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*Editorial*

# eHealth and Artificial Intelligence

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**Abstract:** Artificial intelligence is changing the healthcare industry from many perspectives: diagnosis, treatment, and follow-up. A wide range of techniques has been proposed in the literature. In this special issue, 13 selected and peer-reviewed original research articles contribute to the application of artificial intelligence (AI) approaches in various real-world problems. Papers refer to the following main areas of interest: feature selection, high dimensionality, and statistical approaches; heart and cardiovascular diseases; expert systems and e-health platforms.

**Keywords:** applications of AI in health care; knowledge; data mining and knowledge discovery in medicine; medical expert systems; personal medical feature data; medical device technologies; diagnoses and therapy support systems; machine learning-based medical systems; pattern recognition in medicine

## 1. Introduction

Research in medical fields is very relevant to clinical advances [1]. In this context, computers are changing the healthcare industry, as well as research from many perspectives, including also the Internet of Things (IoT) paradigm [2] and mobile technologies [3]. Within this scenario, machine learning, pattern recognition, and, more generally, AI play a very crucial role [4]. AI is growing rapidly, and its successful application in the eHealth domain is possibly due, in general, to the availability of massive datasets and computing resources. AI has found application in many medical branches: oncology [5,6], dermatology [7,8], radiology [9,10], neurology [11], neurodegenerative diseases [12,13], and many others. In general, a major topic of AI in medicine is related to the clinical decision support (CDS) to assist clinicians at the point of care [14,15].

CDS can be knowledge based [16], where the AI areas involved are inference and logic, or non-knowledge based, where machine learning is used [14,17]. CDS can support all aspects of clinical tasks. However, to be effective, it must be properly integrated within the clinical workflow, as well as with health records. A typical application is computer-aided diagnosis (CAD) to assist doctors in the interpretation of medical images.

## 2. Contribution

In this special issue, a total of 13 papers are published. Topics range from telemedicine, medical suggestion platforms, and DNA microarray analysis to statistical analysis of medical data. Published papers are classified based on their core topic.

*Feature selection, high dimensionality, and statistical approaches:*

Dentamaro et al. [18] propose a new oversampling technique called Less Important Components for Imbalanced Multiclass Classification—LICIC to cope with both class imbalance and the famous "curse of dimensionality" problem. The method enables preservation of non-linearities within the dataset, while creating new instances without adding noise. The method is compared to other

oversampling methods. Results show the validity of the new technique when used with imbalanced, multiclass, and high-dimensional datasets.

Cilia et al. [19] provide a large experimental comparison for evaluating the effect of the feature-selection process applied to different classification schemes. Both ranking-based feature-selection and state-of-the-art feature-selection methods are considered. The experiments provide a broad overview of the results obtainable on standard microarray datasets with different characteristics in terms of the number of features and number of patients. Giles et al. [20] propose a novel numerical algorithm to perform bivariate numerical modeling. The algorithm is applied to correlate glomerular filtration rate to serum creatinine concentration. Glomerular filtration rate is adopted in clinical nephrology as an indicator of kidney function and is relevant for assessing the progression of renal disease.

*Heart and cardiovascular diseases:*

D'Aloia et al. [21] developed an effective approach for peak point detection and localization in noisy electrocardiogram (ECG) signals. Six stages characterize the implemented method, which adopts the Hilbert transform and a thresholding technique for the detection of zones inside the ECG signal that could contain a peak. Identified zones are, thus, analyzed using the wavelet transform for R point detection and localization. Results obtained are presented, discussed, and compared with some other R wave detection algorithms.

Casalino et al. [22] developed a low-cost solution for monitoring cardiovascular parameters. The proposed system is a contact-less device composed of a see-through mirror equipped with a camera that can detect the person's face. It processes video frames using photoplethysmography to estimate the heart rate, the breath rate, and the blood oxygen saturation. In addition, the color of the lips is automatically detected via clustering-based color quantization. The estimated parameters are used to predict the risk of cardiovascular disease by means of fuzzy inference rules integrated into the mirror-based monitoring system.

*Expert systems:*

Song et al. [23] developed a modified robust fuzzy c-means (MRFCM) algorithm for brain MR image segmentation at a local level. The results of segmentation are compared with state-of-the-art algorithms based on fuzzy clustering. The proposed algorithm exhibits robustness to various noises.

Senatore et al. [24] propose a classification method based on a Cartesian genetic programming (CGP) approach, which allows the automatic identification of the presence of neuromuscular disease. The authors showed that their approach compares favorably with state-of-the-art methods. The study deals with off-line Parkinsonian handwriting analysis. Impedovo et al. [25] investigated an ensemble of features (related to on-line handwriting) and classifiers able to support PD diagnosis. These two works are part of the same project named HAND—Handwriting Analysis against Neuromuscular Disease funded by the Italian Ministero dell'Istruzione, dell'Università e della Ricerca (MIUR). Interested readers can find more details in [14,26].

Dresp–Langley [27] proposes a simulator training for image-guided surgical interventions able to detect the evolution of task performance and to take control of individual speed–precision strategies by providing effective automatic performance feedback.

Civita et al. [28] developed tools and methods for estimating the Cartesian kinematic jerk of the hips' orientation during a full three-dimensional movement in the context of enabling eHealth applications of advanced mathematical signal analysis. In this case, a jerk index is estimated based on gyroscopic signals acquired by a smartphone. Experiments confirm that such an index can be used to evaluate the fluency of hip orientation during motion.

*eHealth Platforms:*

Massaro et al. [29] developed an integrated platform able to transfer patient info acquired in a home environment to a remote clinic control room. The system results in an innovative and complete resources management platform (RMP) integrating a homecare decision support system (DSS) based on

a multilayer perceptron (MLP). The study is oriented in predictive diagnostics with experiments on blood pressure systolic values. The workflow elaborates real data transmitted via the cloud by medical smart sensors (patient at home) and provides a prediction of the patient status. The innovative RMP-DSS is then structured to enable real-time alerting conditions, preventative action based on the analysis of historical data and alerting due to patient status prediction. Palestra et al. [30] propose a rehabilitation system based on depth sensors and exergames. The usability and efficiency of the system have been evaluated. The exergame protocol proposed is customizable according to the capabilities and clinical needs of the users. Experiments have been performed within a real scenario demonstrating the viability of the proposed approach. The work was partially supported by a Marie Curie IAPP program, FP7-People-IAPP, Grant 324491.

Amato et al. [31] introduced the HOLMeS (health online medical suggestions) system. It can exploit machine learning algorithms to provide medical suggestions via both chat-bot and web-app modules for prevention aims. The chat-bot, exhibiting a human-like behavior, helps to overcome the limitations of a cold interaction between users and the software. The obtained results demonstrate the effectiveness of the proposed system.

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