

Artificial Intelligence's Role in the Healthcare System

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Please cite this paper as:

Boeru, A.C., 2022. Artificial Intelligence's Role in the Healthcare System. In: R. Pamfilie, V. Dinu, C. Vasiliu, D. Pleșea, L. Tăchiciu eds. 2022. 8th *BASIQ International Conference on New Trends in Sustainable Business and Consumption*. Graz, Austria, 25-27 May 2022. Bucharest: ASE, pp.251-258.

DOI: 10.24818/BASIQ/2022/08/033

Abstract

Nowadays, because of the development and the evolving technologies, artificial intelligence (AI) changed the way healthcare systems function and altered the interactions between medical practitioners and patients. In this context, AI has the potential to revolutionize the healthcare system and is an opportunity to strengthen the doctor-patient relationship by offering accurate information in a reasonable amount of time. After a brief journey of the evolution of defining artificial intelligence, the article first covers the meaning of AI in the healthcare system through a systematic literature review, classifying the essential roles of AI in this system. It continues with the explained grade of involvement of the European Union in this field and its decisions during the COVID-19 pandemic regarding the uptake and upscale of digital health solutions. Lastly, this article emphasizes the necessity of having a unitary approach across the European Union regarding the AI involvement in the healthcare system by suggesting the implementation of a single European platform for medical appointments to adapt to the digital world and facilitate medicine without borders. This article aims to provide an overview of the AI roles in the healthcare system that have been developed and implemented and are playing a much-needed role in improving healthcare services, quality of medical practice, and patient satisfaction regarding the services. The classification underlines the positive aspects of adapting the current healthcare system to the new era and embraces the challenges. Artificial intelligence's roles lead to a better approach to the patient's attitude once they know the benefits of using and accepting artificial intelligence technologies in the medical field.

Keywords

Healthcare system, artificial intelligence, medical applications, healthcare management, patients needs

DOI: 10.24818/BASIQ/2022/08/033

Introduction

As the World is continuously evolving and society is learning to adapt to new practices and develop new technologies that intend to improve the quality of life, artificial intelligence could be considered one of the best things ever happened to humankind. Similarly, it might be the worst thing that could bring about the end of humans if it gets under control, as Stephan Hawking stated in an interview in 2015. Following AI's purpose in our lives, UNESCO states that artificial intelligence can significantly boost the attainment of sustainable development goals. However, each technological innovation brings new inequalities that must be anticipated and limited to protect human lives and avoid dangerous situations. It's a fact that some markets, sectors, and business models are more advanced than others, while AI is still in a relatively early stage of development. It is essential to mention that artificial intelligence is not a single technology but rather a group of technologies that work together (Davenport and Kalakota, 2019).

Moreover, the enormous potential of this domain for the development and improvement of a wide variety of applications is signaled by the numerous applications currently available on the market. Being aware of this inequality, governments throughout the world have established ambitious programs to encourage the development of technologies based on AI and ensure that it works for the well-being of people. Equally important, the involvement of the European's Union in AI's ecosystem relies on social trends and technology created in non-EU states.

The last findings show that hospitals have started implementing and utilizing artificial intelligence-enabled tools to assist medical personnel in inpatient diagnostic and treatment activities for various diseases. Aside from that, artificial intelligence technologies influence the efficiency of nursing and administrative functions in hospitals (Lee and Yoon, 2021). While many research papers can demonstrate that AI can perform as well as or better than humans in critical healthcare activities, today, algorithms are already surpassing cardiologists in detecting atrial fibrillation and radiologists in terms of detecting dangerous tumors and endocrinologists in continuous glucose monitoring. These are just a few examples of how AI technology contributes to health (Davenport and Kalakota, 2019). On the other side, patients have been eagerly awaiting the introduction of augmented medicine since it would provide them with greater autonomy and a more individualized treatment; yet, physicians have been resistant to the idea because they have not been prepared for such a shift in clinical practice. Because of this occurrence, it is necessary to validate these contemporary instruments with traditional clinical trials, discuss the educational upgrading of the medical curriculum considering digital medicine, and address the ethical implications of implementing this technology (Briganti and Le Moine, 2020).

This paper aims to identify artificial intelligence's role in the healthcare system (Figure no.1), as concluded from the literature review. Overall, this paper wants to provide an overview of the AI roles in the healthcare system that have been developed and implemented and are playing a much-needed role in improving healthcare services, quality of medical practice, and patient satisfaction regarding the services. The study systematically identifies the devices and tools found in the public and the private healthcare system. Moreover, this study explains the roles of the devices and tools based on AI technology in medical practice and their benefits for medical practitioners and patients.

This article shall provide a structured overview of artificial intelligence's role in the healthcare system and its benefits over the influence of diagnosis, medical practice, treatments, and customer service. In particular, the paper will discuss an overview of different definitions given to AI and improving health and well-being, how the concept spreads to the healthcare system, and AI's role in people's opinion. The paper will continue with the case of the European Union's attitude towards the use of AI in the healthcare system. Concluding remarks will end the article.

1. Methodology

This article is based on a systematic literature review by selecting and collating findings of prior relevant studies, a method considered very useful in establishing a solid ground for a scientific argument (Tranfield, Denyer, and Smart, 2003).

The collection of scientific production from Web of Science and Scopus databases allows the identification of the variety of definitions that have been given to AI from 1955 until 2022 and select the ones that might be considered representative of the research's goal. These databases were chosen as the best options because of their quality and the vast data sources referring to artificial intelligence and healthcare. In addition, Google Scholar was another database from which the research information was collected in the terms mentioned above.

2. Artificial Intelligence: from computer science to healthcare

Artificial intelligence is a branch of Computer Science that has its origins in various disciplines that contributed ideas, points of view, and techniques and made from AI into what it represents today. The disciplines that constitute the pillar of this field are philosophy, mathematics, neuroscience, psychology, computer engineering, control theory, cybernetics, and linguistics (Russell and Norving, 2021). Sadiku, Fagbohunbe, and Musa (2020) gave one of the possible definitions. They considered that artificial intelligence is a branch of Computer Science that has its origin in various fields. We can find tools and applications dominated by AI in abundance in the present times. Marvin Minsky, the person who is considered to be one of the founding fathers of artificial intelligence, defined artificial intelligence in 1968 as "the science of making machines do things that would require intelligence if done by men." In general, AI is a sub-field of computer science that focuses on whether devices/tools/software can emulate human intelligence as defined by the European Coordination Committee of the Radiological, Electromedical, and Healthcare IT Industry. The discussion is about how it can become human-like rather than being human. Artificial intelligence originated in computer science and penetrated all the fields creating intelligent devices and particularly innovative computer programs.

Since 1956 when the Dartmouth Summer Research Project (McCarthy et al., 2006) was held to study AI, there have been many attempts to define AI. Different other definitions have been given to artificial intelligence. One of the most popular definitions of AI states that it is an artificial agent that can “achieve objectives in various situations.” (Cihon, Schuett and Baum, 2021, p.3). In addition, the term AI refers to what the public considers to be AI. Because people’s expectations increase through time and technology evolves, it is almost impossible to define AI. Still, we can break down the main definitions of AI, considering the point of departure for its journey, and analyze the impact on the healthcare field. Overall, improved diagnosis, new medical discoveries, better forecasting of catastrophic weather occurrences, safer driving with assistance, and ultimately self-driving technology are examples of how artificial intelligence may save lives. (Russell and Norvig, 2021).

If this paper had emphasized one universally agreed definition of AI, it would have made it easier to evaluate AI’s role and legal framework across different countries. Moreover, in the 21st century, there are plenty of definitions of AI with various flavors that are willing to capture the main elements of interest and AI’s capacity to assume its intelligent nature. Furthermore, AI is an algorithm-driven computing technology programmed to self-learn from data and make intelligent predictions and real-time decisions through artificial neural networks, machine learning, robotic process automation, and data mining, among other technologies (Siala and Wang, 2022).

Artificial intelligence has an impactful role in the healthcare system and is advancing quickly. The evolution can be seen through potential applications that have been launched across a wide range of medical and decision-making fields. The use of AI in the healthcare system came very quickly after individuals realized that computers could measure more than numbers. This conclusion led to thoroughly developing traditional intelligent systems that might have a different role. Medicine as an application area is one of the most challenging aspects of artificial intelligence that is hard to accomplish, deal with, or understand. As Holzinger (2014) mentioned, one of the most critical goals in the future treatment of patients is to model the complexity of individuals to personalize medical choices, health practices, and medication to the specific needs of each unique patient. The use of AI in the healthcare environment can be described as using intelligent data-driven technologies to more effectively utilize available healthcare resources and data to support and streamline healthcare decision-making and provide improved health services tailored to individual needs (Siala and Wang, 2022). Computer systems in healthcare have more than one purpose, and besides assisting with documentation and administrative tasks, they can provide efficient assistance to medical practitioners in many situations. For example, in clinical research, we can find a higher diagnostic accuracy even if only a few AI systems have been tested and received regulatory approvals to be considered medical devices. Still, those approvals are increasing day by day (Varghese, 2020).

3. Essential roles of AI in improving the healthcare system

Artificial intelligence brings many opportunities to contribute to the well-being of individuals and the advancement of the healthcare system. Nowadays, in the medical community was introduced a new term named "medical technology" which refers to a variety of tools that can help health professionals improve the quality of life of patients and society by performing accurate diagnoses, reducing complications, optimizing treatment, and providing less invasive possibilities, and shortening the length of hospitalization. Artificial intelligence has transformed medical technologies. It is usually recognized as the branch of computer science capable of dealing with complicated problems involving multiple applications in fields with a large amount of data but little theoretical understanding. Oncology, neurology, cardiology, and radiology are just a few medical sections that use AI systems. The steps that medical practitioners follow are early detection of the disease, diagnosis, therapy, outcome prediction, and prognosis assessment. Artificial intelligence helps medical practitioners go in-depth while investigating and establishing the treatment that should give successful results.

Furthermore, the primary debate about this subject regarding its implementation in the medical system is whether medical practitioners will eventually replace human physicians in the near future? For the moment, no one can come across the proper answer, but it is bound to help medical practitioners make better clinical judgments. Some specific instances can even replace human judgment (Jiang et al., 2017). Furthermore, medical robotics is represented by robots programmed to perform tasks in healthcare science. Therefore, on the market, there have been developed three categories of robots: surgery robotics, wearable, and rehabilitation robots, and robots that replicate the human body. For example, the surgical robot can execute a surgery or could help a surgeon act more precisely, improving his ability to see, create minimally invasive incisions, stitch wounds, and so forth, or an intelligent scan could picture an accurate diagnosis, or a virtual nursing assistant can monitor patients and answer their questions in real-time, or a medical diagnosis could

be pronounced since the beginning of the investigations. Those AI tools support clinicians in their daily work, and through them, we can assure that the medical act is executed professionally and without hindrance. The use of remote-controlled robotic surgeries has been demonstrated to increase procedures' safety and perform surgeries in anatomic regions that would otherwise be inaccessible to human hands (Matheny et al., 2019). As revealed by European Commission, in 2021, they were delivered to hospitals across the member states 305 disinfection robots to ease the burden of hospitals during the COVID-19 pandemic. In short, robots can be used for surgeries or early detection of disease and help alleviate the pressure of clinicians while offering patients more excellent protection against infections.

Moreover, a medical consultation could be carried out without direct interaction with a medical practitioner using just an online sickness database. The sickness databases aim to support medical practitioners in correlating the symptoms presented by the patient with the diseases that have been integrated into the system. Similarly, the virtual nurses' assistants are based on the same technological model (Yamin, 2018). Because of the new medical technology after implementing those devices/tools, we can remark an increase in the accuracy of input because the appliances in use have to be upgraded, and having a significant amount of data in the system can indicate and correct the information inserted immediately.

Additionally, AI is becoming increasingly crucial in surgeries because of its implication for decision-making. For instance, if devices are constantly upgraded and there is an increase in the input in the system, roadmaps could be provided to assist surgical teams in the operating room. The goal is to lower the associated risks and manage surgeries more safely (Matheny et al., 2019).

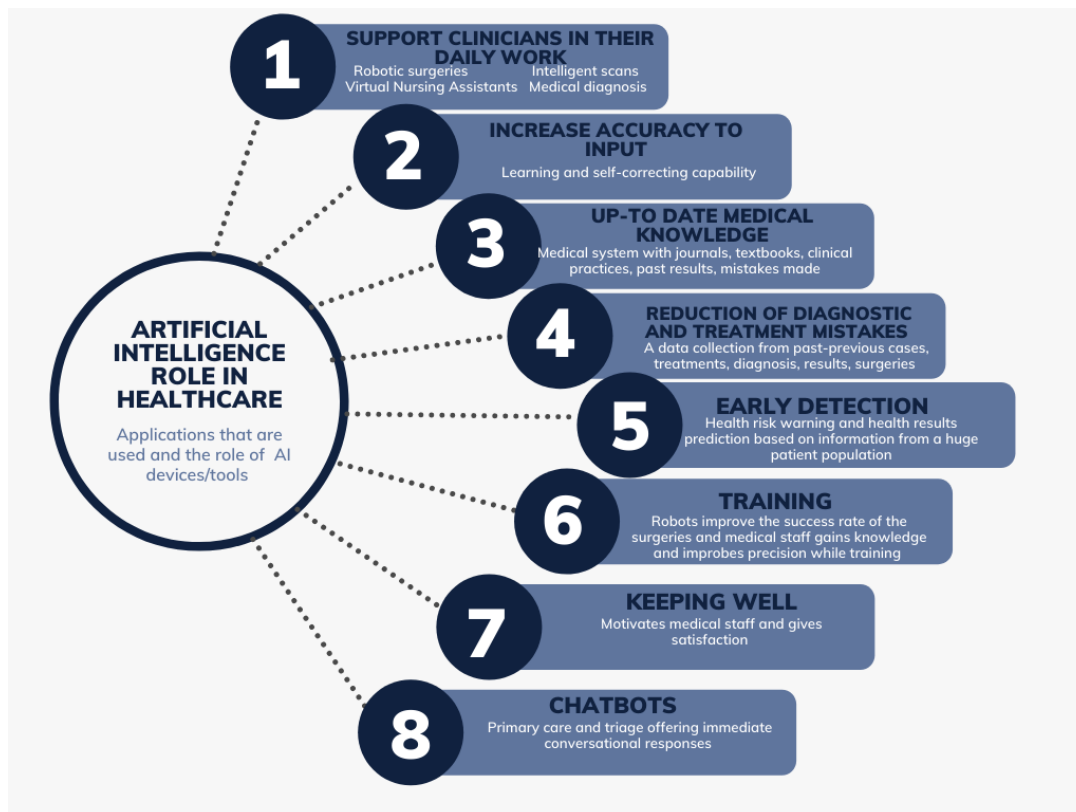


Figure no. 1. The Role of Artificial Intelligence in the healthcare system and the tools/devices that are used

Source: Author's elaboration

Another role for healthcare staff linked to this is to access a straightforward platform to gather medical journals, medical textbooks, clinical practices, and case studies and learn from others' mistakes recorded in the system. Nowadays, plenty of platforms offer this type of information, starting with small observational studies that may have minimal relevance and ending with complete clinical trials. The need for this kind of product was noticed from the need for a trustworthy and evidence-based database in a world where digitalization has taken the place of hardcover publications. On the other hand, AI also has a role in reducing diagnostic and treatment mistakes based on the database, compiled from past-previous cases/treatments/diagnosis/results/surgeries and whose primary purpose is to instruct and indicate when a mistake could be made. Diagnostic image recognition can distinguish between benign and malignant tumors. In this case,

AI's role is to serve as a helping tool by sorting and prioritizing images for an immediate review and diagnosis, highlighting essential findings that might have been missed, and classifying simple results.

In consequence, through this database, the medical practitioners can focus on more serious problems and provide quick and accurate diagnoses and treatments for cases similar to the previous ones (Matheny et al., 2019). Furthermore, collecting all the investigation results and implementing them into a database may help the medical staff determine an early detection of a high-risk disease commonly found in a vast population and whose provided results impact the future. Nowadays, early diagnosis can be achieved by improving the extraction of clinical insights and implementing them into a validated system. Moreover, this system makes it possible to realize an epidemic outbreak prediction if the parameters are partially known, and the gathered information indicates a likely outcome. In particular, medical practitioners recommend devices that can detect early-stage breast cancer- wearable vest- and devices that can improve cardiac monitoring and rhythm management for heart irregularities (Figure no.2). Although training is commonly found in each field and helps improve the quality of provided services and personal knowledge, having a device or a tool that strengthens the capabilities of a medical doctor brings an increase to the public perception about the proper execution of the medical act. Also, we can emphasize here that the success of the medical action contributes to the well-being of the medical staff, and they feel more motivated and secure doing their job. Medical practitioners appreciate each AI device/tool developed because it manages and reduces the potential of unintended consequences and focuses on the real problems. The last tool that brings a significant role to the healthcare system are chatbots for patient interaction, mental health, wellness, and telehealth.

In brief, chatbots are applications whose primary purpose is to automate chats. Suppose a patient uses an online application or calls an emergency number. In that case, the chatbot is answering, offering automated replies without human intervention in two ways: text-based conversation or voice recognition. Besides, chatbots are not entirely based on artificial intelligence, and they have pre-defined and rule-based programming to answer appropriately to patients' inquiries. Currently, chatbots are also called embodied conversational agents. Their role is to analyze symptoms, report back on outputs from health monitoring, and prescribe a course of action based on the information provided, simulating real-world conversation (Matheny et al., 2019). Even though this is not widely implemented, we can appreciate its latent qualities that may be developed and lead to future success or usefulness of the primary-care and triaging patients that are willing to arrive or have arrived at the urgent care and might be helpful for simple transactions like refilling prescriptions or scheduling appointments.

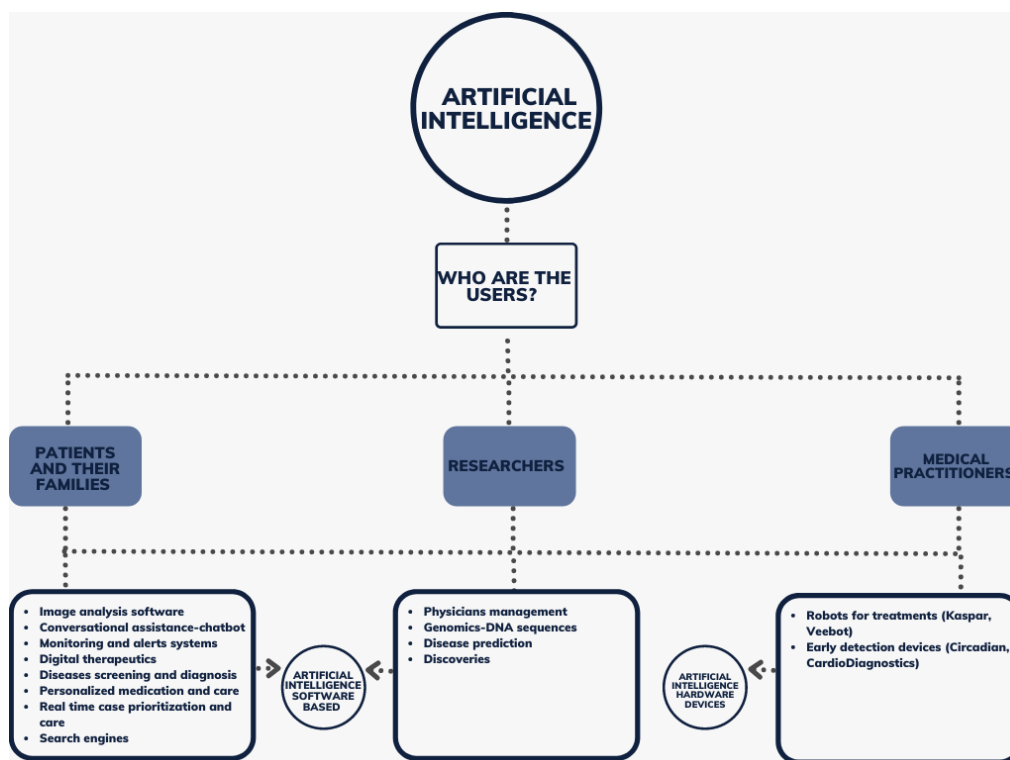


Figure no.2 What kind of AI healthcare devices are used and by who.

Source: Author's elaboration

4. How is European Union involved in supporting AI in the healthcare system?

Artificial intelligence can be considered a soft subject and a playground for political, legal, and technological issues. At the same time, the adoption of AI in Europe can be either impeded or expedited, as the Directorate-General for Internal Policies mentioned in a leadership study in 2018. The success rate of artificial intelligence will not be attained unless governments, businesses, and people adopt and integrate a wide range of AI applications in various ways (van Roy et al., 2021).

Globally, European Union is a leader in applying artificial intelligence in the healthcare field because extraordinary improvements have been made during the past years, and the results have been noticed. Commission proposed and began taking necessary measures to develop European Health Data Space (EHDS) in 2020, willing to ensure the secure free flow of health data, promote the uptake of digital health, and address issues related to governance and security, and data protection. The role of this data space will be to encourage the upscale and uptake of digital health solutions and provide concrete benefits to patients while supporting the training and testing of artificial intelligence algorithms. This legislative proposal is expected to be adopted in spring 2022.

During the COVID-19 pandemic, there was an increased demand for telemedicine and online medical appointments just a few weeks from its debut. Since the beginning, a few startups have noticed the need on the market, and they were quick to develop platforms to fulfill patients' needs. But immediately after the launch, they faced three main problems: the lack of a legal framework for medical services that can be provided through telemedicine, the lack of a legal framework for e-prescriptions, and the lack of a health records platform. Each European member state responded individually to this legislative challenge without taking a standard action at the EU level. In the near future, it is expected that the European Health Data Space and eHealth Digital Service Infrastructure will be implemented in all the member states and simplify access to medical services.

Conclusions

Artificial intelligence is one of the most exciting and rapidly expanding topics today and is already earning billions of dollars in income every year. Equally important, the applied artificial intelligence technologies may help improve population health while also providing access to diagnosis and treatment in an evolving manner. Still, we must remember that none of those devices or tools are less expensive, and as a result, society may face a significant challenge, that of accessibility.

The positive impact of artificial intelligence on the healthcare system can't be disregarded. Artificial intelligence benefits are one of the AI developer's motivations within this field. In consequence, the main perks must be mentioned: helping doctors give more accurate diagnoses and direct opinions toward more efficient treatment alternatives, increasing the productivity of medical practitioners, and reducing the healthcare spending's at a large scale after the investment. Equally important, it must be implemented at the EU level regulation for telemedicine and a platform for medical appointments to avoid exchanging emails between patients and clinics or phone calls that might seem time-consuming. This type of digital platform arises from the need to adapt to new digital trends. Because of globalization, the population is much more open to receiving treatments abroad. Notwithstanding, the people must embrace this challenge of adapting to the new medical practice, which involves artificial intelligence technology, and put their faith in those technologies that constitute the future and were developed for their well-being.

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