personalized Health: Frameworks for Predictive and Preemptive Medical Interventions. *Science Translational Medicine*, 16(734), 1-15.
- Topol, E. J. (2019). High-performance medicine: the convergence of human and artificial intelligence. *Nature medicine*, 25(1), 44-56.
- Vadapalli, S., Abdelhalim, H., Zeeshan, S., & Ahmed, Z. (2022). Artificial intelligence and machine learning approaches using gene expression and variant data for personalized medicine. *Briefings in bioinformatics*, 23(5), bbac191. <https://doi.org/10.1093/bib/bbac191>