Artificial Intelligence Role to Enhance Healthcare System in Egypt: Challenges and Opportunities

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Abstract:

Recently at the fore of 21st century, digital healthcare has emerged as the result of digital transformation, which offers unique opportunities to strengthen healthcare systems and meet different challenges concerning changing health needs as the current epidemics of infectious and chronic diseases. Then, the use of analytics employing diverse data and technologies such as artificial intelligence (AI) are emerging; to eliminate the complexity of healthcare processes and activities by ensuring high reliance on multifaceted information to solve any potential problems. In the same context, the Egyptian government seeks to build an ambitious newly public health care system to meet the expectation of the people to acquire high standard inexpensive and hasty public healthcare services. Consequently, in order to realize such aim, the Egyptian government issued the Universal Health Insurance Law (UHI) at 2018, which aimed to achieve the universal healthcare (UHC) for its population and provide them with the needed qualified health services without financial hardship. Then, it urges a national campaign to reform the healthcare sector and to develop the efficacy and quality of its services. Hence, this paper aims to propose how the healthcare system in Egypt can tackle various challenges and enhance adequately its capabilities; in order to seize the opportunity of digitalization and apply AI effectively through its various domains; which can then provide an adequate modernization of policy and governance frameworks necessary to bestow guidelines on how to manage a quality service system to patient satisfaction by decreasing waste, variation and work disparity in the service processes.

Keywords: Artificial intelligence, digital technology, health care services, Egyptian Universal Health Insurance (UHI) system.

Introduction:

Artificial intelligence (AI) is one of the fast-growing technological sectors (Borana, 2016). Its economic impact is expected to reach $150 billion by 2026 (Safavi & Kalis, 2019). Computer scientists proposed that they could make computers think the same way as humans. AI becomes the most powerful tool for dealing with and processing data in almost all fields. The healthcare sector is one of the huge data sectors that require AI-based solutions. The healthcare system consists of many interconnected subsystems with tons of data interchanged in between. Any healthcare system consists of three main parts: patients, providers and intermediaries. The Egyptian Universal Health Insurance (UHI) system is one of the modern systems that have distinctive intermediaries connecting patients and providers. So, UHI represents a very good example to clarify the possible applications of AI in dealing with medical data. Hence, this paper is organized as follows: In the first section, the concept and significance of AI is presented. Then, in the second section overviews on the applications of AI in healthcare systems is clarified. The institutional arrangements of the Egyptian UHI system are plotted in the third section. Accordingly, in the fourth section, challenges and requirements to AI-based solutions in the UHI system are listed. Finally, the paper's findings and conclusions are presented.

1. Artificial intelligence: concept and significance

Artificial intelligence (AI) is the programing of computer systems to analyze, problem-solve, and make decisions just as a human would (Hamet & Tremblay, 2017). AI was first introduced in the 1950s with many limitations which made it difficult to be introduced into healthcare but has since developed into what we use today in modern medicine (Kaul, Enslin, & Gross, 2020). AI began as a simple system series that analyzed "if this, then these rules" used broadly to advancement into algorithms personalized individual (Amisha, Pathania, & Rathaur, 2019). Simply put, AI refers to the science and engineering of making intelligent machines, through algorithms or a set of rules, which the machine follows to mimic human cognitive functions, such as learning and problem solving (Paul, Sanap, & Shenoy, 2021). AI systems have the potential to anticipate problems or deal with issues as they come up and, as such, operate in an intentional, intelligent and adaptive manner (Chaturvedula, Calad-Thomson, & Liu, 2019). AI's strength is in its ability to learn and recognize patterns and relationships from large multidimensional and multimodal datasets; for example, AI systems could translate a patient's entire medical record into a single number that represents a likely diagnosis (Jiang, Jiang, & Zhi, 2017); (Zheng, Yao, Wu, & Zheng, 2020). Moreover, AI systems are dynamic and autonomous, learning and adapting as more data become available (Mitsala, Tsalikidis, Pitiakoudis, Simopoulos, & Tsaroucha, 2021). AI is not one ubiquitous, universal technology, rather, it represents several subfields (such as machine learning and deep learning) that, individually or in combination, add intelligence to applications.

Accordingly, artificial intelligence (AI) is a rapidly evolving field of computer science that aims to create machines that can perform tasks that typically require human intelligence. AI includes various techniques such as machine learning (ML), deep learning (DL), and natural language processing (NLP). Large Language Models (LLMs) are a type of AI algorithm that uses deep learning techniques and massively large data sets to understand, summarize, generate, and predict new text-based content (Suleimenov, Vitulyova, Bakirov, & Gabrielyan, 2020). LLMs have been architected to generate text-based content and possess broad applicability for various NLP tasks, including text generation, translation, content summary, rewriting, classification, categorization, and sentiment analysis. NLP is a subfield of AI that focuses on the interaction between computers and humans through natural language, including understanding, interpreting, and generating human language. NLP involves various techniques such as text mining, sentiment analysis, speech recognition, and machine translation. Over the years, AI has undergone significant transformations, from the early days of rule-based systems to the current era of ML and deep learning algorithms (Davenport & Kalakota, 2019).

Today, AI is transforming healthcare, finance, and transportation, among other fields, and its impact is only set to grow. In academia, AI has been used to develop intelligent tutoring systems, which are computer programs that can adapt to the needs of individual students. These systems have improved student learning outcomes in various subjects, including math and science. In research, AI has been used to analyze large datasets and identify patterns that would be difficult for humans to detect; this has led to breakthroughs in fields such as genomics and drug discovery (Alowais, Alghamdi, Alsuhebany, & Tariq, 2023). AI has been used in healthcare settings to develop diagnostic tools and personalized treatment plans. As AI continues to evolve, it is crucial to ensure that it is developed responsibly and for the benefit of all (Esteva, Kuprel, Novoa, & Swetter, 2017). The rapid progression of AI technology presents an opportunity for its application in clinical practice, potentially revolutionizing healthcare services. It is imperative to document and disseminate information regarding AI's role in clinical practice, to equip healthcare providers with the knowledge and tools necessary for effective implementation in patient care (Rahman, Evangelos, & Julianne, 2024). Hence, advancements in AI programs have been happening since it was first introduced in the 1950s. The use of them has a positive impact on the quality of medicine improving accuracy, consistency, and efficiency in all aspects (Kaul, Enslin, & Gross, 2020). Then, AI in medicine has evolved over the last five decades into personalized diagnostic, therapeutic, and preventative care. In this paper, it is discussed how artificial intelligence can positively impact the future of medicine, along with its downsides.

2. AI implication to healthcare systems

AI has the potential to bring about positive changes in healthcare and to empower patients by providing them with more control over their health. In recent years, AI has been used to improve the delivery of healthcare in a variety of ways, from providing personalized health information to enabling virtual consultations and remote monitoring. One of the key benefits of AI in healthcare is the ability to provide personalized health information (Hamet & Tremblay, 2017). By analyzing patient data, such as medical histories and lifestyle factors, AI algorithms can provide patients with tailored recommendations for maintaining good health. This information can help patients better understand their health and make informed decisions about their care. Another important application of AI in healthcare is remote monitoring (Kaul, Enslin, & Gross, 2020). With AI-powered remote monitoring systems, patients can have their vital signs tracked and monitored, alerting healthcare providers to any potential issues.

Consequently, this can lead to earlier intervention and improved patient outcomes, as well as reducing the need for in-person visits to healthcare facilities. Virtual consultations are another way in which AI is being used to improve the delivery of healthcare. By providing remote medical care, patients can receive medical treatment without having to travel to a healthcare facility. This can be especially beneficial for those who live in remote areas or who have mobility issues. Medication management is another area where AI can play an important role in empowering patients (Manas & Neil, 2023). By analyzing patient data, such as prescription histories and vital signs, AI algorithms can help healthcare providers improve medication management and reduce the risk of adverse drug events. This can improve patient safety and lead to better health outcomes. Then, AI can increase transparency in healthcare by providing patients with more information about their health and the treatments they are receiving (SH, FC, & TE., 2023). This can empower patients to make informed decisions about their care and help to build trust between patients and healthcare providers.

Furthermore, the application of Artificial Intelligence (AI) in the management of patient complaints has the potential to greatly enhance the hospital experience. One of the ways AI can aid in this process is through the automation of complaint management. By utilizing AI algorithms, the process of registering, categorizing, and resolving patient complaints can be streamlined, reducing the administrative burden on hospital staff and improving the overall efficiency of complaint management. Another way in which AI can help manage patient complaints is through the analysis of patient feedback data (Manas & Neil, 2023). By analyzing the data, trends and patterns can be identified, allowing hospitals to pinpoint areas that require improvement and make informed decisions on how to address patient concerns. This can also contribute to an improvement in patient satisfaction by predicting which patients are most likely to make a complaint and proactively addressing their concerns. Additionally, AI can be

used for predictive maintenance of medical equipment. By using AI algorithms to predict when equipment is likely to fail, hospitals can schedule maintenance in advance, reducing the number of equipment failures that lead to patient complaints and thus improving patient satisfaction. Artificial Intelligence (AI) has the potential to play a significant role in enhancing the quality of medical care and helping doctors to reflect and learn from their mistakes. There are several ways in which AI can be utilized for this purpose (Pichai, 2023).

Accordingly, one of the key ways that AI can help is by detecting and preventing errors in medical care. AI algorithms can be trained to analyze medical records, identifying errors or potential risks such as misdiagnoses, incorrect treatments, or adverse events. This information can be used to help doctors prevent similar errors from happening in the future. Another way AI can be used is through clinical decision support (Mehdi, 2023). AI algorithms can be designed to provide doctors with real-time guidance and recommendations based on patient data, helping them to make informed decisions and reducing the risk of errors. This kind of technology can greatly benefit doctors who are facing complex cases and require quick access to relevant information (Zhang, Liu, & Shen, 2020).

Hence, AI is used daily in many areas of modern healthcare, from the online scheduling service for appointments to drug interaction warnings when physicians prescribe multiple medications to research development (Akyon, SH., et al., 2023). The most widely known and accepted evidence-based medicine used today are flowcharts and database research. A physician will take the patient's history, current symptoms, and lab results to determine the proper diagnosis and give the appropriate treatment plan. An AI system will do this same process, in a fraction amount of time and have greater accuracy because it can tap into multiple databases at once.4 This is only a small area in which AI has tapped into modern medicine. Thus, AI has a variety of positive aspects related to its application in healthcare. Currently, it is primarily used in the diagnosis of cancer, neurological diseases, and cardiovascular diseases (Jiang, Jiang, & Zhi, 2017).

In a nutshell, AI can play a role in quality improvement. AI algorithms can monitor and analyze the performance of healthcare providers, providing feedback and recommendations for improvement. This information can be used by doctors to reflect on their practices and identify areas for growth. In conclusion, the use of AI in medical care has the potential to enhance the quality of care, improve the learning process of doctors, and promote continuous improvement in the field.

3. The institutional arrangements of Egyptian UHI system

Recently, the Egyptian government issued the Universal Health Insurance Law (UHI) at 2018, which aimed to achieve the universal healthcare (UHC) for its population and provide them

with the needed qualified health services without financial hardship. Then, it urges a national campaign to reform the healthcare sector and to develop the efficacy and quality of its services. Actually, the Egyptian health system, known as Universal Health Insurance (UHI), is characterized by a different mechanism of intermediaries between patients and providers. There are three main bodies with different functions and tasks to oversee the system or to play the role of intermediaries (Authority, (n.d.)). These bodies are the Universal Health Insurance Authority (UHIA), the (Accreditation & (GAHAR), (n.d.)), and the General Authority for Health Accreditation and Regulations (GAHAR) (GAHAR, n.d.; https://www. gahar.gov.eg/) (see fig.1). UHIA has a legal personality and an independent budget that manages and finances the system, and the society members' subscription funds are private funds invested safely. UHIA approves price lists for groups of medical services provided, reviews and evaluates the effectiveness of management and performance of system implementation programs and is responsible for following up the treatment of the insured patients at any of the system's health service providers. UHIA also finances the system services by contracting with healthcare service providers and the treatment systems covered by the healthcare authority or any other party that contracts with the authority in accordance with the quality standards set by GAHAR.

Accordingly, GAH is a public service body that has a legal personality and an independent budget. GAH is subject to the general supervision of the Minister of Health and is the main tool of the state in controlling and regulating insurance health services. GAH provides health and curative care at its various levels inside or outside hospitals after qualification according to the quality and accreditation standards set by GAHAR. Within the limits of the strategies, policies and decisions taken by its board of directors, GAH may establish and equip hospitals and healthcare units, or manage entities for healthcare buildings, and provide the medical, technical and administrative cadres necessary for the care authority to perform its duties by appointment or contracting. In the same context, GAHAR is a public service body with a legal personality and an independent budget that is subject to the general supervision of the President of the Republic. It aims to ensure the quality of health services and their continuous improvement, and it sets quality standards for health services and approves their application on medical care facilities. It also accredits and registers medical facilities that meet the quality standards. The period of accreditation and registration is four years, renewable for other similar periods. It also works to educate and inform the community about the level of quality of services in medical facilities.

As we go from small to large healthcare practices, we also see changes in management and in staffing and organization of the practice. In small practices, physicians would commonly see the patients and be responsible for the management process. As practices get bigger, more resources and larger management structures are expected. Larger practices often develop bigger

billing departments. There may be an IT staff dedicated to IT issues, providing more sophisticated, more capable Electronic Health Records (EHRs) and other computer and data infrastructure. A marketing department, a legal department, or a human resources department is required in larger practices (Mohamed, Soliman, & Abdel-Atty., 2023).

In terms of healthcare levels, health facilities are divided into three groups. The first group, which is the basic care and family health units, is responsible for providing the first level of primary health services. The second group is the healthcare centers and it is responsible for providing the second level of health services. The third group is the hospitals and specialized centers responsible for providing the second and third levels of health services. All these establishments should hold a certificate issued by the GAHAR stating that they meet the conditions and quality specifications and that they are contracting with UHIA in accordance with the professionally established insurance referral systems (Ahmed, Mohamed, Zeeshan, & Dong, 2020).
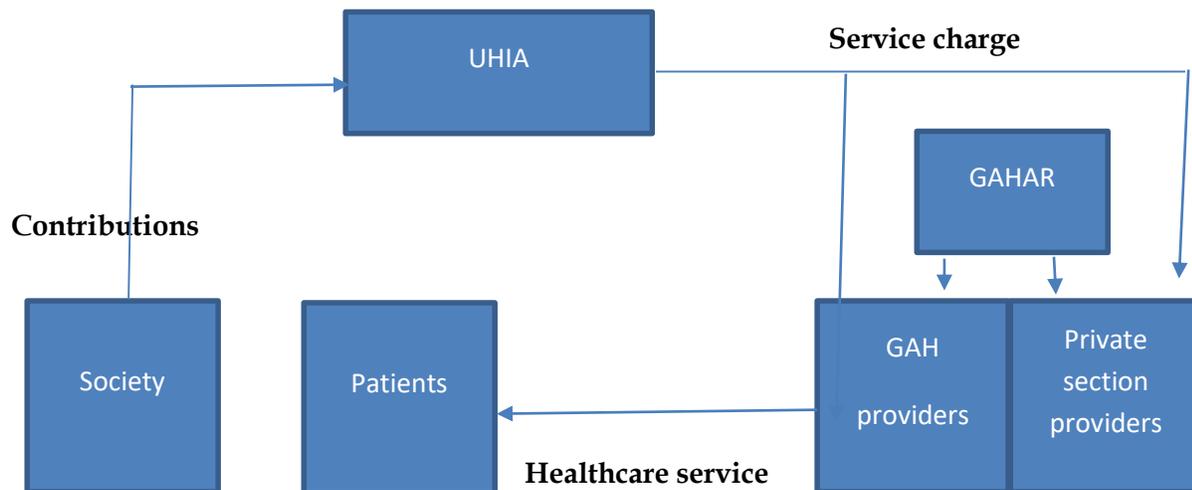

Fig 1: Institutional arrangements of Egyptian UHI system

4. Challenges to Effective AI adoption in the Egyptian UHI system

The health sector in Egypt is still lags behind other industries in seizing the opportunities brought by digital technologies, in spite of the considerable efforts and some promising national success, the health systems are still have not undergone fully digital transformation. Consequently, the use of analytics employing diverse data and technologies such as artificial

intelligence (AI) is only slowly emerging. Then, in spite the complexity of health sector processes and activities and the ensuring high reliance on multifaceted information to solve problems; there are many challenges to AI effective adoption in Egyptian UHI system. These challenges include, but are not limited to, data quality and access, technical infrastructure, organizational capacity, and ethical and responsible practices in addition to aspects related to safety and regulation. They can be illustrated as follows:

• Different datasets and services still are not linked electronically together, hindering the flow of crucial information. The datasets of different segments of health systems within Egypt still do not communicate with each other electronically. In effect, it often falls on patients to carry and repeat information about their care and treatment history through the health system, and health workers are still waiting for an easier workday where the right information is readily available at the right time (Mohamed M. E., 2022). These critical shortcoming have once more brought to light with outbreak of Covid-19 pandemic, with on the other hand, hospitals and clinics having to ask patients, if at all possible for information on comorbidities, on the other hand systems struggling to follow-up on the full spectrum of the development in real-time, also with regard to health outcomes of suspected cases of patients who were not hospitalized.

• The majority of advanced countries have been implemented ways for people to access their health data electronically through linking data across the many health organizations, units and devices that collect date from the electronic health records (EHRs) of the patients as related to hospitals, physicians' offices, pharmacies, laboratories, bio-banks, statistical units, or medical devices and applications. However, in Egypt, that has not fully adopted person-centered EHRs, patients cannot see their full health data in one place (Mohamed, Soliman, & Abdel-Atty., 2023). Moreover, patients continue to have limited access even to their electronic medical records (EMRs) within each sector of a health system.

• Regular deployment and linking the health data for secondary purposes, such as to report on health systems performance, is increasingly adopted but relatively less common than primary use of data in the day-to-day provision of health services. Therefore, the use of existing data to inform improvements in health service and delivery, through for example, designing more tailored or better coordinated service, remains rare in Egypt (Sabra., Elaal., Sobhy., & Bakr., 2023).

• Broader data sharing and use increases the risk of data loss or misuse that can bring personal, social, and financial harm to individuals and can diminish public trust in health systems, and governments, which might prove hard to remedy once it has happened. The governance of data and privacy protection is a fast-moving field, where new questions arise continuously with the development of new data-driven digital innovation (Mohamed M. E., 2022). This requires

deeper, ongoing discussion, also the development of dedicated, clearly articulated ethical frameworks and charters in Egypt.

• The increasing pace of technological development further increases the need for interoperability and flexibility within the health data systems; which represent a true challenge to the Egyptian UHI system. The future lies in the development of flexible component-based architectures, which function as a unified ecosystem, i.e., an open and supplier-independent common network and components linked by common network consisting of independent services and components linked by common standards and principles ((Mohamed, Soliman, & Abdel-Atty., 2023). This is also naturally requires from investments, but at first and foremost it necessitates a long-term strategic vision of digital health technologies should be organized together to work collectively in support of health policy goals. Such a strategic vision needs to include a commitment to create supportive legal frameworks and to continuously modernize the digital data securing standards.

• During the last decade, telehealth has rapidly evolved far beyond what is traditionally associated with this term, i.e., the real-time consultations between geographically separated patients and physicians. Advanced telehealth models not only help to provide care to difficult-to-reach patients, who otherwise would not access any care, but can generally support the design of more effective and efficient care models and help to move away from reactive towards proactive approaches to preserving health (Ahmed, Mohamed, Zeeshan, & Dong, 2020). The main barrier to a wider adoption in Egypt is not only the shortage of sustained funding, but also the lack of any strategic perspective. There are also delays in adopting legislative and functional frameworks for the digital era in Egypt, therefore telehealth is generally allowed in many countries; but it is still limited in Egypt (Mohamed M. E., 2022).

• Health workers in Egypt are not having sufficient opportunities for up-skilling required to put the technologies to full use. Digitization and AI in healthcare will require authorities well-versed in both biomedical and data science. There have been recent moves to educate and train healthcare workers in in these sciences where medicine, biology and information meet through joint degrees, this is still less prevalent in Egypt as well as in many developing counties (Sabra., Elaal., Sobhy., & Bakr., 2023). This skill considered a gap that needs to be effectively addressed to ensure progress and avoid unnecessary strain on health workers. While the skills gaps and other health workforce, related barriers to success fully digital and AI transformation (Taie, 2020). Thereby it is worth considering that the examples of digital technologies can be deployed in almost any aspect of health case provision, across different service sectors, care settings, and patient groups.

• Data challenge breaks down data, collecting the data, and setting up the governance around data management. Still healthcare in Egypt is lagging behind in digital business processes, digital capital deepening, and the digitization of work and processes. It is critical to get the basic digitization of systems and data in place before embarking on AI deployments. In addition, as more healthcare is delivered using new digital technologies, public concerns about healthcare data are used have increased and grown (Mohamed M. E., 2022). Healthcare organizations should have robust and compliant data-sharing policies that support the implementations in care that AI offers, while providing the right safeguards. Another data challenge is getting to talk each other of policy makers, funding bodies, and nonprofit organizations that need to support efforts to sufficiently anonymize and link data as well as build databases that can be accessed by users with appropriate safeguards (Mohamed, Soliman, & Abdel-Atty., 2023).

5. Requirements to AI-based Solutions for the Egyptian UHI System

Medical data are of great importance at all stages of the UHI; which is considered one of the most promising health systems in the region. Thus, it has paid great attention to dealing with data, its processing systems and the related applications of AI in medical data processing; which seemed to be crucial at different healthcare levels. At the patient level, the Egyptian health system, UHI, encouraged patients to use a digital platform that allows patients to communicate with doctors. Through it, medical consultations in various specialties are provided free of charge to patients benefiting from the comprehensive health insurance system as an assistance service for patients to reduce their visits to hospitals and health units especially during periods of crises as the case of the COVID-19 virus (Ahmed, Mohamed, Zeeshan, & Dong, 2020). At the service providers level, the analysis of bills and expenditures to determine the most appropriate values for the prices of groups of medical services provided is the most important application of data analysis to achieve the required sustainability in the provision of health services. For the UHIA, an AI-dependent criterion for choosing the best providers to contract with or the worst providers to drop is essential. Also, the processing of the loads of bills for medical care claims and the optimal setting of cost sharing are vital. UHIA also seeks to provide all services through digital transformation and automation systems, which will be done through full coordination with the Egyptian ministry of communications. It is aimed that all family health units, health centers and hospitals are linked together. Electronic radiation archiving systems and electronic laboratories are considered as the most important stages of the digital transformation process. The GAH is more interested in providing more AI-dependent patient programs (Mohamed, Soliman, & Abdel-Atty., 2023). The optimal design of EHRs is an urgent research topic for efficient decision-making processes. For the GAHAR, the process of registration of members of the medical profession needs more improvement using AI. Also, the process of registration and evaluation of health facilities is of special importance. As the UHI

pays great attention to the opinion of health service recipients, accurate analysis using AI for service user surveys is one of the important current needs. This is to help identify defect points and take corrective measures. Analysis of auditors' reports is another important issue to work for. There are many areas open to research in terms of health quality, such as means of measuring competency, risk adjustment and risk prediction (Eman Salman, 2020).

Consequently, AI has the potential to revolutionize clinical practice and various healthcare services, but several aforementioned challenges must be addressed to realize its full potential. Among these challenges is the lack of quality medical data, which can lead to inaccurate outcomes. Data privacy, availability, and security are also potential limitations to applying AI in clinical practice. Additionally, determining relevant clinical metrics and selecting an appropriate methodology is crucial to achieving the desired outcomes. Hence, the following is a set of requirements that most of the players in healthcare systems and ecosystems will need to be addressed within digitization and AI; they are as follows:

• Quality could come up from factors such as the design and development of applications and systems as well as their ease of use, performance of algorithms, and robustness and completeness of underlying data. Additionally, more stringent data security regulations are needed to maintain privacy through improving client-side data encryption and engaging federated learning to train models without data sharing (Khan, Fatima, & Qureshi, 2023). This will mitigate the raising concern regarding the ethics of using AI in the healthcare industry, and will also give AI experience in processing healthcare data (Sheller, Edwards, & Reina, 2020).

• Keeping accountability of AI systems in practice through enforcing strict regulations, performing regular auditing, and validation are suggested to ensure better human-centered AI systems (Rischke, Schneider, & Müller, 2022). It is imperative that patients are fully aware when AI is processing their information, and that they fully consent to the use of their information for ML. Slowly, as AI improves information processing in healthcare, there could potentially be fewer mistakes than with actual humans (Ueda, Kakinuma, & Fujita, 2024).

• There is also the threat of personal bias toward AI systems, in which people will begin to completely depend on machine work and not make any personal decisions (Stewart, Freeman, & Eroglu, 2023) It will be very difficult to ensure that workers will not do this, and this can only be mitigated by proper training for health experts, medical, and other associated staff in handling AI equipment properly to ensure maximum accuracy in disease screening and treatment. Moreover, AI education should be developed in a way that can be easy for healthcare workers to understand, and leave room for personal decisions at the discretion of health experts (Bari, Ahmed, & Ahamed, 2023). AI can potentially increase workforce efficiency by conducting information processing, leaving healthcare professionals to focus on the vital parts of work. 4

• More broadly skills such as basic digital literacy, the fundamental of genomics, AI and machine learning need to become mainstream for all AI practitioners, supplemented by critical thinking, skills and development of a continuous learning mindset. Alongside upgrading clinical training, healthcare systems need to think about the existing workforce and providing ongoing learning, while practitioners need time and incentive to continue learning (White, Blok, & Calhoun, 2022).

• It is critical to get the basic digitization of systems and data in place before embarking on AI deployments. In addition, as more healthcare is delivered using new digital technologies, public concerns about healthcare data are used have increased and grown. Healthcare organizations should have robust and compliant data-sharing policies that support the implementations in care that AI offers, while providing the right safeguards (SK, S, D, MR, & K., 2023).

• It is crucial to establish a robust collaboration among policy makers, funding bodies, and nonprofit organizations that need to support efforts to sufficiently anonymize and link data as well as build databases that can be accessed by users with appropriate safeguards (Khan, Fatima, & Qureshi, 2023).

• Managing change while introducing digital transformation and adopting AI applications and systems is crucial in complex institutions as healthcare organizations. Thus, it is important to engender solutions that focus on reducing the time people spend on routine administrative tasks, rather than those that seek to act as virtual assistants. Those who interact directly with patients or clinical decision support (CDS) tools; that facilitate activities physicians see as core to their professional role, i.e., the clinical diagnosis (Hussein, Aziz, Chakraborty, Islam, & Dhama, 2023).

• Healthcare organizations need to consider how they will develop new jobs that can be critical to the successful introduction and adoption of digital transformation and applying AI applications and systems, such as data specialists or data engineers. Demand for such skillful employees is becoming important across industries, and attracting talented employees will be crucial especially in advanced communities (Akyon, SH., et al., 2023). Then, developing flexible, agile models to attract and retain such talented candidates had to be a key part of the healthcare organizations' human resources strategy.

• The extent to which patients access to some AI tools needs to be regulated or restricted to prescription. The issue of liability and risk management is a particular challenge. Patient safety is paramount, but healthcare providers also have to think about the professional accountability ultimately rests with clinicians as well as the protection of their organizations from reputational, legal or financial risks (Rahman, Evangelos, & Julianne, 2024).

• Clear criteria for the potential funding of digitization and AI applications that seemed to be crucial, alongside creative funding models that ensure the benefits had to be shared across different healthcare organizations (Ueda, Kakinuma, & Fujita, 2024).

Conclusion

AI is the promising solution for dealing with the huge amounts of data. The healthcare field is in big need of AI-based big data solutions. The basic structure of the healthcare system and the special structure of the Egyptian UHI system clarify the necessity of AI solutions. This paper presents the main future requirements for AI data processing applications related to the UHI system. So, it could help in future research projects plans in that field. it proposes how the healthcare system in Egypt can tackle various challenges and enhance adequately its capabilities; in order to seize the opportunity of digitalization and apply AI effectively through its various domains; which can then provide an adequate modernization of policy and governance frameworks necessary to maintain effective healthcare service system to patient satisfaction.

According to the present observation and available evidence, AI has some impact on healthcare settings. Assisting physicians in accurate, quick diagnosis and developing effective treatment plans, expediting patient waiting time, reducing redundant paperwork for nurses, and ensuring the regulatory requirements can be examples of the use of AI in healthcare. Besides the benefits of AI in the medical sector, some requirements that most of the players in healthcare systems and ecosystems will need to be addressed within digitization and AI such as: Resolving data accessibility, maintaining data privacy, maintaining accountability, and proper training of the health associates are the parameters to overcome the challenges to effective application of AI.

In concluding, digital health and AI have the potential to transform how care is to be delivered in Egypt and in some cases, they are already doing so. Speeding up the pace, through the thoughtful and systematic introduction that could deliver significant benefits to Egyptian patients and population. Therefore, Egypt can build on the unique strengths of its national health systems and datasets, as well as on innovation health systems and ecosystem to ensure that patients' rights to their data remain inviolable, while ensuring those same patients get their full fit from the tremendous promise of digital health and AI in healthcare.

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