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EDITORIAL

Artificial intelligence in medicine

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Artificial intelligence (AI) in medicine began as a special branch of computational science that allows the complex analysis of data in the diagnosis, treatment, and prognosis of different illnesses. Alan Turing proposed the name of AI in 1950[1]. In 1955, John McCarthy named AI the science of making an intelligent machine[2]. In 1976, Gunn applied AI in an algorithm for the first time to diagnose abdominal pain[1].

Nowadays, AI is part of the robots used in medicine. The term robot comes from the Czech word "robota," a biosynthetic machine used for forced work[2]. The possibility of using computational models like an imitation of human behavior is increasing rapidly.

Today, AI in medicine has two branches. One of them is the virtual part, which is in charge of the informatic approach; the specific name is Machine Learning with a core called Deep Learning. Both are directed to analyze the DATA that is comprised of the clinic records, the laboratory results, the histopathologic reports, the information supplied by the pharmacologic industry, the scientific information of different sources, and the monitoring records of patients by Internet of Medical Things (Fig. 1)[1-4]. Machine Learning aims to analyze, classify, and judge a huge digital information to help formulate algorithms for diagnosis and therapy. The main idea is that the computer can learn by itself. This branch of AI utilizes three kinds of algorithms. The first is the unsupervised mode drive to find patterns (K-means, K-methods, Fuzzy C-means, Hierarchical, Gaussian Mixture, Hidden Markov Mode, and Neuronal Network). The second one is the supervised mode aimed at the classification of data (Support Vector Machine, Discriminant Analysis, Naïve Bayes, Nearest Neighbor, and Neuronal Network) and prediction of algorithms with prior knowledge (Linear Regression, Ensemble methods, Decision tree, Neuronal Network). The last mode is called "reinforcement learning," where reward-punishment sequences in specific tasks or missions[3,4].

The physics branch includes the robots charged with rehabilitation (Lokomat) and robots to assist geriatric patients in Japan. Robots assist in surgery, too, such as D'Vinci in general surgery or ROSE ONE for stereotactic neurosurgery.

A specific example of AI application in medicine is designing new therapeutic drugs. Machin learning is used in peptide synthesis, a virtual search of receptors and ligands, predictions of toxicity, monitoring and delivery functions, modeling of pharmacophores, qualitative relation-ship of structure-activity, re-uptake of drugs, polypharmacy, and physicochemical activity[3].

AI has developed several tools such as[4-6]:

- Viewing Machine Learning (human and machine rather than human versus machine),
- Natural Language Processing (the ability of a computer to understand a human language as unprecise, ambiguous, and sometimes unstructured),
- Fuzzy Logic (a multi-valued logic in a solution of problems) and
- Data mining (interaction between database technology, modeling techniques, statistical analysis, pattern recognition, and machine learning).

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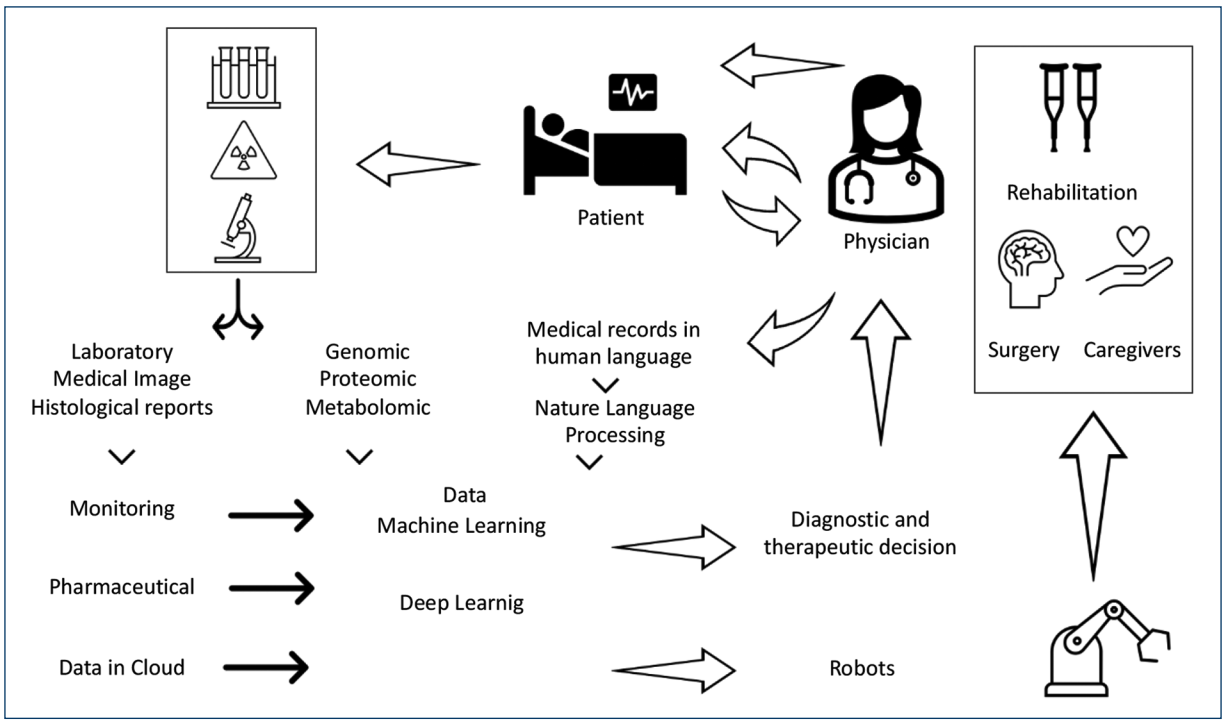

Figure 1. This diagram shows a schema about how Machine Learning (Deep Learning) received information of many sources and allows a computer to learn without previous programming and the analysis move to elaborated algorithms of decision. Two final outputs one of them is robotic solution (rehabilitation, surgery, and caregivers) the other is the physician.

In neurology, AI has shown important advances. AI can produce predictive risk models for stroke, growth of brain tumors, suicide ideation, triggers to seizures, and early diagnosis for Alzheimer's and Parkinson's diseases. The massive analysis of exome, RNA, proteins, and the metabolism mechanism also helps predict the clinical effect of anticancer or antiepileptic drugs[5]. In neurosurgery, the robots have applications for guiding the resection of tumors, detection of the epileptic focus, and directing screws in spine surgery. In rehabilitation or prosthetic surgery, robots make the main contribution. The recent advance in deep brain stimulation allows the delivery of a specific electric energy program in a very restricted anatomical area. In addition, this new system can recognize pathologic patterns of local field potentials and respond with a specific schedule of electric pulse trains[7].

However, AI in medicine must solve several issues like the cost of implementation, the adjustment to the health systems, opposition to change by healthy personnel, and the limits of AI in human activity as medicine. The eventual consolidation of AI in preventing and maintaining health does not see two main functions of medicine: the knowledge of pain and the medic-patient relationship. AI has an advantage over humans in managing a large amount of data. Combining scientific journals with clinical records with lab and paraclinical results information with sociomedical and environmental conditions is very hard for any health professional. AI is now the instrument that gives us an alternative. Despite the concept of the health-disease process, it is a subjective process. Medical thought is naturally rational but involves heuristic knowledge and ethical considerations. The understanding of human suffering is essentially a human act that is not limited to nosology or therapy. Empathy is immanent in medicine and many neurologic aspects and philosophic thought. Machine learning and deep learning cannot reproduce a human mind. It is still waiting and talking about considering a machine as a human being. The human is a subject that means to possess a consciousness. Has AI in a machine consciousness itself?

In addition, the human mind shows a special phenomenon named auto-conscient metacognition, which is the ability to think in the autonomy of the thought. The human is aware of his property thought. On the

other hand, the experience of qualia is the transition from the sensation originated by the external stimulus to the perception-filling, to the emotion, and finally to the interpretation of this stimulus.

How does a patient perceive the painful sensation? How does he or she interpret this feeling? How can other subjects be empathic with a suffering subject? Can AI offer answers to these questions? I recommend additional lectures by Searle on Functionalism[8] and Chalmers on the experience[9]. AI is just a part of the function of the mind. We must remember that the natural human condition needs fillings, emotions, and ethical-moral thoughts combined with rational knowledge. Finally, Bartra proposed an extensive and important extracerebral function on social networks[10]. AI will come to stay, but the human condition is beyond its limits.

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