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# Special Issue on Digital Innovations in Healthcare

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## 1. Introduction

The healthcare service field is currently experiencing a substantial transformation driven by rapid advancements in digital technologies and innovation. The integration of artificial intelligence and the Internet of Things, machine learning and sensing technologies are reshaping the ways we diagnose, treat, and manage the healthcare of patients. This Special Section "Digital Innovations in Healthcare" aims at investigating recent advances in AI-based systems, multimodal data fusion, and real-time digital-based diagnostics, areas that are crucial to increase the diagnostic precision and the efficiency of healthcare businesses. However, implementing such techniques presents several challenges, such as the explainability of models, treatment of uncertainty in clinical decision making and privacy protection of patients. These challenges must be addressed. It is with great pleasure as Guest Editors that we introduce this Special Issue, which demonstrates the interdisciplinary approaches brought to bridge the gap between technology potential and clinical utility. They include wearable sensor validation and remote care models for rehabilitation, as well as cutting-edge NLP architectures, uncertainty-aware predictive monitoring, and privacy-preserving AI training.

## 2. An Overview of Published Articles

The contributions in this Special Issue cover a broad spectrum of digital health, from rehabilitation, remote care technologies and medical natural language processing (NLP) to trustworthy artificial intelligence (AI) in clinical settings (encompassing uncertainty quantification and privacy).

In the realm of rehabilitation and physical assessment, Ruotolo et al. investigated the validity of wearable inertial sensors (XClinic) for measuring the active Range of Motion (ROM) in patients with trauma injuries [1]. Their study demonstrated that these digital sensors provide objective and reproducible data, which are essential for planning personalized rehabilitation programs, which offer a reliable alternative to traditional goniometric measurements.

Complementing this focus on patient management, Ciardi et al. conducted a systematic review of remote care models for patients with spinal cord injuries [2]. Their findings highlight that multidisciplinary home care supported by technology is effective in managing complications such as pressure injuries and infections, as well as improving self-efficacy, decreasing hospitalizations and preventing long-term mortality, although bias risk still remains.

Advancements in Medical NLP and human–computer interaction were addressed by two innovative studies [3,4]. Yuan and Xi proposed the MSA K-BERT model, a knowledge-



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enhanced method for medical text intent classification [3]. By integrating a multi-scale attention mechanism and injecting domain-specific knowledge graphs, the proposed model significantly outperformed baselines in handling the ambiguity and terminology inherent in medical dialogs.

Addressing the safety of healthcare chatbots, Zhang and Lau introduced a multi-view decision boundary approach to detect "unknown intents" [4]. By fusing perspectives from users, system developers, and medical experts, their method helps chatbots identify queries outside their knowledge scope, preventing the generation of potentially misleading medical advice.

Finally, the section also addresses the critical need for trustworthy and secure AI. Majlatow et al. presented a framework for uncertainty-aware predictive process monitoring in sepsis care [5]. By integrating Conformal Prediction with probability calibration and SHAP-based explainability, the authors demonstrated how to provide statistically valid prediction regions, enhancing clinician trust in high-stakes environments of the ICU.

Addressing data privacy, Lee and Lee empirically evaluated the trade-offs between privacy and utility in AI-based Clinical Decision Support Systems [6]. Their research provides an empirical evaluation of balancing privacy and utility in AI-based clinical decision support systems using de-identified electronic health records (EHRs). Their research confirmed that combining enhanced generalization and suppression with Differentially Private Stochastic Gradient Descent (DP-SGD) effectively reduces risks such as membership inference and model extraction attacks while maintaining clinical predictive performance.

## 3. Conclusions

The papers that are collected in this Special Section show how advanced algorithms and clinical practice will meet in the future of healthcare. The research presented in the section introduces the immense potential and digital innovations for enhancing healthcare. Those research ranges from precise measurement of physical recovery, using wearable sensors, to the advancement of "intelligent" medical chatbots, and also remote monitoring systems.

Specifically, the integration of external knowledge sources (i.e., Knowledge Graphs), the adoption of rigorous uncertainty quantification (i.e., Conformal Prediction), and the implementation of privacy-preserving training protocols (i.e., Differentially Private Stochastic Gradient Descent (DP-SGD)) are establishing a new approach to medical AI. These studies illustrate just how digital health can evolve and become more robust, more secure, and, crucially, more patient-centered than ever before. Once these technologies reach a sufficient level of maturity, future work needs to continue bridging any gap between algorithmic performance and clinical interpretability to make this shift work.

We would like to extend our sincere appreciation to all authors for their valuable contributions to this field, as well as to the reviewers for their rigorous efforts in ensuring the high quality of the submitted research papers. We hope that this Special Section will serve as a foundational reference for future research and inspire further innovation in the evolving digital healthcare community.

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