ARTIFICIAL INTELLIGENCE SOLUTIONS AND ITS IMPACT IN HEALTHCARE SERVICES – Part I

17.4.2020

Author's note: This article is part of a series published in SeAMK eJournal about cutting-edge technologies (Artificial Intelligence, Big Data, Robotics, and Internet of Things) that will revolutionize the healthcare in the near future.

When talking about Artificial Intelligence (AI), there is no better definition than that of his father Alan Turing: "AI is the science and engineering of making intelligent machines, especially intelligent computer programs" [1]. Now there is no turning back from the rise of AI in all aspect of our lives; just let see inside of our pockets where there are dozens of AI algorithms running in our smartphone's apps. As a consequence of this trend, the AI market in U.S is expected to grow 6.6 $ billion by 2021 [2].

AI systems have evolved from robust decision rules to machine learning methods able to process complex algorithms to identify patterns in the patients' data. This stage has been achieved due to large data sets availability and improvements in computer hardware as well as the combination with other emerging technologies features (IoT, Big Data, Robotics, 5G). The wide spectrum of AI technologies impacts on many different fields, to our interest healthcare, with outstanding results.

The input information is cornerstone to ensure the reliability of AI algorithms in novelty healthcare applications. Such information should cover from personal historical data based on diagnosis, screening, treatments medication, doctor's notes (stored mainly in Electronic Health Record – EHR), up to patients' demographics. Diagnostic imaging as well as genetic are most prominent data types used in AI. In addition, sensors (wearables, IoT) or smartphones are becoming in another essential source in healthcare data allowing doctors to have a real-time remote monitoring of patients' vital signs and behavioral changes. Sensors are particularly contributing to enlarge the amount of data of an individual, allowing to provide a more tailored and accurate assessment. Regarding all these data sources, there are works trying to link multiple data sources to contribute a feature enrichment and achieve a holistic patient profile for predictive and discovery tasks as well as defining a higher-level semantic structure, an ontology, to harmonize all these medical concepts and understand their correlations. On the other hand, the quality of the output extracted by AI algorithms is highly dependent on the accuracy of the data provided as input; and that is crucial when handling biomedical data due to its inherent characteristics like high-dimensionality, domain complexity, heterogeneity, temporal dependency, sparsity, bias, noise, redundancy and irregularity (missing values) .

By training AI algorithms over these data and guided by relevant clinical questions, association between patient's attributes and other hidden features can be unlocked. The underlying features discovery serve healthcare professionals for predicting different health outcomes indicating the existence of rich but yet underutilized information; assisting the professional in a timely clinical decision-making enabling the precision

medicine that “ensures the delivery of the right treatment to the right patient at the right time”. Some AI algorithms are even able to develop self-correcting abilities to improve its results accuracy allowing an interactive research loop that could engage the clinician in supervising the outcomes generated. Current AI technologies, like products DeepCare [3] or Doctor AI [4], can perform a wide array of functions, such as aiding in diagnosis generation and therapy selection, making patient risk predictions and stratifying disease through patient monitoring, interpretation of patient genomes, or learning embedded medical concepts from EHRs. Moreover, AI systems can reduce medical errors in diagnostic and therapeutic practices that are unavoidable in human practice. For instance, the AI-based triaging would in theory decrease the burden in the system by redirecting resources to those patients who have real medical need [2]. Focusing on diseases, AI has many applications in the healthcare like: autonomous robotic surgery and suturing; early detection and diagnosis of stroke, lung cancer, esophageal cancer, diabetic retinopathy; or even psychiatric disorders like suicide episodes prediction [5]. In a short term period, medical fields that will have an earliest translation of AI-based technology will be those with a strong image-based or visual component (radiology, pathology, dermatology, etc.) because of the AI’s capability to deliver automated medical-image diagnosis being accessible even from mobile devices (in case of dermatology). Nevertheless, not only models’ performance and accuracy are important in AI applied to healthcare problems, but also the interpretability of their results since clinicians will be reluctant to adopt a system and its outcomes that they cannot understand.

The potential application of AI in healthcare is enormous, sometimes outperforming the human doctors’ capabilities. However, the line of action should flow instead of replacing clinicians, in promoting the collaboration between healthcare professionals and AI technologies, for instance, incorporating human expert knowledge in order to enhance the AI algorithms outcomes improving its accuracy. AI can and will play a revolutionary role in assisting doctors to make clinical decisions as well as diagnosis and prognosis of different medical conditions. This complementary interaction would bring benefits to both, and hence to the rest of us.

(Continued in ARTIFICIAL INTELLIGENCE SOLUTIONS AND ITS IMPACT IN HEALTHCARE SERVICES – Part II)
Pedro A. Moreno Sánchez
RDI Expert/ Researcher
PhD, PMP®
Seinäjoki University of Applied Sciences
School of Health Care and Social Work

References

[1] I. B. A. TURING, “Computing machinery and intelligence-AM Turing,” *Mind*, vol. 59, no. 236, p. 433, 1950.

[2] J. He, S. L. Baxter, J. Xu, J. Xu, X. Zhou, and K. Zhang, “The practical implementation of artificial intelligence technologies in medicine,” *Nat. Med.*, vol. 25, no. 1, pp. 30–36, Jan. 2019, doi: 10.1038/s41591-018-0307-0.

[3] T. Pham, T. Tran, D. Phung, and S. Venkatesh, “DeepCare: A Deep Dynamic Memory Model for Predictive Medicine,” in *Advances in Knowledge Discovery and Data Mining*, Cham, 2016, pp. 30–41, doi: 10.1007/978-3-319-31750-2_3.

[4] E. Choi, M. T. Bahadori, A. Schuetz, W. F. Stewart, and J. Sun, “Doctor AI: Predicting Clinical Events via Recurrent Neural Networks,” p. 18.

[5] R. Miotto, F. Wang, S. Wang, X. Jiang, and J. T. Dudley, “Deep learning for healthcare: review, opportunities and challenges,” *Brief. Bioinform.*, vol. 19, no. 6, pp. 1236–1246, Nov. 2018, doi: 10.1093/bib/bbx044.

[6] K.-H. Yu, A. L. Beam, and I. S. Kohane, “Artificial intelligence in healthcare,” *Nat. Biomed. Eng.*, vol. 2, no. 10, pp. 719–731, Oct. 2018, doi: 10.1038/s41551-018-0305-z.

[7] M. Alloghani, D. Al-Jumeily, A. J. Aljaaf, M. Khalaf, J. Mustafina, and S. Y. Tan, “The Application of Artificial Intelligence Technology in Healthcare: A Systematic Review,” in *Applied Computing to Support Industry: Innovation and Technology*, Cham, 2020, pp. 248–261, doi: 10.1007/978-3-030-38752-5_20.

[8] E. Loh, “Medicine and the rise of the robots: a qualitative review of recent advances of artificial intelligence in health,” *BMJ Lead.*, vol. 2, no. 2, pp. 59–63, Jun. 2018, doi: 10.1136/leader-2018-000071.

[9] F. Jiang *et al.*, “Artificial intelligence in healthcare: past, present and future,” *Stroke Vasc. Neurol.*, vol. 2, no. 4, pp. 230–243, Dec. 2017, doi: 10.1136/svn-2017-000101.

[10] S. Latif, J. Qadir, S. Farooq, and M. A. Imran, “How 5G Wireless (and Concomitant Technologies) Will Revolutionize Healthcare?,” *Future Internet*, vol. 9, no. 4, p. 93, Dec. 2017, doi: 10.3390/fi9040093.

-