

Artificial Intelligence in health sector and medical research: impacts and challenges



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Abstract:

Humanity has become accustomed for years to the use of Artificial Intelligence; this one is known for providing assistance and development leading to a saving in effort in time and resources. Health and medical research are not left out, they are among the areas where (AI) assistance has been present for several decades. This has led to the generation of positive impacts on the health care of patients and the improvement of medication for diseases requiring heavy treatments like cancers and other strokes. However, this state of affairs is not without the necessary consideration of issues and a number of risks linked in particular to the fears that intelligent systems could one day emancipate themselves from the will of man, the latter risks being disqualified in his work by relying too much on the assistance of machines. This adds to the risk involved in collecting patient data.

Keywords: Artificial Intelligence; Health; Scientific Research; Challenges; Medical Field.

الملخص:

درجت البشرية منذ سنوات على استخدام الذكاء الاصطناعي، فهذا الأخير يقدم مساعدة ويضفي تطوراً يؤدي إلى تحقيق وفورات في الوقت والجهد والموارد. يعد قطاع الصحة وكذا البحث العلمي في المجال الطبي من بين الميادين التي استعانت بتكنولوجيا الذكاء الاصطناعي منذ عشرات، حيث حمل ذلك إيجابيات إلى الخدمات المقدمة في المجال الصحي وتحسناً في العناية التي ينالها الأشخاص المصابون بأمراض تستوجب معالجة ثقيلة على غرار السرطان و الجلطات الدماغية. لكن الإعتماد على هكذا تكنولوجيا لا يخلو من مخاطر، فالآلات الذكية قد تخرج في المستقبل عن سيطرة الإنسان وإرادته، كما أن الإعتماد على الذكاء الاصطناعي في القيام بعدد من النشاطات من شأنه أن يؤثر سلباً على التأهيل المهني لدى الإنسان، زد إلى ذلك خطورة جمع وإفشاء البيانات الشخصية.

الكلمات المفتاحية: الذكاء الاصطناعي، الصحة، البحث العلمي، المخاطر، المجال الطبي.

Introduction:

Artificial Intelligence is the technological tool that continues to make headlines in scientific circles, and in lay ones, for presenting itself as an advance in knowledge. In the fact, the evolution is spectacular to such an extent that some people think entrusting the future of humanity to a machine to manage it in its slightest manifestations would entail major risks. This is the opinion of a panel of experts, including those who have been at the origin of the innovations recorded in this field, having called for a moratorium to be observed in scientific work aimed at producing a “new model of language processing launched by OpenAI, the company behind the chatbot ChatGPT” (Piquard, 2023). Due to its ability to process mega-data, and its ability to learn from past situations, Artificial Intelligence opens a wide horizon for all of humanity, by innovating and publishing solutions to modern problems and surpassing the big challenges, particularly scientific ones.

Scientific research is the great beneficiary of this technological advance, and many fields now rely on the contribution that this technology offers following its capabilities for processing big data, their coordination, and their correlations.

In this context, medical research is experiencing an evolution through the contribution of Artificial Intelligence to its growth by offering an invaluable time saving in the diagnosis of diseases requiring heavy treatments, and in the search for molecules that can even perfect any healing process.

It would be interesting to specify the nature of the assistance that Artificial Intelligence offers to medical research in its different fields, and its impacts, before listing the challenges of the introduction of such technology in this discipline.

The use of a historical approach is required in order to retrace the different stages of the advent of this technology in different areas of modern life, notably health and medical research. This before using an analytical approach with the aim of understanding the impact of AI on medical research, and identifying the issues linked to its use in this field.

1. Artificial Intelligence, its definition and its intrusion into several sectors:

It is a technology with great contribution to the lives of men that we are talking about, which has always experienced difficulties in processing, analyzing, and listing enormous quantities of knowledge, and data of all kinds given the limited capacities of the human brain.

1.1. Definition:

Several definitions have been produced concerning Artificial Intelligence (AI), so we can for example cite Kaplan and Haenlein who see it in 2019 as “ a system’s ability to correctly interpret external data, to learn from such data, and to use those learnings to achieve specific goals and tasks through flexible adaptation” (Bartneck, Lutge, Wagner, & Welsh, 2023).

For Poole and Mackworth, (AI) is, in 2010, a field that “studies the synthesis and analysis of computational agents that act intelligently” (Bartneck, Lutge, Wagner, & welsh, 2023).

The “intelligent” reference is applicable to an agent when it meets the criteria listed in table n°1 below.

Table n°1: Criteria for an agent’s intelligence

Clues	Criteria
Actions	Its actions are appropriate for its circumstances and its goals.
Flexibility	It is flexible to changing environments and changing goals
Relation to expériences	It learns from experiences
Choices	It makes appropriate choices given its perceptual and computational limitations

Source: (Bartneck, Lutge, Wagner, & Welsh, 2023)

For their part, Russel and Norvig noted that machines are qualified as intelligent because they are capable of reproducing certain acts specific to humans, this offered the opportunity to list four schools of thought, each referring to a type of act human. Table n°2 illustrates the details.

Tableau n°2: Human acts performed by machines

Nature of acts	Acts performed by machines
Thinking	Machines think like humans
Acting	Machines act like humans
Acting rationally	Machines act rationally
Thinking rationally	Machines think rationally

Source: (Bartneck, Lutge, Wagner, & Welsh, 2023)

It is therefore a field of computer science that we are talking about, the work is focused on the development of machines qualified as intelligent, using algorithms allowing them to analyze large quantities of data, to learn from experiences, “and then make a determination or prediction about something in the world” (Habeeb, 2023).

The very first beginnings of research in (IA) date back to the work of John Mc Carthy, he was the first to use the term “Artificial Intelligence” and this, “during a conference at Dartmouth College in 1956. This symbolized the birth of IA scientific field” (Yong & al., 2023). Then the (AI) had gone

through stages of development leading it to its current configuration, it went from a first stage where tools gave it an ability to perceive, to arrive at another, where it had cognitive abilities, then a last stage where machines became capable, like humans, to make optimal decisions. Table n°3 provides a summary.

Tableau n°3 : Synthesis of AI development stages

Type of intelligence	Machine's abilities
Perceptual intelligence	Vision, learning, touch
Cognitive intelligence	Induction, reasoning, acquisition of knowledge
Decision-making intelligence	Making optimal decision

Source: (Yong & al., 2023)

1.2. The different types of Artificial Intelligence:

The evolution of intelligent machines using increasingly sophisticated algorithms has produced different types varying according to their uses, so we can list them as follows (Bartneck, Lütge, Wagner, & Welsh, 2023) :

1.2.1. Expert systems:

These are systems that emerged during the 60s, we wanted to make them, at that time, intelligent systems whose mission was to provide answers to well-defined problems in a given field.

1.2.2. Planning systems:

Such systems attempt to generate and organize a certain number of actions which can be adapted to a given state of the world with its unknowns.

1.2.3. Computer vision:

It concerns a sub-field of (AI) whose mission is to convert data collected using camera, they are transformed into knowledge representations.

1.2.4. Machine learning systems:

Through this type of (AI) computers are able to refine their responses in a given area based on past experiences.

1.3. The use of Artificial Intelligence in scientific research:

A multitude of areas of people's lives have been fully invested by (AI), this is due to its immense capacity to process gigantic quantities of data, which has facilitated its propagation in countless scientific disciplines.

1.3.1. The various forms of assistance offered by Artificial Intelligence:

Computers, machines and robots, are powered by computer programs, these contain sequences of operations in the form of formal rules called "algorithms", their mission is to resolve specific problems by carrying out a type of reasoning close to human intelligence (L'intelligence artificielle au service de la santé, 2023). With this ability, (IA) offers varied assistance in scientific research.

1.3.1.1. Reconciliation, crossing, and correlation of data:

The algorithms used in the various IT tools have the capacity to browse in a short time gigantic databases containing data in different scientific specialities around the world. In addition to collecting a large amount of information in a given scientific field, (AI) is able to make connections and cross-references between a multitude of information from research work scattered across various centers and laboratories.

(AI)'s help to the world of science takes the form of weaving correlations between this information that no human could have had (Rolland, 2023).

1.3.1.2. Data analysis and learning:

Machine learning is a technique specific to (AI), it is characterized by the analysis of high-speed data in order to obtain information, which will be used when making decisions based on evidence in an innovative way (Yong & al., 2023).

1.3.2. Examples of AI-assisted research areas:

The fields where (AI) intervenes are numerous to such an extent that there is no sector of activity where it is not integrated; we can thus find it in fields as varied as physics, the study of the behaviour of populations, business management, and health.

1.3.2.1. In the field of physics:

Theoretical and experimental physics are some of the pioneering fields to have used (AI) in the search for new particles, it dates back to the end of the 1980's. Machine-learning algorithms serve as the basis for artificial neural networks, and the contribution of this technology is required in the realization of "millions of collisions within particle accelerators giving rise to the recording of a very large number of data" (Boisson, 2023).

1.3.2.2. In the study of population behaviour:

Social networks are the most modern way to exchange information in large quantities, resulting in a very large number of people connected. Millions of communications per day can be recorded. The role of (AI) in any study of this type of communication used to profile the behaviour of connected users is vital, since it involves processing millions of pieces of data (Boisson, 2023).

1.3.2.3. Decision making in businesses:

(AI) is no longer the prerogative of large industrial groups as was the case in the recent past, small companies are increasingly using this technology to offer their products. The advances recorded in the programming of algorithms are an opportunity to be able to extract information by processing large quantities of data, these are used for predictive purposes; the predictions can be used to make better decisions (Charlin, 2017).

1.3.2.4. Health:

Health remains among the fields that used (AI) very early, for example, robot-assisted surgery appeared in hospitals in the 1990's, particularly in urology and gynecology and then in general surgery. It was during the 70s that the modelling of medical expertise in different specialties using (AI) programs took place.

With the advent of the 2000s and the development recorded by (AI), various operations in the health sector have seen the introduction of it, this goes from diagnosis to health monitoring, including treatment recommendations, treatment procedures, surgery, assistance to people, prevention, and research (Touraine, 2021).

2. Medical research supported by Artificial Intelligence:

The health field therefore integrated (AI) very early in its multiple operations, thus the development of algorithms and their increasingly growing ability to process ever-exponential quantities of data, made the collection of information, their cross-referencing, and their use in decision-making is easy.

2.1. Health and medical research assisted by (AI):

Different specialties in health and medical research benefit from the support and assistance of (AI) in their processes. This field, which is a large generator and consumer of massive quantities of data, is among those that feel an urgent need to have information available, thereby generating a certain impact.

2.1.1. The impact of (AI) in the field of health:

Health has a great need for information available in a short time given the urgent nature of certain medical interventions requiring rapid decisions, and for the management of the stages of the admission process in health establishments.

2.1.1.1. Its impact on patient orientation:

Hospitals and other health structures benefit from the contribution of (AI) in terms of time saving and simplification of procedures, thus emergency departments, in their capacity as advanced track of health establishment, frequently use this technology for the purposes of classify patients according to their degree of urgency. (AI) is able, with the information requested by the computers, to determine whether the need for care is respiratory, pulmonary, or cardiac (Lefer-Palos, 2023).

2.1.1.2. Its impact on medical diagnosis:

Diagnosis is the most sensitive task in the work of doctors, it is a decisive stage from which follow the operations specific to the medical treatment process. The relevance of using (AI) is revealed in particular when interpreting medical imaging and radiology. The programs accompanying this technology are used in the identification of anomalies and early tumors that are difficult to access to the eye of the doctor, and which generally affect the lung and breast (Lefer-Palos, 2023).

2.1.1.3. Its impact on surgical interventions:

More and more surgical procedures are performed using intelligent robots. These are of great benefit to surgeons as tools offering greater ease in the practice of their interventions. Such tools also contribute to improving patient comfort.

2.1.1.4. Its impact on predicting the effectiveness of a drug:

Having a precise idea of the effectiveness of a treatment or medication is undoubtedly one of the major concerns among practitioners who prescribe it. It is easy to get an answer when administering so-called "non-heavy" treatments, but in the case of "neoadjuvant chemotherapy" prescribed for breast cancers, or when it is question of administering "immunotherapy" for bronchial cancer, (AI) can precisely predict the effectiveness of the treatments in question (Benamouzig, 2023).

2.1.2. Impact of (IA) on medical research:

Medical research is also experiencing an impact due to the use of (AI), its tools are « becoming increasingly common in science, and many scientists anticipate that they will soon be central to the practice of research » (Van Noorden & Perkel, 2023). The deep-learning systems have opened the way to an acceleration of the potential of medical (AI) (Zeitoun & Ravand, 2019).

The use of (AI) in medical research had the first effects of the publication of results in increasingly large numbers, thus "dozens of clinical studies and trials testing medical (AI) products are now conducted and published each year, concerning practically all specialities" (Zeitoun & Ravand, 2019).

2.1.2.1. Cancerology:

This is one of the specialties where the use of (AI) is most obvious, clinical research in this field continues to experience a real acceleration in view of the increasingly high number of cases in recent years. The contribution of this technology consists, for example, in making cross-checks and correlations, through interposed algorithms, on the basis of selections made on patients; the evolution

of their illnesses and the type of treatments that are prescribed to them are taken into account. There is also question of locating files of people suffering from so-called rare cancers (Danaher, 2023).

(AI) is able to account for the possible causes of cancer using algorithms associated with the deep-learning system capable of performing billions of tests from clinical molecules, which the computer compares with other data (Bengio & Lemieux, 2023). The other impact of the use of (AI) in clinical cancer research consists of this probe role played by intelligent systems allowing the prediction of potential relationship between data relating to active genes and specific behaviors (Bengio & Lemieux, 2023).

We could one day aspire to the personalisation of anticancer treatments by using information technology associated with biology (bioinformatics), this could identify correlations between data from the analysis of genomes, and the clinical manifestations of cancers (Danaher, 2023).

2.1.2.2. Research into cardiovascular diseases:

Finding effective treatments for cardiovascular diseases is a major challenge for medicine in these times; predicting the occurrence of heart attacks remains a great concern for patients and practitioners. This is how scientific teams carry out clinical research by combining (AI), and by developing algorithms capable, on the basis of the collection and analysis of magnetic resonance imaging data of the heart, of predicting the risks of death incurred following a myocardial infarction or indeed a stroke (L'intelligence artificielle au service de la santé, 2023).

In this sense a research team at Stanford University in the USA has developed a new algorithm which can by sifting "hours of heart rhythm data generated by some wearable monitors to find sometimes life-threatening irregular heartbeats, called arrhythmias" (Kubota, 2023).

(AI) is further used by clinicians to research genomes, this can lead to isolating "DNA sequences that may correspond to an increased risk for a particular illness" (Armitage, 2023).

2.1.2.3. (AI) and research in the field of mental health:

The modern world and its pace of life generates numerous cases of psychological illnesses, these represent a real challenge for human society called to adapt and find solutions to such deficiencies. In this case the need takes the form of being able to detect psychological illnesses such as schizophrenia or chronic psychoses in time, in order to be able to provide personalised psychiatric care for preventive purposes.

The other necessity is to be able to recognise people who may be victims of mental illness, in this sense it is vital to have the possibility of modeling knowledge around schizophrenia and identifying a set of biomarkers. To do this, research is being carried out with the aim of developing an (AI) whose algorithms are able to guarantee such contributions (L'intelligence artificielle au service de la santé, 2023).

2.2. The challenges of the emergence of (AI) in medical research:

The advent of (AI) in a multitude of sectors of people's lives in these modern times has caused a certain optimism about the benefits that brings, particularly with regard to health and medical research; notable advances have been recorded there. But despite the benefits of this technology, some people identify fears about putting too much emphasis on it.

2.2.1. About benefits of introducing (AI) into medical research:

What (AI) holds in terms of benefits in the health sector and medical research is notable, the limits are pushed well beyond what humans know as capacities in the collection of data, and their processing.

2.2.1.1. Reduction in the cost of clinical research:

Carrying out more accurate evaluations has always been a serious pitfall facing clinical research, it took in fact more time when it was a question of using human capacities alone, causing exorbitant costs. It is in this sense that (AI) has reduced the cost of research by using its ability to exploit significant quantities of health data from the results of medical examinations, connected objects worn by patients, online forums, and other messaging (Chaix, 2018).

2.2.1.2. Reduced drug development time:

The development of new drugs usually requires compliance with protocol made up of scientific and clinical steps that it is strictly necessary to respect, this means that the development of new treatments is likely to take a long time. (AI), with its deep-learning systems, has quickly made progress, so the algorithms attached to it are capable of carrying out billions of tests on chemical molecules, and the computer begins to compare with other data (Bengio & Lemieux, 2023).

In this regard, the development of vaccines can perhaps be carried out in a shorter time, with (AI) helping to optimise preclinical research (Lefer-Palos, 2023).

2.2.1.3. Healthcare practitioners benefit from more comfort:

The use of (AI) in the field of medicine has not only helped practitioners and clinical researchers in the processing and correlation of vast quantities of data of all kinds, but above all has relieved them of heavy tasks that consumed the majority of their time. This is palpable, for example, in the interpretation of medical imaging in interventions increasingly carried out by surgical robots. (Lefer-Palos, 2023).

This state of affairs creates a comfortable situation where medical researchers and caregivers can free themselves from carrying out tedious and time-consuming tasks, since (AI) does it for them.

2.2.2. Fears raised by the use of (AI):

The enthusiasm induced by the introduction of (AI) in health and medical research has not been accompanied by certain fears, reservations have been expressed as to the effects that this could produce on medical research, but especially on the status of the one who carries out this research, that is to say: the human being.

2.2.2.1. Fears related to the automation of cognitive aspects:

As long as the intervention of (AI) was limited to secondary aspects such as the collection of data, as well as its processing, one could only be confident about the help that this technological tool could provide. But it turns out that the increasingly rapid developments in intelligent systems, with the automation of professional tasks as a corollary, are experienced as wave that goes beyond the simple collection of data to extend to aspects of a cognitive nature affecting human activities such as reasoning or decision-making (Zouinar, 2020).

2.2.2.2. Of the risk of the emancipation of (AI) from human will:

We have seen how the different intelligent systems provide useful and consistent help to humans in different fields and professions, going so far as to replace humans in tasks that are intrinsic to them, such as decision-making. But some feel concern and mistrust about the turn that this delegation of complex tasks to increasingly autonomous technological systems could take (Lapin, 2020) ; there remains a risk that the machine will one day be equipped with a will and an intention of its own, leading to its emancipation from the control of man (Hours, 2019).

2.2.2.3. Risk of deskilling:

Among the fears raised by the introduction of (AI) in certain professions one of them is about the future of work, and the risk that this would entail due to the delegation of certain tasks to algorithms, which would move from simple assistance to man in its pure replacement (Georges, 2019).

We are talking about a situation which could one day cause the deskilling of humans in all fields and specialties where (AI) is introduced, in particular professions linked to medicine. The risk in this case would be that doctors and other clinical researchers would forget how to carry out certain tasks, by the simple fact of delegating them to intelligent machines (Zeitoun & Ravand, 2019).

2.2.2.4. Risks related to the collection of personal medical data:

In the health sector, the tasks delegated to (AI) in order to facilitate the reception of patients, their orientation, the diagnosis of their illnesses, and what follows as treatments, are all operations consuming very personal data, in this case arises an ethical problem regarding the misuse of such information. This is what appears in one of the reports prepared by the WHO as major challenges linked to the introduction of (AI) in the health sector in terms of patient safety, cyber security and the environment (OMS, 2021).

2.2.2.5. Poor countries will not benefit like rich ones:

The majority of intelligence technology is developed in rich countries, especially that dedicated to assisting health tasks; thus the data introduced into these systems are collected almost exclusively from people living in said countries, these are known for example for their high incomes, these intelligent systems may not be effective for those whose income is reliable (OMS, 2021).

2.2.2.6. Risks related to open access to data:

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The success of medical research assisted by (AI) is dependent on the availability of a certain amount of data, so cancer research, for example, would be ahead in the discovery of adequate treatments. Finding data of the desired quality is not easy in some cases; certain health networks as well as the industries associated with them do not easily provide access to their data since they fall under the imperative of respect of privacy.

Companies operating in the pharmaceutical industry are in turn reluctant to use their data, citing reasons of industrial secrecy (Bengio & Lemieux, 2023).

Conclusion:

Artificial Intelligence is one of the greatest technological advances known to man. Several definitions have been produced about it, it is generally an intelligence whose actions are appropriate to achieve previously defined goals, flexible enough to fit with changes in the environment, and intelligent enough to learn from its experiences.

From this point of view, we are talking about machines capable of thinking and acting like humans. Machines powered by algorithms whose capabilities allow them to analyze vast volumes of data.

The name Artificial Intelligence dates back to 1956, since that date, the evolution of this technology has made it today, machines capable of producing optimal decisions, like humans, with a typology varying from expert systems, planning systems, through computer vision, to machine learning systems.

The assistance that (AI) offers varies from reconciliation, cross-referencing of data, and analysis and learning from it. Thus, various fields of knowledge benefit from it, like physics, the study of population behavior, and decision-making in businesses.

Health and medical research are among the fields that have very much exploited intelligent systems; for example, the modeling of medical expertise assisted by (AI) dates back to the 1970s. The 2000s saw them, its instrumentalisation in areas such as diagnosis, health monitoring, surgery, prevention, and research.

Health has recorded a certain impact following the introduction of (AI) in several of its fields, the same goes for the orientation of patients which has benefited from an appreciable saving of time and the simplification of procedures, but also from the improvement of diagnosis, with in particular its assistance in medical imaging. The impact of (AI) on surgical interventions is not to be outdone; intelligent robots provide significant assistance. Finally, intelligent systems are of great support in predicting the effectiveness of a treatment. The practice of medical research is in turn having a certain impact in vital areas such as oncology, cardiovascular diseases, and mental health. On the other hand, (AI) is associated with a number of risks linked in particular to the fears that intelligent systems could one day emancipate themselves from the will of man, he risks being disqualified in his work by relying too much on the assistance of machines. This is in addition to the risk incurred by the collection of patient's personal data.

(AI) today represents a real and logical advance in technology linked to robotics and data processing, a multitude of fields use it and benefit from its advantages. Humanity should therefore not separate itself from it or put an end to its progress, from this point of view, but rather deal with the issues, which accompany its instrumentalisation, especially in the field of health, and scientific research that is dedicated to it.

An excellent health institution, such as WHO, is ideally suited to be entrusted with the mission of establishing ethical rules governing the use of (AI) in the field of medical research.

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