

Designing a Proposed Framework for Applying Artificial Intelligence Technology to Support Treatment Decision-Making at the Expense of the State (Applying to the Arab Republic of Egypt)

تصميم إطار مقترح لتطبيق تكنولوجيا الذكاء الاصطناعي لدعم اتخاذ القرار العلاجي
على حساب الدولة
(بالتطبيق على جمهورية مصر العربية)

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Abstract:

With the continuous technological development, the application of Artificial Intelligence (AI) in medical diagnosis and treatment has become increasingly extensive. In this paper, the researcher designs a proposed framework for applying Artificial Intelligence Technology to support treatment decision-making at the expense of the state without human intervention, enjoying the advantages of saving time and providing high-quality medical service.

Keywords: Artificial Intelligence, Decision-Making, Medical Services.

المستخلص:

مع التطور التكنولوجي المستمر، أصبح تطبيق الذكاء الاصطناعي (AI) في التشخيص والعلاج الطبي واسع النطاق بشكل متزايد. وفي هذا البحث يصمم الباحث إطاراً مقترحاً لتطبيق تكنولوجيا الذكاء الاصطناعي لدعم اتخاذ القرار العلاجي على حساب الدولة دون تدخل بشري، مع الاستفادة من مزايا توفير الوقت وتقديم خدمة طبية عالية الجودة.

الكلمات المفتاحية: الذكاء الاصطناعي، اتخاذ القرار، الخدمات الطبية.

1. Introduction

In this digital age, the world is witnessing a global shift to Artificial Intelligence technology, which has made great strides in many medical fields such as

diagnostics, pharmaceuticals, biotechnology, etc. It neither became science fiction nor an intellectual luxury.

Most of these technologies and applications have made great strides in development and maturity in various directions of medicine, in many cases, it takes a long time or even several years to make decisions related to the patient's life, diagnose the disease, and determine the patient's treatment method, which is a cumbersome, time-consuming, and difficult process. to save the patient's life, this is also a process that puts pressure on doctors.

On the other hand, Artificial Intelligence and machine learning have made significant progress in diagnosing and making rational decisions as the process becomes simpler and cheaper.

2. Literature Review

Although specific research on the impact of applying AI to healthcare delivery is limited, there are a few studies and case studies that have examined relevant aspects and can provide valuable insights. Here are some relevant references:

(2022), Yanli Zhao; Xiaomin Li in a study entitled “Research on the application of artificial intelligence in medical imaging diagnosis”, the paper puts forward some suggestions on how to better use artificial intelligence technology in medical imaging diagnosis with reference to the current actual situations [1].

Zhou Ziang; Lee Jihaeng (2021), in the research entitled “Research on Development and Challenges of Chinese Medical Artificial Intelligence” focus and development orientation of China's current health informationization. And how can Medical artificial intelligence transform and upgrade modern medical service industry as well as promoting the innovation and development of health industry constantly [2].

Mais Farkhadov; Aleksander Eliseev; Nina Petukhova (2020), In a study entitled “Explained Artificial Intelligence Helps Integrate Artificial and Human Intelligence in Medical Diagnostic Systems: An Analytical Review of the Literature” it was emphasized that medical systems based on artificial intelligence can now diagnose various disorders with high accuracy. This study shows that there are reasons for the lack of trust in these systems due to vague models and vague algorithms [3].

In a study by Xu, Min; Jia, Chuanhai (2021), entitled “Application of Artificial Intelligence Technology in Medical Imaging” mainly studies the application of artificial intelligence technology in the field of medical imaging [4].

He Zhou, Jianjun Huang, Xuemei Peng (2021), In a study entitled “Design of Medical Diagnostic System Based on Artificial Intelligence” The purpose of this paper was to design an artificial intelligence-based medical diagnosis system. After learning about the basic architecture of the artificial diagnostic system and building the database, the medical diagnosis system can be updated using the phase change algorithm [5].

All previous studies have agreed on the significant and important impact of applying Artificial Intelligence Technology in the medical field, and indeed on all other sectors related to this sector. Our modest study provides a new framework for one of the uses of Artificial Intelligence in the medical field, and proposes a model to support decision-making related to treating patients at state expense.

3. AI Technology Analysis

The concept of Artificial Intelligence Technology first appeared in 1956. Since then, Artificial Intelligence has gradually advanced in society. It overlaps with many sciences, including mathematics, philosophy, linguistics, psychology, computer science, and medicine. The idea is to use science and technology to support human intelligence and organize its thoughts by simulating related concepts and creating databases based on augmented and extended techniques.

The biggest difference between artificial intelligence and previous technologies is that it is no longer just a system that performs simple tasks, but a simulation system with powerful learning and thinking capabilities. With the continuous advancement of artificial intelligence, this technology has also demonstrated its potential in continuous practice.

We can define Artificial Intelligence as follows: Artificial intelligence (AI) is a new technology science that researches and develops theories and methods. Technologies and applications for simulating, augmenting, and extending human intelligence [6].

4. Artificial Intelligence and the Medical Field

4-1 History of Artificial Intelligence in healthcare

In the past, the first researchers envisioned a machine that could hold a great deal of medical knowledge and have the ability to give possible diagnoses. In the early 1980s, the importance of this field was recommended by improvements in storage and computing power (AIM). Artificial Intelligence was in demand. Research conducted at Rutgers, Stanford, and MIT paved the way for the current extensive use of AI in the fields of medicine.

4-2 Using Artificial Intelligence Technology in the Medical Field

The definition of Artificial Intelligence in the medical field is a term that expresses the use of machine learning algorithms and programs (meaning Artificial Intelligence) to simulate human cognition in analyzing and understanding complex medical and health data. Specifically, Artificial Intelligence refers to the ability of computer algorithms to draw conclusions based solely on the amount of input data.

What distinguishes Artificial Intelligence technology from traditional methods that are used in medical care is the ability to collect and process data and give clear and simple results to the end user. Artificial Intelligence relies on machine and deep learning algorithms to arrive at results. These algorithms can recognize patterns of behavior and can create their own logical sequences. To gain useful insights and forecasts. AI algorithms behave differently from humans in two ways:

1- Algorithms are a directed and limited method: Once the desired goal is determined, algorithms rely exclusively on the input data, and they can only understand what they were programmed to do.

2- Some deep learning algorithms represent black boxes; Algorithms can predict the outcome with extreme accuracy, but they do not provide a strong explanation of the logic used to reach it, regardless of the data entered and the type of algorithm used [7].

The main development conditions of Artificial Intelligence technology in the medical and health industry are data, calculating power and algorithm, the data includes structured data and unshaped data. Typical data types include electronic medical records, medical images, inheritable data, etc.

After 2006, with major modifications in computer software, the computing power of computers has greatly improved, which greatly promoted the development of Artificial Intelligence technology and made great progress in the medical field. In terms of algorithm, major machine learning includes supervised learning, unsupervised learning, reinforcement learning, and transfer learning [8].

In its first global report on Artificial Intelligence, the World Health Organization noted that Artificial Intelligence promises to improve healthcare and medicine around the world, but only if ethics and human rights are placed at the core of its design. Dr Tedros Adhanom Ghebreyesus, General Director of the World Health Organization said that: “Like all new technologies, Artificial Intelligence has enormous potential to improve the health of millions of people around the world,” and added that this new and important report provides valuable evidence about the benefits of artificial intelligence, and provides the increasing use of Artificial Intelligence in health. Opportunities – and at the same time challenges – for governments, service providers and communities.

The report indicates the possibility of using Artificial Intelligence to improve the speed and accuracy of diagnoses and disease detection, assist in clinical care, enhance health research and drug development, and support various public health interventions, such as disease surveillance, outbreak response, and health systems management.

The World Health Organization called for concerted efforts by governments, service providers and designers to address concerns related to ethics and human rights at every stage of the design, development and deployment of Artificial Intelligence Technology.

The World Health Organization has established six guidelines to ensure that (AI) works for the public good in all countries:

1. Protecting human autonomy.
2. Promoting human well-being, safety and public interest.
3. Ensure transparency, explainability and clarity.
4. Enhancing responsibility and accountability.
5. Ensuring inclusivity and equity.
6. Promoting responsive and sustainable Artificial Intelligence [9].

4-3 The benefits of Artificial Intelligence in medical field are as follows:

4-3-1 Diagnoses of illnesses

In many cases, diagnosing the disease takes long periods or years. It is an arduous and time-consuming process, and may make it difficult to save the patient's life. It is also a process that puts doctors under pressure. On the other hand, Artificial Intelligence and machine learning have helped achieve significant progress in diagnosis, as the process has become easier and less expensive.

Diagnostic methods developed by Artificial Intelligence include computed tomography, magnetic resonance imaging, x-ray imaging, and genomics and proteomics.

4-3-2 Drug development

It is known that the process of discovering and developing drugs is a long process, and requires a lot of time and cost, but the application of Artificial Intelligence in the medical field has helped to make it more efficient, through:

A- Determine the biological origin of the disease.

B- Identifying candidate drugs for treatment by observing the effect of the compounds on the targeted part of the treatment, and choosing the appropriate drug.

C- Accelerating the clinical trial process, helping to select suitable candidates for testing, improving the drug effect monitoring process, and thus developing the drug.

D- Determining vital signs during the process of diagnosing the disease and testing the drug.

4-3-3 Improving the treatment plan

It is known that patients respond differently to medications and treatment plans, based on many factors. Artificial intelligence has helped determine the treatment plan for the patient based on identifying the factors that make the patient more responsive to a particular treatment.

4-3-4 Gene modifications

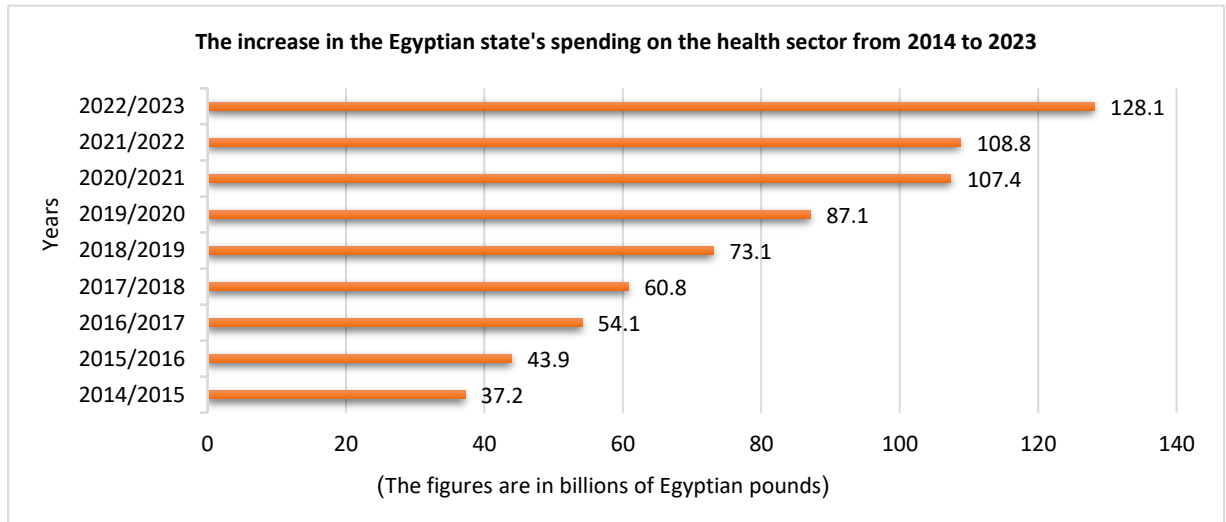
Gene modifications are considered difficult and expensive operations, and artificial intelligence has helped improve gene modification and ensure the least side effects [10].

5.The Nature of Treatment at State Expense as one of the Health Care Fields in Egypt

Health is one of the basic and indispensable human rights, as it is one of the human rights that an individual must enjoy. Also, every person has the right to obtain the highest level of health services that he can obtain, and to the extent that enhances one's feeling that he lives in dignity.

The government is fully committed to ensuring that every member of society has equal and fair access to health services, and to live in a healthy, disease-free environment.

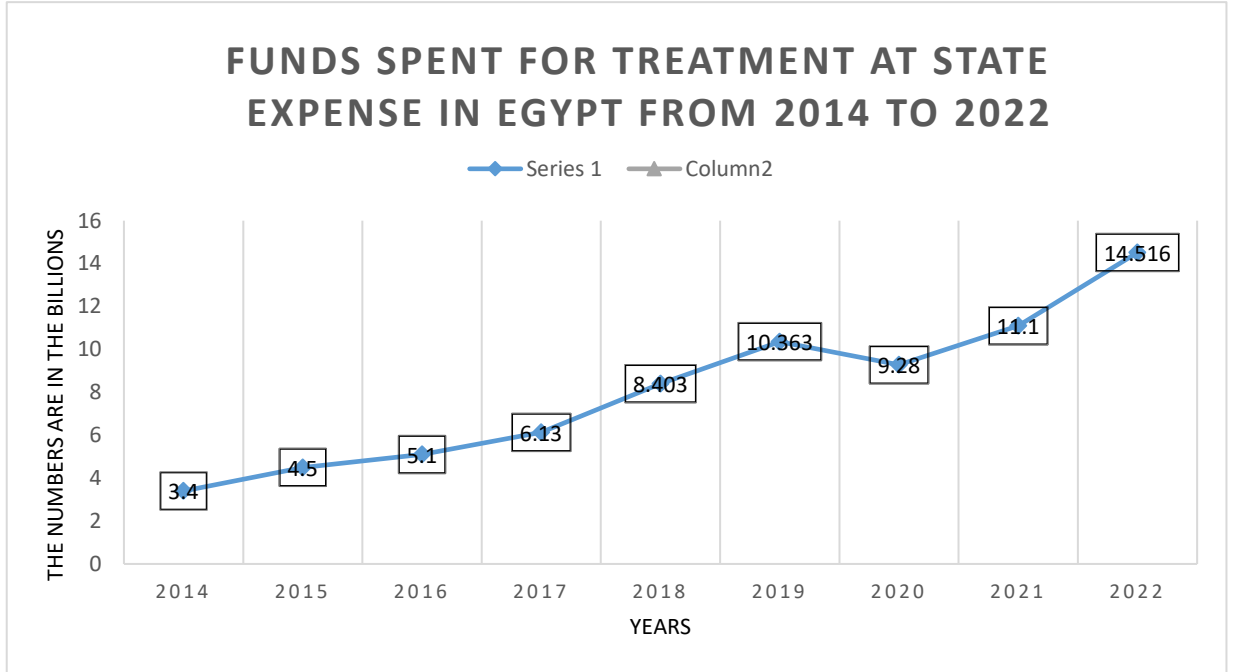
Egyptian law stipulates that the Egyptian Ministry of Health maintains the health of citizens by providing preventive and curative health services at the local and central levels, providing health improvement services to individuals, disease prevention, early detection, treatment and rehabilitation, developing and upgrading these services, and facilitating citizens' access to them , Therefore, the Egyptian state allocates a financial percentage of the annual budget , which is directed to spending on health care and services , The item “treatment at state expense” falls under this percentage.



Source: Egyptian Ministry of Health and Population, 2023, <https://www.moHP.gov.eg>.

The National Network for Treatment at the expense of the state affiliated to the Ministry of Health is spread in the governorates of the Republic, so that its number reaches (27) sub-medical councils in all governorates of the Republic, and the number (12) of the major hospitals frequented by treatment seekers at the expense of the state, to include the centers of tumor centers and educational institutes.

The database of treatment in specialized medical councils is the strongest treatment database in the Middle East. It was designed to support decision-making in the areas of prevention and treatment, regardless of the treatment service system used. It contains patient databases since 1997 and has been developed and updated, adding the patient's national number data since 2007. A patient is registered with it only by using the patient's own national number to ensure that the service reaches those who deserve it [11].



Source: Statistical Year Book, Central Agency for Public Mobilization and Statistics - A R E, 2023, <https://www.capmas.gov.eg/Pages/Publications.aspx>.

The previous figure shows the increase in public spending in the field of health, especially treatment at the expense of the state. Expenditure has evolved from 3.4 billion Egyptian pounds during 2014 to 14 billion and 516 million pounds. This is due to the increase in the population in Egypt and the development of the Egyptian government's thinking and vision to confront other countries and achieve prosperity for the people. and granting appropriate health care to him, taking into account that there are many obstacles facing those seeking health service, such as:

A- The delay in some decisions related to treatment at the expense of the state, whether internally or externally, due to the great pressure on that service due to the steady population increase, with that increase not being commensurate with the annual increase in the state's general budget, especially allocated for health care.

B- The difficulty of moving some patients from remote areas to obtain the service.

C- Sometimes nepotism is still one of the factors in setting priorities for choosing health service seekers.

Therefore, the researcher saw the need to design a model that helps, through the application of Artificial Intelligence technology, to assist in classifying the treatment service seeker at the expense of the state according to the seriousness of the case and a number of other factors that favor one patient over another, believing that the product presented here with its quality and speed of presentation makes a difference [12].

6- Proposed Framework for Applying Artificial Intelligence Technology to Support Treatment Decision-Making at the Expense of the State

ITEMS	Within the Budget	Extra Budgetary	Treatment is Available Locally	Inevitability of Treatment Abroad	Total Effect	Partial Effect	Total Evaluation Points
Very Critical							
Critical							
Average Condition							
Simple Case							
Unworthy Case							

(designed by the researcher)

(Reading key)

Case Evaluation	Weighting Points
Very Critical	4
Critical	3
Average Condition	2
Simple Case	1
Unworthy Case	0

Impact Elements	Weighting Points
Within the Budget	+1
Extra Budgetary	-1
Treatment is Available Locally	+1
Inevitability of Treatment Abroad	-1
Total Effect	+1
Partial Effect	-1

7-The Algorithm:

$$F = \int_0^i dU + \sum_{x=-1}^{+1} x + \sum_{y=-1}^{+1} y + \sum_{z=-1}^{+1} z$$

- F is the Evaluation degree
- U is the Case Evaluation

$$i = \begin{cases} 4 & \text{For very Critical Case} \\ 3 & \text{For a Critical Case} \\ 2 & \text{For average Condition Case} \\ 1 & \text{For simple Case} \\ 0 & \text{Unworthy Case} \end{cases}$$

$$x = \begin{cases} +1 & \text{For within the Budget} \\ -1 & \text{For extra Budgetary} \end{cases}$$

$$y = \begin{cases} +1 & \text{For local treatment} \\ -1 & \text{For abroad treatment} \end{cases}$$

$$z = \begin{cases} +1 & \text{For total effect} \\ -1 & \text{For partial effect} \end{cases}$$

8- An Illustrative Example of Setting Priorities in Supporting Treatment Decisions:

Messrs. (A), (B), and (C) applied to the Medical Committees Department to issue treatment decisions at the expense of the state, and all the documents required to evaluate those cases were submitted, so the artificial intelligence program evaluated the cases and then placed the evaluation on the aforementioned proposed decision-making support model.

Evaluation of Mr. A's condition:

ITEMS	Within the Budget	Extra Budgetary	Treatment is Available Locally	Inevitability of Treatment Abroad	Total Effect	Partial Effect	Total Evaluation Points
Critical	★		★			★	

Evaluation of Mr. B's condition:

ITEMS	Within the Budget	Extra Budgetary	Treatment is Available Locally	Inevitability of Treatment Abroad	Total Effect	Partial Effect	Total Evaluation Points
Very Critical		★		★		★	

Evaluation of Mr. C's condition:

ITEMS	Within the Budget	Extra Budgetary	Treatment is Available Locally	Inevitability of Treatment Abroad	Total Effect	Partial Effect	Total Evaluation Points
Average Condition	★		★		★		

Using the key to reading the evaluation form and setting priorities, we will reach the following results:

Mr. A:

Very Critical	Within the Budget	Extra Budgetary	Treatment is Available Locally	Inevitability of Treatment Abroad	Total Effect	Partial Effect	Total Evaluation Points
4	1+		1+			1-	5

Mr. B:

Very Critical	Within the Budget	Extra Budgetary	Treatment is Available Locally	Inevitability of Treatment Abroad	Total Effect	Partial Effect	Total Evaluation Points
3		1-		1-		1-	0

Mr. C:

Very Critical	Within the Budget	Extra Budgetary	Treatment is Available Locally	Inevitability of Treatment Abroad	Total Effect	Partial Effect	Total Evaluation Points
2	1+		1+			1-	3

9- The Result:

Thus, priorities can be arranged to assist in making medical treatment decisions at state expense as follows:

Mr. A, then Mr. C, and finally Mr. B.

Conclusion:

There are more and more applications of Artificial Intelligence in various medical fields, and with the maturity of technology and the construction and improvement of networked and Artificial Intelligence medical databases, the role of Artificial Intelligence Technology in medical diagnosis is becoming more and more important. In the future, this technology will help to reduce bureaucracy, save a lot of time and avoid personalization and favoritism, leading to more transparent decision-making.

It offers tremendous opportunity and space to provide higher quality care to those who use healthcare services.

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