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ARTIFICIAL INTELLIGENCE IN MEDICINE: A PRESENT FUTURE

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Abstract: OBJECTIVE: Artificial Intelligence (AI) has attracted attention in the medical field. However, due to the complexity of the system, the variability of its architecture, as well as ethical and regulatory concerns, there is an ongoing need to analyze its application and performance. The objective of this study was to address artificial intelligence in medicine and its respective benefits or harms. **METHODOLOGY**: This study presents a narrative commentary on the applications of AI and learning algorithms in medical devices, past, current and future application perspectives. A research focus of this study was the identification of problems and issues related to the implementation of AI in the medical field. The commentary is based on scientific articles published in the databases PubMed, Scopus ad ScienceDirect, official publications of international organizations: European Commission (EC), Food and Drug Administration (FDA) and World Health Organization (WHO) published in the period 2015 to 2023. **RESULT AND DISCUSSION**: AI is revolutionizing healthcare, from medical applications to clinical engineering. The future of AI application can be seen not only in increasing treatment accuracy but also in preventing injuries and deaths caused by medical devices. Because healthcare is generating a lot of data, as in fact all medical devices are generating a lot of data, these big data structures can be used to predict the safety and performance of medical devices. For example, the use of smart infusion pump systems has become the preferred method for ensuring the safety of intravenous medications. Most of these systems are based on specialized AI systems rather than ML, but the durability and reliability of such devices have led to more extensive ML-based applications, such as implantable insulin pumps and emerging closed-loop artificial pancreas devices. **CONCLUSION**: However,

before realizing the full potential, ethical, legal and social concerns need to be resolved and their application needs to be harmonized and regulated with regard to equitable access, privacy, appropriate uses and users, to responsibility, prejudice and inclusion.

Keywords: Artificial intelligence; Medical devices; the present; Future.

INTRODUCTION

In 1956, at a conference at Dartmouth University, academics formally proposed the term "artificial intelligence". That moment was the first step in a new topic of study of how machines simulate human intelligence activities. In early 2016, AlphaGo defeated the world chess champion. This event immediately sparked global interest in artificial intelligence (AI) (L. XU, 2013). The development of artificial intelligence has brought enormous economic benefits to humanity and benefited all aspects of life, even as it has greatly promoted social development and brought development into a new era (Y. LU, 2019). Many scholars have started to be relevant to AI research since the end of the 20th century (L. XU, 1999). AI is the general term for the science of artificial intelligence. It uses computers to simulate intelligent human behaviors and trains computers to learn human behaviors such as learning, judgment and decision making (L, D. Xu, Y. LU, L, LI, 2021).

AI is a knowledge project that considers knowledge as the object, acquires knowledge, analyzes and studies the expression methods of knowledge, and employs these approaches to achieve the effect of simulating human intellectual activities [19]. AI is a compilation of computer science, logic, biology, psychology, philosophy and many other disciplines, and has achieved remarkable results in applications such as speech recognition, image processing, natural language processing, automatic theorem proving and robot intelligence (L. Duan, L. Xu, Y. Liu, J. Lee. 2009). AI plays an indispensable role in social development and has brought revolutionary results in improving work efficiency, reducing labor costs, optimizing human resource structure and creating new job demands.

THE HEALTH INDUSTRY

In the medical field, AI-related algorithms are used to provide medical assistance, to detect cancer and to develop new medicines (D. Ravì, et al 2016). Extensive promotion of medical information is of great importance for the development of medical enterprises on a global scale (P. Hamet, J. Tremblay, 2017). One of the most famous is undoubtedly Watson, IBM's intelligent robot. The IBM technical team first inputs a large amount of data and information into Watson. This huge database includes medical information and reports, clinical guidelines, medication usage reports, and thousands of patient medical records. Since then, AI algorithms have been used for analysis and processing in order to provide medical assistance to stakeholders and perform medical diagnoses more effectively and accurately (A. Esteva. Et al 2019). Medical device manufacturers are utilize these technologies to innovate their products to better help healthcare providers and improve patient care (Burki, 2019).

New AI advances in hardware and software have enabled the interpretation of physiological data from sensors that have enabled the rapid growth of wearables such as smart watches, which contain digital health monitoring applications. This trend in the increasing number of wearables entering the market impacts the digital health monitoring segment (Jha, 2016). With the continuous development of assisted diagnosis technology, a large amount of data is used in the process of detecting, diagnosing, and treating diseases

(Abernethy, 2010). For doctors, organizing and analyzing this data in a short period of time is a challenge. Therefore, AI is increasingly used in medicine to help doctors predict diseases and treatment outcomes.

From analyzing medical images such as echocardiograms, computed tomography (CT), endoscopy and skin photographs, to tissue histology and physiological data such as electrocardiograms (ECG), these technologies have demonstrated enormous potential for healthcare. They are designed to track diseases, classify malignancies, and provide personalized treatment recommendations, among other things, often sooner than was possible using traditional technologies.

Machine learning is one of the most effective algorithms in machine learning. In recent years, ML has played an important role in medicine, especially in disease prediction. Patients with a history of idiopathic bleeding ulcers may have a higher rate of ulcer recurrence. If serious complications (such as ulcer rupture) occur, patient safety is threatened. In 2018, machine learning was used to build a high-accuracy model to predict idiopathic peptic ulcer rebleeding, called IPU-ML (Wong, 2019). In another case, the enterovirus caused by severe foot-and-mouth disease rarely causes serious complications in children, such as pulmonary edema and myocarditis (Liu, 2014). In 2019, to predict serious hand diseases, foot and mouth disease, the CatBoost model was established, which showed higher specificity and sensitivity than other models (such as decision trees and SVM) (Wong, 2019). Additionally, machine learning can predict the effectiveness of radiotherapy.

The combination of new imaging technologies and an artificial intelligence engine that uses a large number of historical images can improve current detection methods through faster analysis, real-time diagnosis, and human error (Graber, 2005). Conditions such as epilepsy, Alzheimer's disease and stroke are a daunting challenge.

Current diagnostic technologies (such as MRI, EEG) generate large amounts of data to detect, monitor and treat neurological diseases. Data analysis is often difficult. It is essential to use intelligent systems that can automatically accumulate, manage, analyze and detect abnormalities in the nervous system. The application of artificial intelligence in this field will improve the consistency of diagnosis and increase the treatment success rate (Blahuta, 2012). Diabetic retinopathy (DR) is one of the leading causes of preventable blindness worldwide. In a study published by the American Academy of Ophthalmology, a total of 75,137 public fundus images of diabetic patients were used to train and test an artificial intelligence engine to distinguish between healthy fundus and DR. results. The results showed an impressive sensitivity and specificity of 94% and 98%, respectively (Gargeya, 2017).

AI is becoming increasingly popular in image recognition applications. AI using deep learning algorithms can automatically perform more efficient, quantitative assessment of complex medical image features. One application is to use radiology, ultrasound, and nuclear medicine to image the liver to look for possible liver disease. In image analysis, artificial intelligence is used to detect and evaluate focal liver lesions, promote treatment, and predict the appropriate response to treatment (Zhou, 2019). AI can be used for in vitro diagnostics, using real-time imaging to capture the fluorescence signal from passing cells. Use AI algorithms to distinguish cells by size, shape, and emission wavelength and classify them as predictors of specific diseases. Furthermore, combined with other hardware technologies, it can be completed in the real world. Integrating AI into the in vitro diagnostic platform can improve the device's diagnostic performance and accuracy (Smith, 2018).

THE FUTURE

The future of the application of AI in DM can be seen in the harmonization of standards and laws that specifically regulate the use of artificial intelligence in medical devices. Some advances in the field have already been made by the FDA. Unlike European legislators, the FDA published its view on artificial intelligence in a document titled "Proposed Regulatory Framework for Modifications to Artificial Intelligence/Machine Learning (AI/ML)-Based Software as a Medical Device (SaMD)" which was published in April 2019. This document talks about the challenge of continuous learning systems. However, it notes that previously approved medical devices based on AI procedures worked with "locked algorithms."

As regulators address this area, leading manufacturers are shifting their business models from conventional production models to intelligent, data-driven models. For example, Medtronic is committed to integrating artificial intelligence into its existing surgical industry, including advanced imaging, robotics and navigation, as well as increasing recruitment for remote patient monitoring. One of the key products Medtronic plans to implement in surgery is a preoperative platform called UNiD ASI, which can use predictive modeling algorithms to reconstruct the spine for digital modeling and take measurements. UNiD ASI was developed by Medicrea GROUP, a French medical device company that provides surgical solutions for neurosurgeons and plastic surgeons.

On the other hand, Philips decided to focus on different market trends, especially AI diagnostics and workflow calculations with greater accuracy. In the world of medical devices, artificial intelligence is a relatively new field. Unlike many traditional devices often developed by teams of materials, mechanical, and electrical engineers, artificial intelligence-based medical devices require expertise in software programming and coding.

The future of AI application can be seen not only in increasing treatment accuracy but also in preventing injuries and deaths caused by medical devices. Because healthcare is generating a lot of data, as in fact all medical devices are generating a lot of data, these big data structures can be used to predict the safety and performance of medical devices. For example, the use of smart infusion pump systems has become the preferred method for ensuring the safety of intravenous medications. Most of these systems are based on specialized AI systems rather than ML, but the durability and reliability of such devices have led to more extensive ML-based applications, such as implantable insulin pumps and emerging closed-loop artificial pancreas devices.

Several examples related to healthcare were cited above, and applications in healthcare are increasing rapidly due to ubiquitous memory and applications and cloud computing resources. For example, most smart infusion pump systems are now designed with modules and ancillary equipment, such as barcodes and radio frequency identification (RFID) readers, to help realize the "Five Rights": the right patient, the right medicine, the right dose, the right path and the right time. MD's management strategy is very different from decades ago, so consider how we can contribute to the future.

Inadequate monitoring and improper monitoring of medical devices (MD) will bring a high risk of deviations in performance accuracy and safety, which will affect the clinical accuracy and efficiency of patient diagnosis and treatment. Even as equipment technology matures, incidents involving defibrillator failure are not uncommon.

Articles published in 2019 present the results of applying machine learning (ML) technology in the management of incubators and infant defibrillators in medical institutions (Badnjevic 2019, Kovacevic 2019). The results show that introducing machine learning algorithms into machine learning management strategies can not only improve patient diagnosis and treatment safety and quality, but can also benefit medical institutions in terms of optimization and management of costs. The results of this study show that clinical engineering and health technology management benefit from the application of machine learning in terms of cost optimization and medical equipment management.

For some time now, there has been an attempt to develop computerized systems to support clinical diagnosis. Howard Bleish (Bleish H. 1972), more than 50 years ago, already offered a system that, by evaluating a patient's data, suggested actions to reestablish their hydroelectrolyte balance. Recent work (Bond WF. Et al 2011) selected four systems, after analyzing data from 20 clinical cases presented in the New England Medical Journal and in the Medical Knowledge Self-Assessment Program (MKSAP) of the American College of Physicians, which aims to assess knowledge of internal medicine from third-year medical students from US schools. Two of these differential diagnosis systems – DDX (DXPlain, from Harvard, and Isabel, private) – indicated significant hits, even though they failed to correctly diagnose two cases of *MKSAP*.

Berner et al. (Berner ES. 1999) discussed the relevance of having a list of diagnostic hypotheses, whether for the clinician or for medical students. A list of possible diagnoses, accepted uncritically, could result in the request for many tests to clarify the case, making the patient's treatment more expensive.

Recent work (Wikipedia contributors. 2017) analyzes the adoption of clinical decision support systems to improve the accuracy of medicine, considering the increased workload of doctors in emergencies and family clinics. The American Association of Medical Schools (AAMC) estimates a demand for 130,600 doctors by 2025, which would justify the adoption of decision support programs as a way to reduce the possibility of medical errors.

In 2009, it was found that 32% of medical errors in the USA resulted from a decrease in the doctor's interaction time with patients, producing mistaken diagnoses, failure to recognize the urgency or worsening of the patient's evolution that would require prescribing or carrying out relevant actions. Even in hospitals that have electronic medical records (Castaneda C. et al 2015), with the possibility of better data collection, it is admitted that 78.9% of medical errors would be related to problems in the doctor-patient relationship, clinical examination deficiency, failure to evaluate patient data or lack of tests that would prove the diagnostic hypothesis.

A classic work by Elstein et al. (Elstein AS, Shulman LS. Sprafka AS.1978) indicated, after extensive research recording the problem-solving process in various controlled situations, the following: Problem-solving hypotheses are often generated early when interviewing a patient, either because the doctor remembers similar cases, or because he read an article that discussed situations with the same characteristics; Hypotheses are, as a rule, presented in a limited number, even in complex cases; nevertheless, general hypotheses, such as abdominal pain, can be proposed along with others; As a consequence of proposing hypotheses early, doctors may seek new data to prove their hypotheses rather than to reevaluate them, requiring much more information or test results to review these hypotheses; The solution to a case is, as a rule, related to the professional's competence in relation to the problem presented by the patient. As Claude Bernard said, "those who don't know what they're looking for don't understand what they find".

Studies by Rimoldi (Rimoldi HJA, 1988) showed that the number of anamnesis data, physical examination and complementary exams requested by interns, residents and specialists to solve a case varies significantly, indicating the importance of experience in proposing possible diagnoses. Pattern recognition and diagnostic criteria (combination of symptoms, signs and test results) are used to determine a correct diagnosis.

A study by `` Universidade Estadual de Londrina`` on the clinical reasoning of medical students (Fornaziero CC, Gordan PA, Garanhani ML, 2012) indicated two processes for developing diagnostic hypotheses among students: hypothetical-deductive and inductive. It showed a predominance of students (69%) inducing a diagnosis. These processes highlight two types of thinking: the theoretical-deductive (which goes from the general to the particular), more common among Latins, and the empirical-inductive (which goes from the particular to the general), which characterizes, in general, the Anglo-Saxons. (Conant JB, 1964). Szlovits, in a 2009 publication, admits that today AI in medicine is becoming not just a part, but an essential component of medical informatics and an important resource in solving problems in healthcare (Patel VL. Et al 2009).

In a recent work, Mukherjee reports on the experience of Sebastian Thrun, from Stanford University, who stores, in a neural computing network, 130 thousand images of skin lesions classified by dermatologists. The system uses algorithms that recognize images and their characteristics (*pattern recognition*). In June 2015, Thrun and team began validating the system using a set of 14,000 images that had been diagnosed by dermatologists, asking the system to recognize three types of lesions: benign, malignant and non-cancerous growths. The system was correct 72% of the time, compared to a 66% accuracy achieved by qualified dermatologists. Thrun's experience was expanded to include 25 dermatologists and a sample of 2,000 biopsied cases. The machine continued to be more accurate (Mukherjee S. A.I. Versus M.D, 2017).

Research carried out at USP showed that the generation of hypotheses and differential diagnoses, in general, is done through immediate visual recognition of certain injuries. The experiment was carried out with 25 radiologists who tried to recognize images of the lung presented to them inside a functional magnetic resonance imaging tube. The average time to propose a diagnosis was 1.33 seconds, always activating the same area of the brain. The important thing seems to have been prior knowledge of the shape and characteristics of the lesion, which could be done by Artificial Intelligence (Melo M. et al 2010).

CONCLUSION

The deficiency in interaction with the patient, the lack of clinical examination and the dependence on complementary exams in medical diagnosis will increasingly increase the use of computers in medicine. The availability of highly accurate clinical decision support systems, the use of wearable/body devices, the exponential increase in the capacity to store and process patient and population data (*big data*) are facts that have already become part of reality in many countries. Artificial Intelligence processes this data through algorithms that tend to improve through their own functioning and propose increasingly precise diagnostic hypotheses.

The English *Deep Mind* computing system, recently acquired by Google, currently processes 1.6 million medical records of patients treated in England's National Health Service (NHS) hospitals, seeking to develop a new generation of clinical decision support systems, analyzing data from these patients and generating alerts about their evolution, avoiding contraindicated or conflicting medications and informing healthcare professionals about their patients in a timely manner.

The processing of a large volume of health information will improve the understanding of the genesis, diagnosis and treatment of health problems not only for the individual, but also for the population. It will therefore allow new actions aimed at promoting, preventing and recovering health to be proposed, which would include the need for eventual restructuring of the systems aimed at developing these actions.

But if the computer provides the *know-what*, it will be up to the doctor to discuss the health problem and its possible solutions with the patient, indicating the *know-why* of their case. This requires continuous concern with the quality of medical training and the understanding that the doctor is perhaps the most important therapeutic agent, due to the guidance he gives to his patient and, consequently, the relief of his tensions and needs.

To support the adoption of the regulatory framework and harmonize the market, international standards regarding AI in MDs are needed. ISO, IEC, and IEEE organizations are working on standardizing data quality management and applying AI that affects human well-being.

Even with recognized obstacles, we can conclude that AI has already completely changed the traditional medical model, significantly improved the level of medical services and ensured health in all aspects. It is not yet known how future prospects for the development of medical AI will impact the human population in combating growing challenges such as infectious pandemics, chronic diseases and the elderly population.

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