Artificial Intelligence Applications in Healthcare Sector: Ethical and Legal Challenges

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Abstract

Recently, artificial intelligence (AI) has been one of the hottest topics in the technological world. Although it is involved in many domains, it was recently involved in the healthcare sector. AI can be used for diagnostics, drug development, treatment personalization, gene editing, disease prediction, and many more. It helps to improve healthcare services by benefiting medical professionals, hospitals, and patients. Saudi Arabia has a particular interest in the healthcare sector, and it has a clear vision for the future, which points toward the development of AI-based technologies. Few studies investigated the use of AI in Saudi healthcare, and most of them focused on healthcare employees' perceptions. This study is beyond the focus of the existing works. It aims at: 1) presenting the main AI-based healthcare applications; 2) exploring the use of AI in the Saudi healthcare sector; 3) addressing their ethical and legal challenges, along with the policy questions in Saudi healthcare; 4) studying the benefits of these AI-based applications and the acceptance of professionals to use AI in daily practice; 5) introducing the new Personal Data Protection Law (*PDPL*) in Saudi Arabia; and 6) discussing the importance of AI to the future of Saudi healthcare. To this purpose, a survey was distributed among four main Saudi hospitals. The findings showed that AI should not only lead to better health but also save manpower and simplify the healthcare processes. The respondents agreed that AI helps reflect human intellectual competencies and pushes its limits.

1- Introduction

Artificial Intelligence (hereinafter referred to as "AI") offers undeniable opportunities for economic growth, social advancement, and research by leveraging computers and machines to perform tasks commonly associated with human beings. While a number of scholars have attempted to define AI, John McCarthy, who coined the term back in 1956, defines it as "the science and engineering of making intelligent machines, especially intelligent computer programs". It is related to the similar task of using computers to understand human intelligence, but AI does not have to confine itself to methods that are biologically observable [1].

In recent years, the field of AI has shifted from abstract concepts to the realization of data processing and inference. This change was possible because of AI's synergistic relationship with big data. When big data is fed into the AI machine, the latter learns and improves its decision-making processes. AI technologies offer new opportunities in different fields such as energy, the environment, education, and health. The focus of this research, however, is on the impact of this change on the medical world through the transformative digital advancements in healthcare, such as the AI systems that scan medical records and information to identify risks or complications expected in a medical procedure and offer preventative care [2].

AI's effectiveness in healthcare is becoming increasingly evident. It is an indispensable tool that now assists doctors, physicians, and other healthcare professionals. AI can be used for diagnosis [3], drug development [4], treatment personalization and gene editing [5]. Moreover, machine learning can assist doctors in examining patients using digitalized diagnostic information, such as detecting lung, breast, skin cancer, or any other type of cancer disease [6, 7]. It has also helped in assessing the risk of sudden cardiac death and other heart diseases based on electrocardiograms and cardiac MRI images [8, 9], and medical image classification [10, 11]. AI is further proven to have found indicators of diabetic retinopathy in eye images [12].

By becoming a global technological center, Saudi Arabia is diversifying its economy. It has embarked on the most ambitious and far-reaching development plan in the history of the modern era, guided by its vision, the 2030 vision (Saudi Vision 2030, https://www.vision2030.gov.sa/). The vision aims at reducing the country's reliance on oil and diversifying its economy. The country launched an AI strategy, as part of its 2030 vision, and is investing billions of dollars in AI projects. Undoubtfully, AI would bring tremendous improvements to healthcare in the country, but it will also entail many other legal and ethical issues, such as the data transfer liability and intellectual property rights.

Few studies have investigated the use of AI in the Saudi healthcare sector. For example, the authors in [13] presented a study about the employee experiences and feelings regarding the use of AI technologies in the healthcare institutions. The authors in [14] aimed at evaluating the attitude of the radiologists toward the utilization of AI in Saudi Arabia.

This research aims at presenting the main studies investigating AI based-healthcare applications in the worldwide and especially in Saudi Arabia. It not only shows how the healthcare employees perceive the use of AI (as performed in the previous works) but also the importance of AI in the Saudi healthcare, the legal and ethical challenges as well as its impact on fundamental rights and freedoms. The contributions of this study are as follows:

- Presents the important AI based healthcare applications.

- Investigates the use of AI in Saudi healthcare sector and addresses its ethical and legal challenges, along with some policy questions.

- Examines the acceptance of healthcare professionals to use AI in daily practice.

- Addresses a comparison study of the existing data protection legislations including the new The Personal Data Protection Law (PDPL) in Saudi Arabia.

- Suggests new directions to the future of healthcare in Saudi Arabia.

This research tackles the following research questions:

- How is AI used in healthcare?

- What are the main applications of AI in healthcare?

- What are the benefits of using AI in healthcare?

- What is the current frequency of AI use in healthcare practice?

- How Saudi healthcare professionals appraise the use of AI in daily practices?

- What are the ethical and legal challenges in AI?

- What is the importance of AI to the future of healthcare organizations?

The research uses content analysis and survey method and a survey was distributed among public and private hospitals in Saudi Arabia.

The rest of the research is organized as follows. Section 2 introduces AI and Section 3 presents the research methodology. Section 4, then, describes some of AI's applications in healthcare and its benefits. Section 5 presents the importance of AI in healthcare. Section 6 introduces a study about the utilization of AI and its acceptance by healthcare professionals in Saudi hospitals. Section 7 discusses AI's legal and ethical challenges along with policy questions. Section 8 addresses a comparative study of the existing data protection legislations, including the new Personal Data Protection Law (PDPL) in Saudi Arabia. Section 9 introduces the importance of AI to the future of healthcare in Saudi Arabia. Finally, Section 10 offers recommendations and a conclusion.
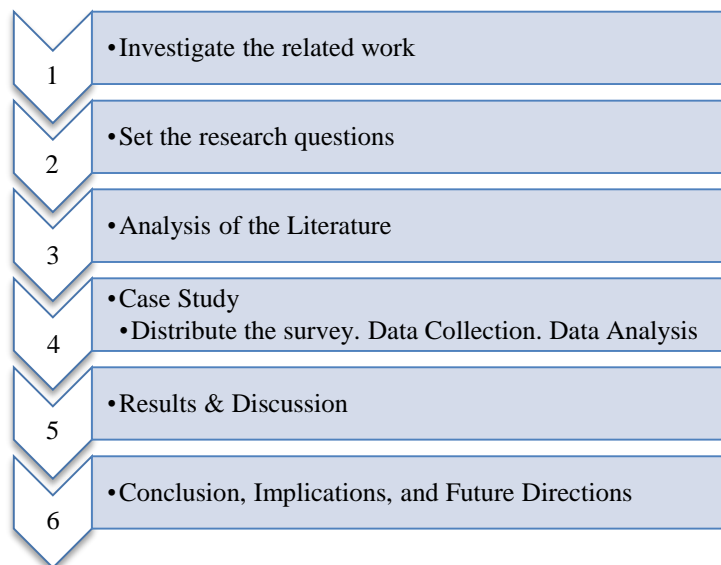
2- Artificial Intelligence

AI is a general concept and there is no single acceptable definition for the term 'Artificial Intelligence'. Some define AI as a system that is capable of rationally solving complex problems or taking actions to attain specific goals in specific circumstances. To put differently, AI is an envelope that includes a long list of tools, methods and ways designed to give the computer capabilities like those of humans, such as the facial recognition [15]. The fields commonly associated with AI are Machine Learning (ML), Deep Learning (DL), and Artificial Neural Networks (ANN). All are machines that mimic the human cognitive functions, such as learning and problem solving.

ML is a method of teaching the computer by giving computers the ability to learn from experiences without specific programming. ML has been effectively employed in numerous domains including healthcare. ML has four main applications: classification, clustering, prediction and object recognition. It involves four main steps: data preprocessing, feature extraction/selection, domain application and validation [16]. ML algorithms pass through three main stages: training, validation and testing. In the training stage, the computer gets the data with the results to learn from and form a training model. In the validation and testing stages, a new data is provided to the computer to predict the results using the training model without any prior knowledge.

DL is a sub-field within ML. DL is mainly based on ANN. ANN is programming tool that enables the computer to learn from observational data. The main difference between all of them is how each algorithm learns and how much data each type of algorithm uses [17, 18]. DL differs from ML in two important and significant points, preprocessing and feature extraction. In DL, there is no process of preprocessing and feature extraction by humans at all. In ML as well as in DL, the system receives a lot of information such as numerous pictures or many texts. In ML, the computer will look for certain information that is instructed to look for (through feature extraction/ selection) according to algorithms defined by humans, whereas in DL, the process is slightly different. Contrary to ML, DL requires huge amounts of information.

3- Research Methodology

The present research study is based on 6 steps as shown in Figure 1. The first step consists of reviewing and investigating the related works to determine the research gap. In the second step the research questions are defined (as discussed in the introduction). Then, in step 3, the literature is deeply analyzed to show the main AI applications and techniques involved in the healthcare sector and their benefits. The main goal of this study is to show how AI is implicated and used in the Saudi healthcare sector. Step 4 is dedicated to a case study. A survey is prepared and distributed. Later, the data is collected and analyzed. Step 5 includes a deep discussion about the results obtained from the survey. Finally, step 6 examines the importance of AI to the future of healthcare in Saudi Arabia.

1	•Investigate the related work
2	•Set the research questions
3	•Analysis of the Literature
4	•Case Study •Distribute the survey. Data Collection. Data Analysis
5	•Results & Discussion
6	•Conclusion, Implications, and Future Directions

Figure 1. Proposed Methodology

4- Artificial Intelligence Applications in the Healthcare

This section briefly describes how, over time, AI has been gradually merged in the healthcare sector. It also presents the benefits of AI in healthcare.

4-1- How is AI used in healthcare?

Now that AI systems can analyze complex algorithms and self-learning, we enter a new age in medicine where AI can be applied to clinical practice through risk assessment models, improving diagnosis accuracy and workflow efficiency. AI enabled tools are capable to identify the relationship in raw data and can be applied in most of the medical fields, including drug development [4, 19], treatment decisions [20], patient care [21] and even financial and operational decisions. The recent uses of AI in medicine show that humans alone cannot tackle complex problems in a limited time without the assistance of AI [22]. Therefore, AI could be a valuable resource for medical doctors, radiologists, and all medical professionals. AI helps them to better use their expertise and provides precise decisions before doing the procedures.

Diagnostics are often arduous and time-consuming process, and this puts doctors under huge pressure. Thus, DL algorithms have made recently tremendous progress in automatically diagnosing diseases, making diagnosis cheaper and more accessible [23]. More ambitious systems will involve combination of multiple data sources (CT, MRI, genomics and proteomics, patient data etc.) in assessing a disease or its progression.

The healthcare sector tries to improve the quality of care, including developing better drugs, monitoring patients' condition and implementing AI-based models for clinical trials. Common use is in the field of visualization, such as CT and MRI imaging analysis, as well as in the field of information analysis, such as predictions and medical file analysis. Today, medical organizations are looking for solutions to operational problems related to efficiency, improving the patient experience and the motivation of the treating staff. The key lies in the operational databases, which are not included in the world of clinical research and belong more to the world of IT, for example: queue management, waiting times, schedules of the various staffs, use of hospital facilities and current expenses [24-27].

4-2- AI based Healthcare Applications

Below are some of AI's applications in healthcare.

Predicting the medical need: ML techniques are used through the data of hospitals, health centers and pharmacies to track the need for medicine, medical staff, devices and equipment in various hospitals and health centers. This helps to reduce the waste of medication and provide equipment in a timely manner especially those that are broken down or out of stock. All of this will reduce the expensive costs of the health sector and increase the effectiveness of health institutions. An example of a mismatch in the supply and demand for equipment is what happened during the Covid19 crisis in 2020 with a severe shortage of medical masks.

Automatic radiation analysis: The radiologist is considered one of the most expensive doctors in hospitals to compensate for the risk of radiation he/she is daily exposed to. DL technologies are now working to diagnose oncological and lung diseases more effectively than doctors [28, 29]. It places the job of the radiologist among the economically feasible jobs by automating it with AI technology. In fact, AI is popular with the largest application in the field of radiology. This is thanks to the remarkable progress in image recognition which has seen an important development in terms of the amount of data collected as well as an important computational power [30]. Using deep learning for diagnosis has demonstrated great success in some areas such as lymph node metastasis detection [31] and mammography malignancy detection [32, 33]. Detection of meningiomas in MRIs demonstrates again a great potential and value of AI. According to [34], radiology has the potential to provide a high precision in healthcare by incorporating AI, computational intelligence, and radiologists' domain intelligence as shown in Figure 2.
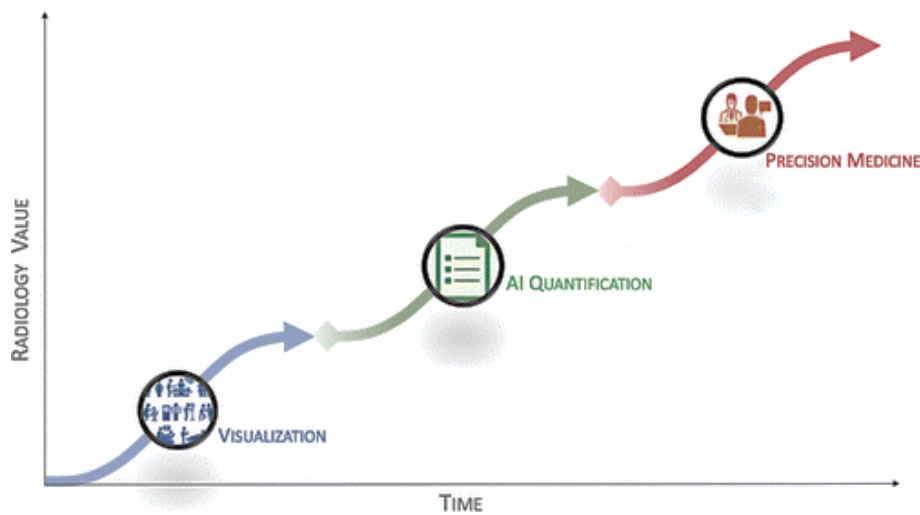

Figure 2. High precision in AI based radiology [34]

AI in ophthalmology: AI and machine learning are utilized in detecting diabetic retinopathy (DR). This disease affects a great number of diabetic patients. It touches the tiny blood vessels which supply the retina and may cause hemorrhage or retinal detachment which may cause even blindness. The application of AI to detect this disease is recommended to be done at early stage to diagnose DR in advance [35].

Robotic surgery: One of the modern technologies in medicine is remote surgery [36, 37], which has become possible especially with the presence of 5G technology. A surgeon can perform a remote operation using a medical robot and a robotic arm. One of the leading companies in the field is *GE** which is working to develop a remote health system to reduce the cost of physicians' mobility and provide health services in remote areas. These technical medical systems

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*GE Healthcare is an American multinational conglomerate incorporated in New York and headquartered in Chicago, Illinois. As of 2017, the company is a manufacturer and distributor of diagnostic imaging agents and radiopharmaceuticals for imaging modalities that are used in medical imaging procedures (*www.gehealthcare.com*)

(such as robots) help generate data that can be used with ML algorithms. The generated data is based on collecting the experiences of thousands of doctors remotely. The data can be saved into a unified database to be used to teach an agent client who is able to diagnose and perform surgery by robotic and even deal with the patient in a decent and automatic manner in the future. This digital transformation will reduce costs dramatically and save the lives of thousands of people in the future, especially those who live far from cities.

Smart Monitoring Devices: computer vision is also used in the health sector through cameras to follow up patients and sending automatic reports to the doctor to better assess the patient's condition. This will reduce the costs of continuous review and increase the effectiveness and quality of health service. These smart cameras that use video analysis techniques can be in the hospital or in the patient's home. They can be used with other wearable technology devices such as a medical watch that measures other vital signs (biometrics) to continuously monitor the patient's condition and alarm in case of emergency [38].

Drug discovery: AI techniques are being implicated in the four stages of drug development including basic research for drug discovery, pre-clinical and clinical stages, and finally post-marketing. AI was successfully applied in discovering the molecular targets and determining the central component of the drug [4, 19]. The use of AI in this context allowed performing the discovery of drug in a short period while lessening the human workload [19].

Increasing Access to Healthcare: AI is contributing in increasing the access to healthcare through different ways. In the recent years, especially during the COVID19 pandemic, the telehealth has been innovated using AI. This smart digitalization improved the quality and rapidness of the delivered services. The tele-diagnosis was developed based on the interaction of computer-to-human [39]. It increases the access to healthcare through answering to healthcare interrogations and checking the health conditions based on personal provided data.

Better Patient Journey: Patient Journey is a list of Electronic Health Records (EHR) that contains the patient's personal data, the visits to hospitals, the admission information, and the provided medications over a period of time. The EHR helps the medical professionals in decision making. Machine Learning was used to predict the patient state based on a patient's journey, such as admissions and imminent diagnoses [40]. This prediction plays an important role in the healthcare system to set admissions and also to estimate in advance the availability of facilities and professionals.

4-3- Benefits AI Can Bring to the Medical Field

AI enabled tools can extract relevant information from a huge amount of data and generate actionable insights, which may be applied in many applications. Furthermore, by using the AI technologies, the physicians could find information in an unstructured medical literature to support cadre decisions. In addition to helping the physicians, AI may also support the user needs by searching and presenting the data to help people find full health information. AI tools are capable to search structured and unstructured medical records to provide relevant patient medical history. They can also target similarities and patterns to help researchers create dynamic patient cohorts for studies and clinical trials.

In the other hand, AI algorithms can help provide a quick and efficient disease diagnosis. The existing studies showed that the AI algorithms can successfully prevent some diseases. They also showed their efficiency in predicting some diseases (Cancer, Diabetes, etc.) and then reducing the death cases. They help diagnose the disease before the first sign of symptoms and was proven to reduce hospital mortality rates by 20%. AI's major benefits in healthcare can be summarized in three main points: disease diagnosis, disease prevention and reducing mortality rates.

5- The Healthcare Sector is the Top Priority of Saudi Arabia

Healthcare remains a top priority for the Saudi Government and there are enormous opportunities for growth in this high potential sector. In line with the government's Vision 2030 and the National Transformation Program (NTP), the Ministry of Health (*MoH*) is expected to spend close to US$71 billion over five-years ending in 2020. According to US-based consultancy *Aon Hewitt**, the healthcare sector in KSA is expected to grow at a compound annual growth rate of 12.3% by 2020. In addition, the population is growing rapidly especially those over the age of 60 years, as well as the adoption of mandatory health insurance in the country. The Saudi government has explored private sector involvement to increase efficiencies and reduce costs in the development of the healthcare infrastructure in the Kingdom. By introducing *Public Private Participation* (PPP) models for healthcare, the government is working towards unlocking value in the health system and fast-tracking healthcare reform with plans to increase private sector contribution in total healthcare spending to 35% by 2020. In fact, technology also remains a core factor in upgrading the KSA healthcare sector in the coming years with information technology playing a pivotal role in offering solutions related to cost, quality, access, and resources. The Saudi government is also focusing in increasing the availability of a skilled workforce in healthcare. Tremendous efforts are put to provide educational and training facilities for doctors, nurses, and paramedics through the expansion of new medical colleges.

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* US based consultancy *AON Hewitt.*

Saudi Vision 2030 and the national transformation program Healthcare is one of the main focus. According to a report by Knight Frank[*], the main goal of the Vision 2030 is to diversify the economy away from hydrocarbons and achieve greater participation of the private sector by encouraging both local and international investments in several key industries such as healthcare. Saudi Arabia's healthcare plan under the NTP has placed the sector on a rapid path to privatization and growth over the coming years. The strategic objectives stated for healthcare in the NTP include privatization of one of the medical cities using the PPP in addition to increasing the private sector share.

Saudi Arabia has given great importance to the health sector and it holds a clear vision for the future which points towards the development of AI-based technologies. Introducing AI in Saudi Arabia is one of the fundamental pillars of its economic development strategies. Saudi Arabia announced that it will use other sources seeking to diversify the economy by not relying anymore on oil and it declared that Artificial Intelligence is in the heart of its endeavors.

Based on the Ministry of Finance's data, Saudi Arabia has allocated about 990 billion riyals of expenditures for the year 2021, compared to an estimated expenditure for the year 2020 of 1068 billion riyals. The healthcare and social development are the key sectors for the Saudi Arabian government. It holds 17.7% of the country's budget expenditure—the third-largest share in 2021, as each sector allocated about 175 billion riyals, considering that the volume of spending therein increased by 4.6% from what was estimated in 2020[†].

6- AI in Saudi Healthcare Sector: Its Usage, Benefit, and Level of Acceptance by Professionals

The goal of this section is to collect data and examine the growing use of AI in Saudi Arabia's healthcare sector. Questionnaire surveys have been distributed among public and private hospitals in Riyadh, the capital city of Saudi Arabia with a population of more than 7 million people as of 2020, making it the highest populated city in the country.

6-1- Results and Analysis

The study focused on four main hospitals namely King Khalid Hospital, Al Hamadi Hospital, Dallah Hospital, and Al Habib Hospital. These hospitals are among the most distinguished healthcare providers in Riyadh with a reputation of excellence in using competitive advantages and advanced technologies in their medical services. Al Hammadi hospital, for example, complies with the international standards of quality and healthcare services, and has been awarded and accredited with many accreditation certificates including the Canadian accreditation certificate (ACCREDITATION CANADA), Joint Commission International (JCI), The Australian Council on Healthcare Standards International (ACHSI), The Saudi Central Board for Accreditation of Healthcare Institutions (CBAHI), ISO 9001:2008 certification and Saudi Heart Association Certificate [‡]. The questionnaire targeted doctors, technicians, radiologists, and nurses and consisted of four main parts (See the Appendix I).

- The first part is on the familiarity and knowledge of AI use among the population of experts, including doctors, radiologists, and nurses.

- The second part is about the advantages of AI use.

- The third part is on assessing the challenges and threat of AI.

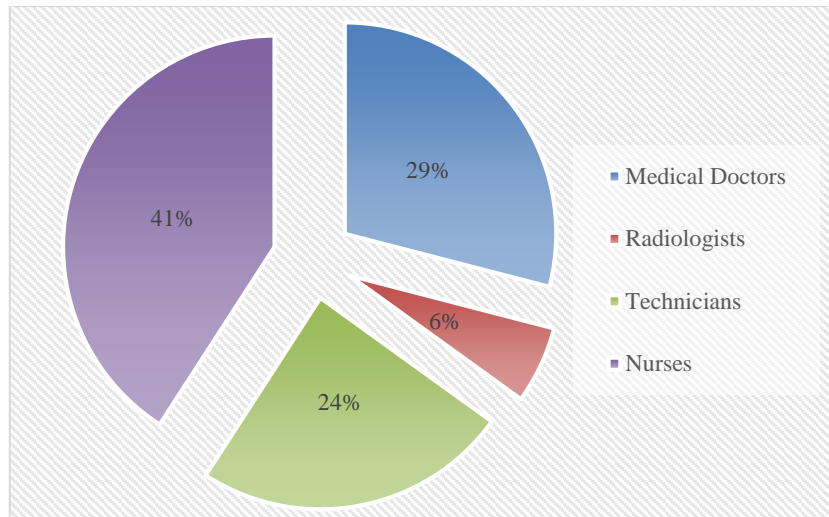- The fourth part tested the level of acceptance of AI as part of the society.

A total of 186 questionnaires related to health practitioners from the four hospitals mentioned above were returned. Figure 3 shows the number of participants in different fields (medical doctors, radiologists, technicians, and nurses). As shown, most of the answers came from the nurses making up 41% of the total respondents. Next is medical doctors and technicians (29% and 24% respectively), and finally radiologists with 6%. This last low number is due to the small number of radiologists working in hospitals. In the following each part of the survey is discussed and analyzed.

Figure 4 shows the participants' answers related to AI knowledge. The overall analysis result shows that almost 100% agree about the idea that they are familiar with the use of AI in the medical sector especially that the surveys were distributed among the health personnel. In fact, Saudi Arabia holds a clear vision for the future which points towards the development of AI-based technologies. The vision 2030 goal is to improve the efficiency and effectiveness of the healthcare sector using information technology and digital transformation.

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[*]Dr. Gireesh Kumar, Healthcare in Saudi Arabia, Knight Frank (2018), *https://content.knightfrank.com/research/1526/documents/en/healthcare-in-saudi-arabia-opportunities-in-the-sector-may-2018-5563.pdf.* Also see, Healthcare in Saudi Arabia, 2nd Edition, Knight Frank (2019), *https://content.knightfrank.com/research/1526/documents/en/healthcare-in-saudi-arabia-opportunities-in-the-sector-2019-6706.pdf.*
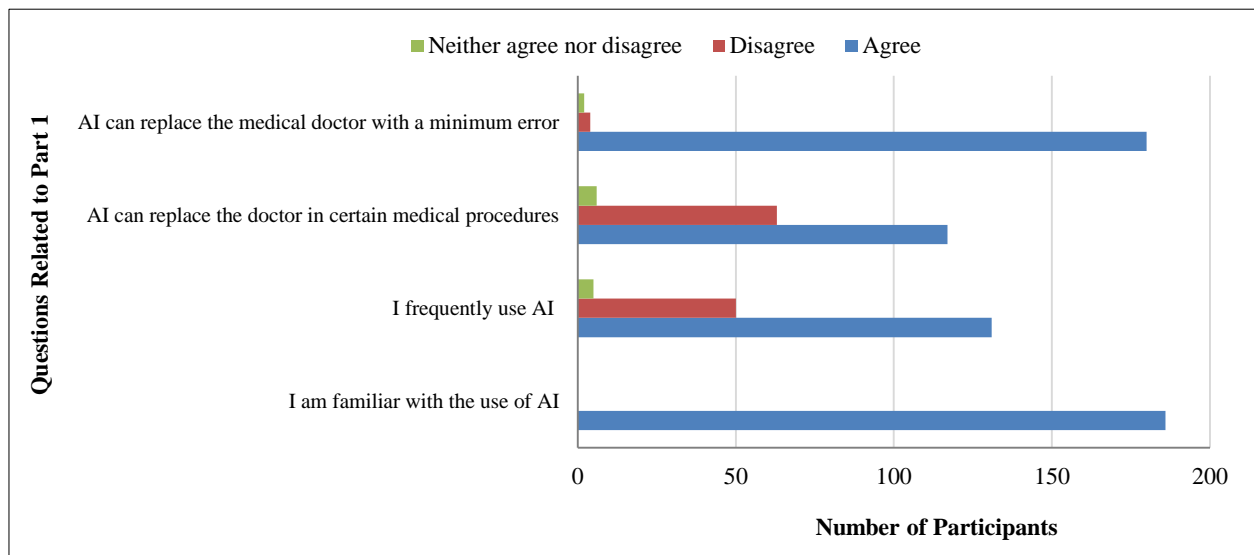
[†] *https://cdn.mof.gov.sa/mofportal/Citizen_Ver_2021.pdf*

[‡] For more information: *https://alhammadi.med.sa/Certificates.aspx?lang=en&ID=164.*

Figure 3. Number of participants in the survey and their fields

## Part 1- Familiarity and Knowledge of AI use among the Saudi Healthcare professionals

Figure 4. Knowledge of AI

Based on the analysis, 70% respondents agreed That AI as an innovative technology may replace the doctors with minimum errors. There was a paradigm shift in human evolution. From a traditional health sector to a digitized sector, the current era of a digital revolution where AI is playing a bigger role if not fundamental. The digital revolution has given to the machine the possibility to replace the medical doctor, the radiologist or even the nurse conduct different procedures with minimum of errors and efforts. Some medical specialists might see it as a real revolution. Almost 63% of the respondents use frequently AI in different tasks and procedures. They believe AI is helping tremendously the medical staff getting full advantages from the usage of AI.

However, few respondents have doubts about AI and there is an impression that using AI will lead to a loss of jobs among the medical personnel. In addition, AI systems may be prone to errors, which eventually leads to patient injury or other significant health problems. For instance, a drug recommended by the AI system may be taken wrongly by a patient leading to more questions about the accuracy of AI use in the health sector.

Part 2- The Advantages of AI use in Saudi Healthcare Sector

The Analysis results, displayed in figure 5, show a large agreement on the fact that AI can speed up the process and procedure, and also is faster in analyzing the data in the medical sector. Almost 90% of the respondents, agree that the diagnostic that AI provides is right and the margin of error is very slight. However, a small number of the respondents disagree about the accuracy of the information as the results may be biased. Few examples can show the risk of errors in AI use in hospitals; the AI-driven radiological scan may miss a tumor, or a wrong allocation of a hospital bed based on AI predictions may lead to injuries and relapse. Thousands of patients could suffer just from one error.
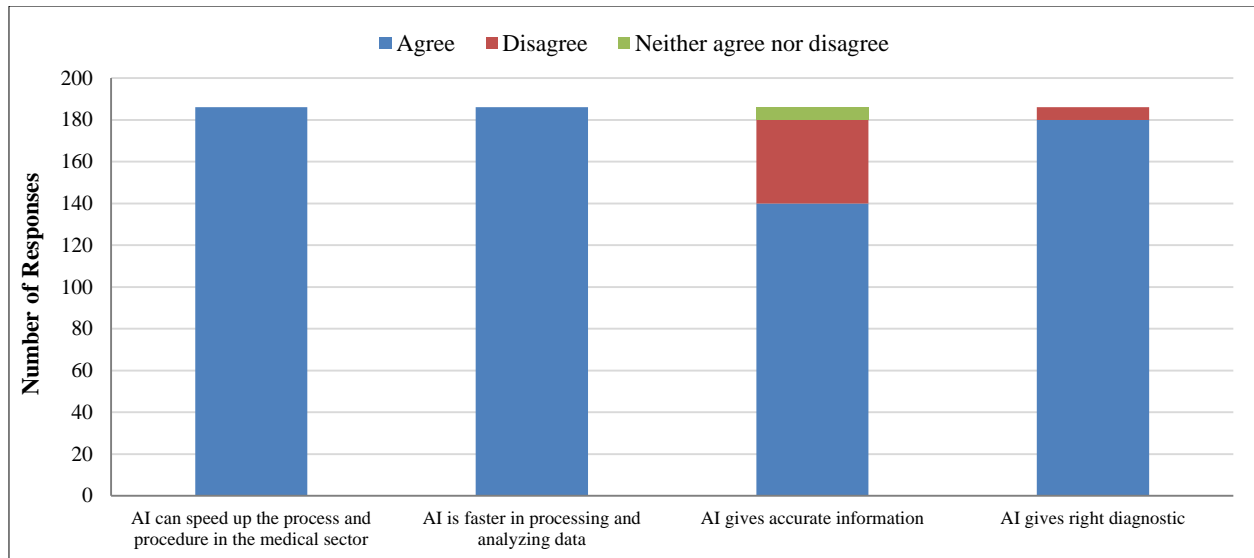
Figure 5. Advantage of AI in Saudi Healthcare sector

To conclude, almost all the respondents agree on the advantages of AI in hospitals. It should be noted that while there are risks and challenges, it is obvious that AI bring benefits to the global healthcare ecosystem. AI is seen as a helper designed to assist healthcare practitioners in their diagnostic tasks.

Part 3- The Challenges and Threat of AI in Saudi Healthcare Sector

The analysis results, displayed in Figure 6, is generally positive, however, respondents expressed a big concern for the privacy of patients and the ethical use of AI. The privacy concern related to the use of AI is a worldwide concern. The different legislations, either the Health Insurance Portability and Accountability (HIPPA) or the General Data Protection Regulation (GDPR) have expressed a major concern for implications for privacy and data protection. Besides the ethical issue is of major concern in the use of AI.
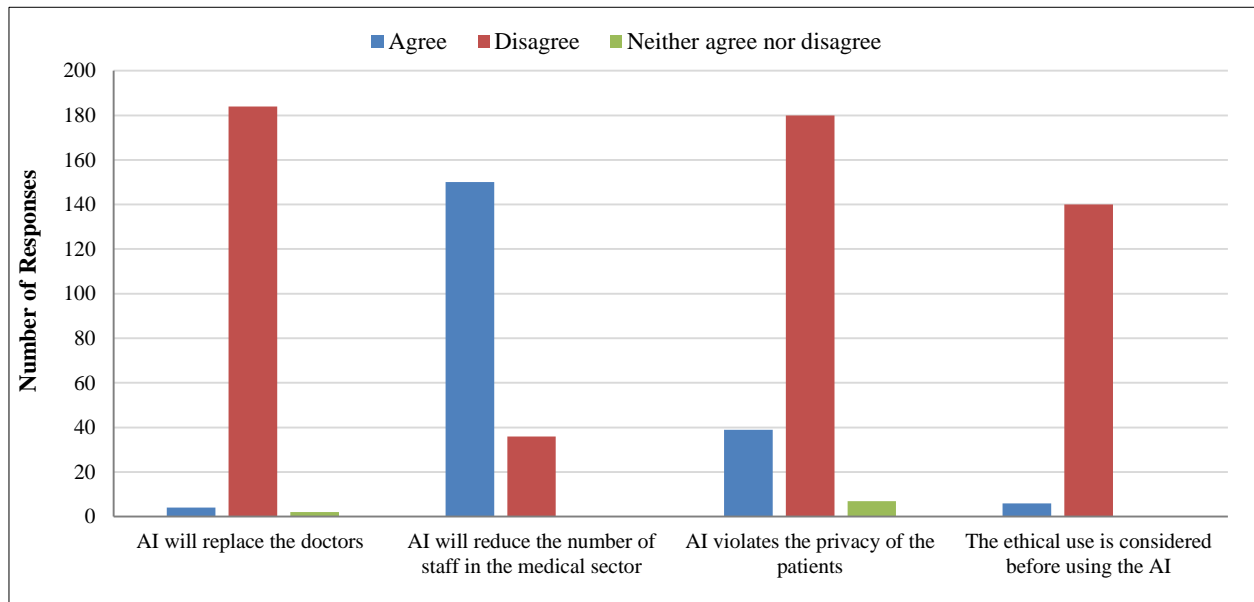
Figure 6. Challenges and Threat of AI

The respondents raised particularly the ethical issue and almost 80% agree that ethics are not considered before the use of AI. As for the replacement of doctors by AI most of the respondents disagree, however they agree that the number of medical staffs in general will be reduced while using AI.

To achieve the Kingdom's vision and national strategies as well as enhancing the government effectiveness and transparency, Saudi Arabia has established the National Data Management Office ('NDMO') to develop the policies and the governance mechanism related to AI and data collection and utilization in the Kingdom. On October 20, 2020, Saudi Arabia's Data and Artificial Intelligence Authority issued the National Data Governance Interim Regulations to

address the collection and use of personal data and the freedom of information. The most notable provisions of the regulations are about obtaining consent from Data Subjects, maintaining data localization within Saudi Arabia, and limiting personal data collection to data that is necessary and relevant to the activities of Data Controllers. Nonetheless, the regulation does not constitute a data protection law, rather an introduction of data privacy type concepts. Additionally, the regulation borrows a lot of definitions from the General Data Protection Regulation (GDPR), but it diverges significantly from the GDPR type approach and places a heavy reliance on the data subject consent.

The Personal Data Protection Law (PDPL) recently appeared in Saudi Arabia. The first comprehensive data protection law to be promulgated by Royal Decree No. M/19, dated 16 September 2021 and it was published in the Saudi Official Gazette (*Umm AlQura*). The law will come into effect on 17 March 2023. The law grants mandatory rights to data owners over their personal data. It stipulates that processing of personal data is subject to the data owner's consent. The (PDPL) also identifies a sub-category of personal data of a more sensitive nature that should be given more protection; such as bio-identifying and genetic data, health data and location data etc.

Part 4- The Level of Acceptance of AI as Part of the Society

More and more the use of AI is becoming a part of the society. The potential of AI to promote better health care has become an important debate for the public and private medical institutions, public health, and public policy. AI has been involved in the development for more than fifty years. People are accepting AI to become a part of the society. Within the context of Saudi Arabia, AI is becoming a major actor especially during the corona virus pandemic.

Figure 7 shows that most of the respondents agree that AI becomes part of the society, and it is fully understood that AI is also fully accepted to be part of the society. Ever since the launch of the Saudi Vision 2030 in 2016, the Kingdom of Saudi Arabia has been living in a state of "technical recovery", if we can express it, in terms of knowledge and application in all governmental and private sectors. This is due to a simple reason, which is the clear and strong adoption of transformation strategies which will move the Saudi state and its society towards an advanced level within the group of modern and advanced digital countries and societies. The issuance of the decision to approve the "Saudi Data and Artificial Intelligence Authority" was not a sudden decision in the technical community, companies, and business sectors, because this decision is a continuation of the process of achieving Vision 2030. In 2017, Saudi Arabia in an unprecedented move granted the Robot Sofia the Saudi citizenship. This came as the Kingdom embraces an AI-driven innovation and economic growth using digital technologies to realize its 2030 Vision. In addition, Saudi Arabia is building a robust technology sector to support its vision and prepare the next generation for the jobs of the future. To that extent, digital skills course has been introduced in K-12 education to meet the changing demands of the workplace.
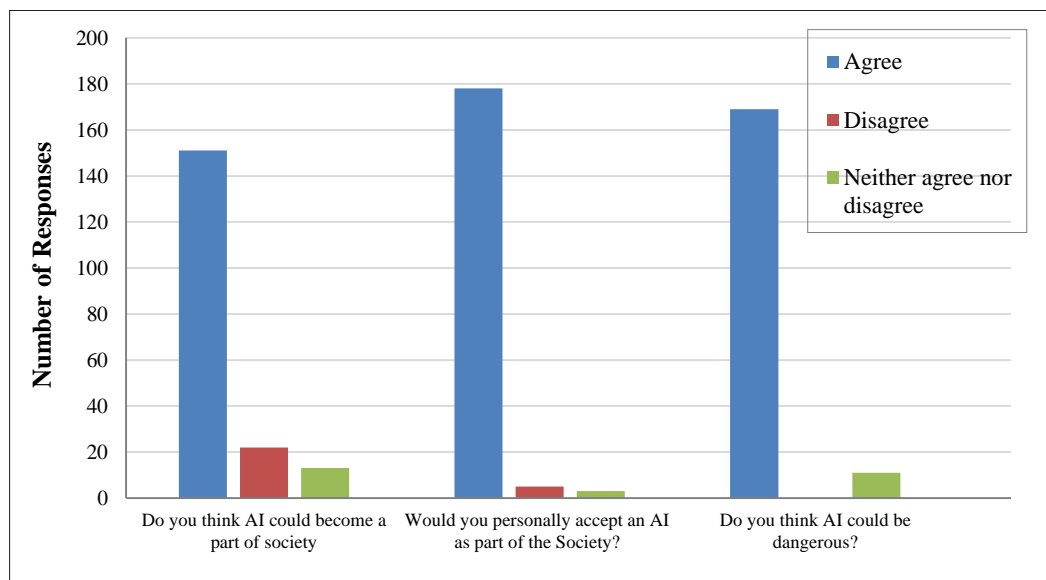
Figure 7. Acceptance of AI to be Part of the Society

6-2- Discussion

Main Findings

The result of this study shows that the healthcare sector personnel strongly believe that AI brings benefits to the health sector, whereas very few of the respondents have doubt for AI in terms of liability and accountability. AI according to the respondents may violate the privacy of the patients and may fail to protect the sensitive data of the patients. This failure is more obvious when the health procedures are executed by the humans (doctors), where the liability is clear in case of error.

its limits are known to us. If the doctor is wrong, there are mechanisms in the law to deal with the consequences of diagnoses or treatment. However, when a machine makes a mistake and advises us to increase a certain frequency of activity or to get a certain medicine, who is liable for its mistake? How to avoid recurring the mistake?

Processing information using AI and on the basis of a machine learning process is usually not very transparent. The machine is unable to tell us what exactly were the stages of the analysis that led to the diagnosis or recommendation for treatment, except that the result is based on a huge accumulation of data and information and their statistical segmentation in such or other paths chosen by the AI that processed the information. The margin of error can be reduced by adhering to accepted scientific methodologies that will help to optimize the databases that form the basis of the AI decision-making process, such as avoiding selection bias and other biases, as well as by establishing effective control mechanisms such as diagnostic verification or recommendation by a senior physician or team of physicians, comparing data from a number of information analyzes performed by the AI, and cross-referencing information from different AIs and more. The effectiveness of algorithms and AI applications in such cases has been repeatedly demonstrated in studies, however, it should be borne in mind that even in the simplest AI applications in healthcare, there is still a long way to go for effective regulation.

The road of affectively regulating AI in healthcare is still long as regulators struggle to find the right balance between regulatory caution and the need to deliver freedom to innovation. However, in order to get the most out of AI applications in the fields of healthcare, international cooperation is required. Relevant and effective regulation cooperation on these issues must first be strengthened. Along with inter-state collaboration, there are also other collaborations: the technology giants including: Amazon, Apple, Facebook, Google, IBM and Microsoft.

Implication and Explanation of Findings

The study shows that AI in the Saudi health sector is part of the future of healthcare. It brings huge benefits to hospitals in terms of diagnoses of serious diseases, such as cancer, and leads to advancements in healthcare treatments. Moreover, it can speed up the process and procedure. In fact, AI will evolve in a way to help the medical personnel and not replace them. However, there is a small risk that AI might be less accurate and reliable thereby putting the patients at risk.

The findings show also that AI may entail challenges and threats. According to the survey analysis, a moderate number consider that there is a violation of the patient's privacy while using AI in hospitals. A big number of the respondents think that the privacy and the patients 'data are not breached. There is a disagreement in the responses about the privacy of health data because until recently Saudi Arabia doesn't have a data protection law. This is only recently that a Personal Data Protection Law (PDPL) has been issued. This needs time to assess the implementation of the law.

Strengths and Limitations

The study focuses on the tremendous interest of the Saudi Vision 2030 accorded to the digitization and the use of AI in the Saudi health sector. It shows the benefits AI may bring to the medical personnel. In addition, the new Personal Data Protection Law issued recently will evolve to promote the culture of trust and privacy.

Some limitations of the study may be raised. The surveys were distributed only in for hospitals in Riyadh and may not express the point of view of the most hospitals in Saudi Arabia. The surveys were distributed among the medical personnel and the biggest number includes the nurses, who may be less confronted to use AI in hospitals and their knowledge is limited. This may bias the results.

7- AI Legal and Ethical Challenges: Implications and Policy Questions

Despite the great potential of Artificial intelligence which is now being applied to many different fields, the legal and ethical implications of AI applications cannot be overlooked. In this part, we investigate and discuss the legal and ethical challenges pertaining to artificial intelligence in Saudi Arabia. Such recognition of various ethical issues can sufficiently contribute to preemptively devise countermeasures in the future. In addition, research, and development of responsible artificial intelligence whose judgment and behavior are controlled by ethical values and norms would minimize legal problems caused by artificial intelligence. AI principles and ethics are set to advise leadership on the challenges and opportunities presented by AI innovations. The principles are:

- Fairness—hat AI should treat all people fairly.

- Reliability and safety—that AI systems should be secure and respect privacy.

- Inclusiveness—that AI should empower everyone and engage people.

- Transparency—that AI should be understandable.

- Accountability—that people should be accountable for AI systems.

7-1- Artificial Intelligence Legal Challenges

There are 7 basic challenges, as indicated in Figure 8, facing the development of artificial intelligence practices and businesses within the legal responsibilities.

Figure 8. Challenges related to AI practices within the legal responsibilities

These challenges are represented in the absence of special laws to regulate the use of machines that have artificial intelligence, and the available regulatory frameworks do not keep pace with the development of artificial intelligence technology. The validity of contracts that may be concluded by smart programs without any human intervention, and how to assign responsibility for unexpected behavior of the programs are all regulatory concerns that could be addressed in a unified piece of legislation regulating the use of artificial intelligence. Technology, and artificial intelligence technology has not reached the perfection, and its programs are vulnerable to viruses, technical malfunctions, and legislation is unable to protect the user from machine errors, placing full responsibility on those who use electronic systems, regardless of the surrounding environment and related factors [41].

a) Regulation

The legal legislation regulating any investment sector contributes to providing a harmonious environment commensurate with the desired growth objectives in the concerned sector, within specific policies that work to enhance uses in a manner that achieves reassurance for investors [42]. In that sense, the fields of artificial intelligence are growing very large, which makes it imperative for the concerned authorities to strive to prepare legal legislations that control their uses and define responsibilities for the results of practices and business, to create an advanced and pioneering investment environment in technological technologies related to artificial intelligence. Additionally, technology precedes legislation, due to its rapid and rapid development, and its entry into all fields, which requires the formulation of flexible laws capable of keeping pace with the modernity and development of AI practices. Any developing investment environment must be based on legal legislations that control practices and business to form an attractive environment for international investments and the world has not yet reached unified legislative frameworks that regulate technological and technical development to define its legal and ethical responsibilities.

That begs the question, who is responsible for the error? Generally, there are no special laws to regulate cases that violate AI and current legislations regulate computer programs that operate automatically, but do not regulate programs that work independently, such as robots operating in many domains. The legislations do not include any comprehensive treatment of the various aspects of AI technology, and most of the legislations considered the programs' actions an extension of their users who ask absolutely about the results of their work as if they were issued directly by them, because legislation is equal in judgment between smart programs and other programs that lack the characteristics of intelligence Independence and movement. The smart programs enjoy unexpected independence, according to the dictates of the surrounding environment, and make their decisions without referring to their users, which may create concerns about the legal and moral responsibility that may result from the work of these programs, such as that an autonomous vehicle causes severe damage, as a result of factors [43]. It cannot be predicted or pushed, wondering who should be asked in such eventualities, is it the user, the programmer, the manufacturer, the website manager, the service provider, or the others?

AI technology has not yet reached the utmost perfection, and its programs are still vulnerable to viruses or technical failures, which may sometimes make them operate in an unexpected or unauthorized manner and cause severe damage that brings to mind which begs the question of how the responsibility arising from the actions of such programs is distributed. The failure of the smart program or the robot is not always due to negligence or error in the programming and development processes, or to problems in use and guidance, as much as it is sometimes related to the nature of the program and the digital environment, or to other factors and parties that are difficult to define precisely, including viruses and technical malfunctions. The need to create a mechanism for assigning legal responsibility in a way that establishes a balance between design, production and use agencies.

It is necessary to enact a law on AI, provided that computer scientists play a role in drafting its texts in cooperation with representatives of the sectors concerned with artificial intelligence technology, and taking into account adherence to legal requirements during programming and development of smart applications to reduce their risk, in addition to the necessity to distinguish in judgment between programs depending on the degree of its development and intelligence, and setting professional, industrial and ethical standards regarding the use of artificial intelligence techniques, and restricting this use in the first stage to technically and financially qualified companies, to bear the consequences that may result from it, and to prepare national cadres to deal with various aspects of this technology, and raise awareness

With its various advantages and risks. Additionally, the AI and the free flow of data are intertwined. However, the regulation of free flow of data needs to be balanced with AI. Some argue that a data government regulation which restrict the free flow of data will eventually hinder the development of AI. Nonetheless, as seen in the case of GDPR, the flow data should not be restricted rather regulated. In the sense that data can flow between different jurisdiction enabling AI to flourish and at the same time protecting privacy and personal data. Measures like adequacy decision* or data subject consent could be implemented to ensure the free flow of data that enables AI

The responsible use of AI includes 5 basic factors to codify its practices and actions, namely, non-bias that can pose gaps in undesirable behaviors in the nature of work, as the algorithms must be comprehensive and diverse, and the ability to clarify the outcome of the decision to determine responsibility, in addition to securing algorithms from hacks, governance of the way algorithms are used, and finally, ethics and legal legislation that is commensurate with technical technology developments and areas in AI. The laws have not developed in line with the development of technical technology until today, and there is nothing that determines the legal and ethical responsibilities in the uses of artificial intelligence so that they are advanced and consistent with the rapid development of technology and its uses.

b) Liability, Risk Allocation, Insurance, and Indemnification

Imagine an AI-based robot assisting doctors during an operation and making the wrong decision. The operation therefore goes wrong and the patient can claim damages or compensation for pain and suffering. A self-driving car decides to use the footpath instead of the hedge and injures people in the process [44]. Again, the resulting damage must be replaced. But by whom? Who is liable here? Doctor or driver who, as system users, use artificial intelligence for their own purposes? The manufacturer? Or can even artificial intelligence itself be liable?

These questions are very difficult to answer legally. The basis of the Saudi liability system is always misconduct that leads to damage. Misconduct that is legally punished cannot be demonstrated by everyone. According to Saudi law, only those who have legal personality can be liable [45]. This has not yet been the case with robots and machines, which is why the wrongdoing of a person behind the AI must be taken into account. But can this person even be accused of wrongdoing if the AI-based machine makes decisions independently? Or are we facing a large liability loophole that legally blocks the use and development of robots and AI?

There will always be a suitable legal basis for the new challenges that AI and robots bring with them - the only question is whether they are also relevant. Here are the most important facts at a glance:

- Manufacturer liability: The manufacturer can be called upon for liability through product or producer liability. In practice, product liability claims will not stand a chance, but producer liability will.

- System operator liability: The system operator will only have to be liable if he can be accused of misconduct. If he has operated the robot correctly, then he will not have to stick; and

- Motor vehicle owner liability: In the special case of autonomous motor vehicles, the strict owner liability. The holder will therefore mostly have to stick [46].

There are certainly several ways to approach different people and have the damage (material or immaterial) compensated. Questions that are difficult to answer in practice, such as the distinction between negligent and non-negligent behavior, however, make the liability system appear incomplete. Until the legislature has come up with a different system for incorrect behavior by AI, this will apply. For example, consider introducing insurance obligations for manufacturers and system users along with strict liability for all. So, it would always be clear who is liable and who can be financially supported by the insurance.

c) Privacy & Data protection

The battle for future markets has broken out: Google, Microsoft, Apple and Amazon are in a race for ever more sophisticated bots and thus ultimately for real AI [47]. Above all, the company from Cupertino is likely to get into a conflict: Apple, in contrast to its competitors, repeatedly emphasizes the high priority given to customers' data protection. In order for AI to actually conquer our everyday lives at some point, the algorithms have to be fed with their data [48]. Can data protection and AI be combined?

AI is based on the principle of Machine Learning. In order for an algorithm to be able to "learn" independently, it has to analyze a large amount of data. So far, the answer of companies to this data protection problem has been crowd sourcing. Another term for this is "differentiated data protection". Specifically, this means that a set of anonymized data, which is also given a blurring, is used in the development instead of individual data sets that can be traced back to a person.

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*An adequacy decision permits a cross-border data transfer outside the EU, or onward transfer from or to a party outside the EU without further authorization from a national supervisory authority (Article 45(1), GDPR).

Nevertheless, AI as a concept poses major challenges for data protection [49]. The principles of transparency, purpose limitation and data minimization even contradict the strategy of AI in some respects - how, for example, should big data work under the principle of data minimization? Continuously analyzing an autonomously operating system (black box AI)* here should prove to be extremely difficult. The fact that the subject of AI is an important future project is hardly questioned today, global sales for hardware, software and related services in the areas of "Cognitive Computing" and "Machine Learning" are expected to increase 92% grow - at least an impressive sum of 4.3 billion euros.† The limit of 2 billion euros is to be exceeded annually by 2020. Data protectionists view such a development with some skepticism, in particular informational self-determination at risk. Digital assistants such as Google Home or Amazon Echo are currently celebrating success because they can make our everyday lives easier. From the point of view of the data protectionists, however, it is unclear to what extent the information collected about the users may be processed further.

In addition, it should not be forgotten that the devices are switched on at all times and, from a technical point of view, the users can listen. But even if this scenario does not happen, the big digital companies get a lot of information from us. The vacuum cleaner robot "Roomba"‡ also came under fire in 2017, the rooms are measured by the device in order to perfectly remove dirt from the apartment. In a way, this creates a digital map of the apartment. Manufacturer iRobot considered to sell exactly this data to companies - and names like Google or Amazon were also mentioned in this context. This gives rise to the problem that the large digital corporations receive extensive information that can of course also be linked to one another without any problems. From the size of the apartment, for example, conclusions can be drawn about income, and the advertising may then be tailored even more individually to specific people.

7-2- Artificial Intelligence Ethical Challenges

There are 5 basic challenges facing the development of artificial intelligence practices and businesses within the ethical responsibilities, as displayed in Figure 9.
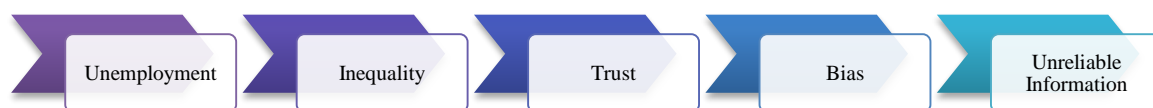
Figure 9. Challenges related to AI practices within the ethical responsibilities

a) Unemployment

An edge with two swords is the perfect analogy to describe AI when it comes to AI. The literature is divided into two arguments when it comes to unemployment as a result of AI's expansion. The first argument is that AI is expected to create more job opportunities and can help in easing the process of finding job [50]. The process of finding a job is often time consuming and troublesome and by AI job search automation a lot of these issues can be solved. On the other hand, more than one-quarter of our jobs are threatened and expected to be eliminated and replaced by AI according to a new Brookings Institution report. Although the report is focused on the United States job market, the results can be generalized to any job market by analogy. The report says roughly 36 million Americans hold jobs with "high exposure" to automation meaning at least 70% of their tasks could soon be performed by machines using current technology. Among those most likely to be affected are cooks, waiters, and others in food services; short-haul truck drivers; and clerical office workers.

With the international trend of investing in AI, concerns have increased about the impact of AI applications in the labor market on unemployment rates. These fears did not come out of nowhere, because global spending on AI development continues to increase. After the total global investment in this field did not exceed 8 billion dollars in 2015, this amount jumped to more than 13 billion dollars this year, and this amount is expected to exceed 46 billion dollars by 2020, and with the announcement of the Joint Vision Fund between the Fund Saudi investments and Japan's Softbank - one of the largest, if not the largest, investment funds in the world with a value of more than $90 billion - it has been announced that part of this amount will be allocated to investment in artificial intelligence.§

84% of enterprises believe investing in AI will lead to greater competitive advantages. 75% believe that AI will open up new businesses while also providing competitors new ways to gain access to their markets. 63% believe the pressure to reduce costs will require the use of AI (Source: *https://www.statista.com/*).

These high numbers in investments confirm the global trend of investing in this area, especially after it has proven successful in companies such as Amazon - where the entire inventory is managed using AI applications - and General

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*Black box AI is any artificial intelligence system whose inputs and operations are not visible to the user or another interested party. ... In one situation, AI used in a recruitment application relied upon historical data to make selections for IT professionals.

†Worldwide Spending on Artificial Intelligence Is Expected to Double in Four Years, Reaching $110 Billion in 2024, According to New IDC Spending Guide, IDC Analyze the Future, (2020).

‡ Vacuum robot sold by the company iRobot.

§ Sam Shead, SoftBank's second Vision Fund hangs in the balance after the first one posted a record $18 billion loss, CNBC News (2020).

Electric.[*] Many economic analysts believe that the application of AI in industrial fields in particular will produce factories with a much smaller number of employees than the current number, which will cause an increase in unemployment rates, and these expectations have formed popular pressure on politicians in some countries. Some of them called on governments to prepare alternative plans to maintain low unemployment rates if artificial intelligence programs were applied in industrial fields.

However, previous experiences have shown that these technical changes do not cause a significant increase in unemployment rates. Rather, they cause a change in the form of the labor market, by transferring the need in the market from one area to another. Perhaps the first example of this was in 1470 in Germany, when the first book was printed.[†] At that time, calligraphers held widespread protests, arguing that the invention of the printer would bring them woes and that they would not be able to work if these printers were proliferated. However, with time, they discovered that these printers needed someone to engrave the letters in their templates, and the work of these calligraphers shifted from a repetitive writing work to a more important and less repetitive work.

With the change of times, these concerns were also repeated with the information technology revolution in the nineties, with people seeing that the world would be run from screens, and that employers would dispense with many of their employees, but the labor market had another opinion, and the demand for employees with skills increased. Computer [51], and whoever can develop his skills finds himself with more job opportunities. As for those who protested this change without developing himself, he finds himself without work and has been left behind.

Recently, with the increase in the amount of information on the Internet, the number of workers collecting and analyzing data has doubled, with the data itself doubling. Especially with the increasing importance of information security and content monitoring in the network. The reason for this is the emergence of new jobs that were not required before these changes in technology [52]. The figures indicate that companies such as Facebook and YouTube have increased the number of their employees to monitor the content of these sites, especially with the increase in international content monitoring systems, which require these sites to remove any contradictory content, otherwise these sites will be subject to financial penalties [53].

The impact of AI on the labor market can be measured by changes in previous times. AI systems inevitably need someone with experience to operate, maintain, and transfer their technology as well. The first beneficiary of this technology is those who realize that this technology has positive aspects, not in terms of productivity or effectiveness, but in terms of qualifying employees whose skills are compatible with this technology. Perhaps the Indian experience at the beginning of the nineties is the closest example of that, as India has benefited perfectly from the information revolution, by establishing colleges and universities that brought out millions of computer specialists and its sciences, until the American information technology became dependent on nearly 70% of Indian human resources.[‡] For example, in India, more than 10 million people work in information technology, and this number is constantly increasing.

While some Western people protest that AI will cause them to have more unemployment rates, other countries such as China, India and Korea are adapting to these systems, not only at the level of research and development for these systems, but also on the extent of strategic planning for what these systems can bring about change [53]. On the economic level in general, and on the labor market at the private level. Economic change in the market is inevitably coming, and these investments in the technical field will bear fruit sooner or later, and the victor is who is ready for that change when it occurs [54].

Despite the benefits of making life easier and more comfortable, the development of automation has raised concerns about the future of jobs and the legal and moral responsibility of the machine's operation. A clear picture must be formed about the desired goals of using artificial intelligence in companies, as artificial intelligence is just one tool within the set of technical tools that can be used to achieve the desired results in business. The success of artificial intelligence depends on the data used in its training, so the use of high-quality data through effective data engineering is the key to the success of artificial intelligence in enterprises.

b) Inequality

Despite countless benefits, the current AI health powered System suffers from inequality. How can we distribute the wealth created by the machines equally? By using Artificial Intelligence, the health sector will drastically cut down on relying on the human workforce, and this means that revenues will go to fewer people.

c) Trust

Many people may not feel comfortable with a machine making potentially life and death decisions about their healthcare. This mistrust may impede the adoption of AI technologies in the healthcare sector, where patients prefer to rely on the interaction with the more experienced doctors to feel comfortable. In fact, direct care remains at the core of healthcare. In addition, legislative governance of these technologies and the manner in which they are tested before being used in medical contexts may affect the level of trust the patients may have towards AI.

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[*] Blake Morgan (2018). How Amazon Has Reorganized Around Artificial Intelligence And Machine Learning, Forbes.

[†] The age of Early Printing: 1450-1550, Britannica.

[‡] Daniel Faggella (2019) Artificial Intelligence in India – Opportunities, Risks, and Future Potential, the AI Research and Advisory Company.

d) Biased Results

Biased result is another concern raised in the used of AI in Saudi hospitals. Since AI technology learns from data, twisted data may be a major concern for the patient [54]. The implicit racial, gender or other biases of the humans who code the algorithms or the data that is fed into the algorithms may affect the results. In fact, the data may not represent the whole populations in their multiple differences and diversities; for example, the ethnic minorities are under-represented in the medical studies representing the actual medical data [55]. Consequently, this situation may lead to biased results, which may affect some population [56].

Biased results can also be caused due to the lack of Interoperability and connectivity. A key barrier to breakthrough is the fact that the information is in different sections by business entities, medical, and the individual himself, when there is no link between the information from the various sources. Splitting information is a complex and problematic reality [57].

e) Unreliable Information

Medical search terms are the majority of Google searches. Common are back pain, headaches, anxiety, and depression. Health officials rightly protest that online information is not always reliable, and the risk is that consuming such information leads to wrong decisions and treatments. This is also where entrepreneurs come in who develop applications for evidence-based information. There are many start-ups that try to provide the end user with evidence-based information and provide patients and physicians with reviews of the most recent and relevant articles for them. Developments such as these will reduce vulnerabilities due to unprofessional information, unnecessary and even harmful treatments. At the same time, it is important to emphasize to the public the importance of reliable sources of information.

7-3- Policy Questions

There is no unified infrastructure or policy regulating the use and application of AI in general and in healthcare in particular. However, with no doubt the penetration of AI technologies raises many policy concerns. Specific policy questions are:

- What will be the effects of automation processes on the labor market? For example, what will those who make a living today do? From their work as radiologists with the full penetration of autonomous devices? Who is responsible for the decisions of AI systems? For example, who is responsible for an autonomous doctor that committed a medical malpractice over a patient?

- Is there a governmental effort to reap the benefits of intelligence technologies?

- Is there a coping strategy to reduce the expected consequences due to loss of jobs?

- Is there a need to encourage dedicated investment in basic research in the fields of AI?

- Is the level of digital literacy of students in the education system in Saudi Arabia and the general public is sufficient? What is the extent of the digital gaps in Saudi Arabia and what is being done to reduce them and prevent exclusion and discrimination in services due to different ability to use and understand information technologies?

- Is it necessary to promote a comprehensive national strategy in the fields of AI?

- Are existing regulatory tools effective for the digital age in general and for AI technologies in particular?

According to various estimates, in the short term the economic impact of the introduction of AI technologies is expected to be on the one hand, to the said automation processes. Nonetheless, there are likely to be positive consequences of an increase in economic productivity; on the other hand, they may have negative effects on employed in areas that will go through the said automation processes, which may lose their jobs.

The report of the Science and Technology Committee of the British House of Representatives on "Robotics and Artificial Intelligence" reads: "some estimate that an increase in the unemployment rate is expected when the labor force is replaced by robots and machines that use AI. Others anticipate a change in the type of employment with the creation of jobs."*

From an economic point of view, productivity in the Saudi Arabian economy is relatively low compared to productivity in Organization for Economic Co-operation and Development (hereinafter 'OECD') countries, and in particular in its fields agriculture, traditional industry, and mixed industry. Generally, in these areas it is easier to implement automation, and therefore have a high potential for improving productivity. On the other hand, workers in these fields are more exposed to job loss, and therefore in order to reduce the harm to them, relevant professional training is required. According to various experts in the field, this issue is already relevant today, as various companies and entities in the healthcare sector uses or examines uses that include intelligence-based profiling and classification processes.

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* House of Commons Science and Technology Committee, Robotics and Artificial Intelligence, Fifth Report of Session (2016).

8- Comparative Discussion

Although the implementation of AI in healthcare generates significant benefits, its implementation raises big concerns about how access, control use and protect data in the healthcare sector. AI may face serious privacy and data protection challenges. Therefore, it is important to have laws in place to protect the privacy of individuals, especially the personal health data.

In table 1, the different legislations were compared in terms of scope and challenges. In the United States, the Health Insurance Portability and Accountability (HIPPA) Privacy Rule (45 C.F.R. 1 Part 160 and subparts A and E of Part 164) is the federal law to protect the health data privacy. In Europe, the General data Protection Regulation (GDPR— 2016/679) has been applied since May 25 2018 (Art 99 (2)) of the GDPR introduced a new era of data protection law applicable in all EU States. In addition, the European Commission adopted its AI strategy for Europe in April 2018 [57]. The commission launched a European initiative on AI to ensure an appropriate ethical and legal framework and published the Ethics Guidelines in April 2019. They contain the key requirements that AI should fulfil; 1) human agency and oversight, 2) technical robustness and safety, 3) privacy and data governance, 4) transparency. 5) diversity, non-discrimination and fairness, 6) environmental and societal well-being, and 7) accountability (*Ethics Guidelines for trustworthy AI*). Moreover, the European Commission published a White paper on AI that contains a European approach to excellence and trust [58]. Tremendous efforts have been done to overcome the legal and ethical challenges in the use of AI in the clinical practice of healthcare, however the (GDPR) and the (HIPPA) are still facing the challenges of the great progress in the new technologies used in the health sector to and are unable to address many of the challenges associated with the new technologies.

Table 1. AI usage in healthcare in the different legislations

	Law & related documents	Date of issue	Scope	Challenges	Ethical and legal Challenges in US and Europe
USA	The Health Insurance Portability and Accountability (HIPPA)	August 21,1996,	The (HIPPA) regulates the healthcare industry Requires institutes to safeguard sensitive patient health information (PHI)	Fails to address all the legal and ethical issues raised by AI.	**Ethical:** 1) Informed consent to use Safety and transparency 2) Safety and transparency 3) Algorithmic fairness and bias Data privacy **Legal:** 1) Safety and effectiveness 2) Liability 3) Data protection and Privacy 4) Cybersecurity 5) Intellectual property
Europe	The General Data Protection Regulation (GDPR)	In 2016, the EU adopted the General Data Protection Regulation (GDPR).	The GDPR one of the greatest achievements in recent years. It replaced the 1995 Data Protection Directive, which was adopted at a time when the internet was in its infancy. The GDPR is now recognized as a law throughout the EU.	Criticized for its limitation to address the legal and ethical changes of AI.	
	The European Commission Communication for Europe	April 2019 EC Published the Ethics Guidelines	The Ethics guidelines promoted the slogan "Trustworthy AI" The guidelines are not mandatory	The Ethics Guidelines are not mandatory.	
	- White paper; - Communication on European Strategy for data; - Report on the liability implication and safety of AI, the Internet of things (IoT) and robotics.	Feb. 2020 release of a White Paper on AI, a communication and a report	European approach to excellence and trust.		
Saudi Arabia	The Personal Data Protection Law (PDPL) The Personal Data Protection Law (PDPL) Saudi Arabia	The PDPL implemented by the Royal Decree M/19 of 16 Sep. 2021. It was published in the Saudi Official Gazette on the 24 of Sept. 2021. Will be in force the 23rd of Mar. 2022	Ensures that data owner's rights of privacy are protected. The law will regulate: the personal data processing in Saudi Arabia and outside Saudi Arabia for its citizens	Still in the process of implementation It is early to speak about the challenges and the risks assessment	A need to promote the trust and privacy culture. The implementation of the PDPL will raise problems of compliance, however too early to assess

After many debates, Saudi Arabia has issued the Personal Data Protection Law (PDPL) comparable to the data protection regimes in other jurisdictions. The law regulates the collection and use of personal data. The PDPL intends to protect "personal data "which has been defined as any information of whatever form, through which a person may be directly or indirectly identified. The law refers in its article 1 to sensitive data and health data, which is every personal data related to an individual's health status, whether physical, mental, psychological or related to his health services. However, the reference is made to the executive regulations of the PDPL, which will be supplementary to the law and will help the organizations with the implementation of the Law (*Murdoch BMC Med Ethics 2021*). The new law will need to build the value of privacy in the organizational culture. In fact, building a culture of privacy and trust is needed during the implementation stage.

9- The Importance of AI to the Future of Healthcare in Saudi Arabia

The pace and quality of implementation are derived from two opposite forces: technological developments on the one hand, and system blockers on the other hand. Oppositions can be from users, doctors, hospitals, insurers, they stem from budget considerations, a desire to protect patients from risks, a flood of inquiries, and conservatism and risk aversion. In addition, there are FDA regulatory barriers and similar entities. The rushing world poses major policy and regulatory challenges. The regulator must quickly prepare for the dramatic changes, while maintaining patient safety.

9-1- An Optimistic Look at the Coming Decades

The information revolution has already led to a change in the patient's centralization, a shift from a hierarchical place, where the doctor holds knowledge and power, to a more egalitarian point. 'Patient at the Center' means a perceptual change of both physicians and patients. Technology is a catalyst for change. The accessibility of information in the palm of every person makes patients the leading partners in therapy. Almost any physiological variable can be measured, such as average hours of sleep, average resting heart rate, blood oxygen saturation, and more. This way the patient knows what the symptoms are, read about the disease, and holds relevant information from the cellphone, smart watch, or any other sensor. Statistically - the younger the patients, the more information they come up with, come up with relevant questions, and make their relationship with the doctor more egalitarian.

The centrality of the individual also means a focus on preventing disease and maintaining health, beyond treating patients. It derives the patient's involvement in the diagnostic and treatment processes, and of course customized medical care for the individual, his preferences, his genetics, and his body bacteria and so on. It can be estimated that 'custom prevention' can, in addition to improving public health, help curb the rising costs of medicine. Harnessing the data revolution is necessary in order to continue to provide health and maintain a defined budgetary framework. The NHS, the UK's National Health Agency, has already announced a strategy that combines data, technology and digital, and has published a 'Guide to a Local Digital Roadmap', and it also funds technologies in its "*health basket*".

Another value is support for the medical staff, who are kneeling under the multiplicity of work and the amounts of information and academic publications. There are not enough hours in the day to be properly update in the articles, to go through the patient's data in order to work in a fact and evidence-based manner. AI can be a major tool in the work of the doctor, including the mining of information about the patient, and of course the latest information in the medical literature. Already today, there are companies that help teams that detects and warns of errors in administering drugs through AI.

Smart hospital administrators are already refraining from spending replica amounts on purchasing and implementing new information systems and are waiting for new solutions to arrive. The need is for "disruptive" solutions that will address the range of issues presented: connectivity, regulation, technological, and moral. There is no doubt that a system that succeeds in replacing the variety of expensive and partial systems currently in use will not be a collection of narrow and incremental solutions, but will operate in an "end-to-end" integration for both paying and non-paying customers. It can be estimated that such a leap forward, if and when it happens, will cause a "disruption" and a major revolution that will be added to the digital medicine revolution we are in. It can be carefully estimated that innovations such as blockchain and the interfaces between medicine and cyber security will allow for transformative breakthroughs in the next decade or two, i.e., products that will be 50-100 times better and cost much less. Until this leap appears, it is important to emphasize the importance of maintaining a healthy lifestyle, which AI cannot do for us.

10- Conclusions

This article dealt with the use of AI in the health care sector, especially in Saudi Arabia. It started by showing the importance of applying AI in Saudi healthcare by focusing on Vision 2030. Then, a brief definition of AI was given. After that, the research questions were answered, starting with explaining how AI is used in healthcare. Later, the main AI applications used in the healthcare sector were described along with their benefits. The questions about the frequency of AI practice and the professionals' opinion about the use of AI in hospitals were addressed in Section 4, where the results of the survey were discussed.

The findings suggest a broader—and potentially more successful—use of AI in the health sector in Saudi Arabia. 100% of medical professionals are familiar with the current use of AI in the healthcare sector, and 70% of respondents think that AI could successfully replace doctors with minimum errors. More than 70% of the respondents agree that AI's advantages outweigh its threats, but a small number of respondents are concerned about AI's algorithm bias.

Moreover, the legal and ethical challenges of the use of AI in the health care sector were deeply studied in section 5. Notwithstanding the legal and ethical challenges of AI, in order to facilitate the use of AI in the healthcare system, we must deal with the objections and policy concerns surrounding the technology. The process of implementing the technology in cooperation with the medical staff and the regulators must be streamlined. The importance of AI to the future of healthcare was introduced in section 6.

It should be noted that many issues that could not be addressed in the present article require further in-depth study, including the interrelationships of AI's application in the healthcare system with human rights violations. With AI in health care, we must consider the human element. The users should be trained on exactly how their data will be used and then have the option to decline consent. In fact, how can we balance the potential for health outcome benefits with concerns raised by most legislation in terms of legal and ethical risks of AI in the health sector.

The new Personal Data Protection Law in Saudi Arabia, issued recently and considered a comprehensive personal data protection law, will definitely raise many issues related to its implementation. Although it stipulates heavy penalties and fines in cases of non-compliance, the health sector in processing health data needs to build a culture of trust before compliance.

The future direction is to extend this study among patients to get their opinion on the use of AI and assess their feedback on the benefits and challenges of AI. It is also crucial to focus on the Personal Data Protection Law (PDPL) in Saudi Arabia, its application, and the implications of AI in the health sector under the PDPL.

11- Declarations

11-1- Author Contributions

Conceptualization, E.C. and A.A.; methodology, E.C., S.L.M.S., and A.A.; software, A.A.; validation, E.C. and A.A., and S.L.M.S.; formal analysis, E.C. and A.A.; investigation, E.C. and A.A., and S.L.M.S.; resources, E.C.; data curation, A.A.; writing—original draft preparation, E.C. and A.A., and S.L.M.S.; writing—review and editing, E.C. and A.A., and S.L.M.S.; visualization, A.A. and S.L.M.S.; supervision, E.C. All authors have read and agreed to the published version of the manuscript.

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Data sharing is not applicable to this article.

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11-4- Informed Consent Statement

Not applicable.

11-5- Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been completely observed by the authors.

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Appendix I

Survey (Medical Staff)

Thank you for completing this questionnaire. Its purpose is to gather information about the use of Artificial Intelligence in the Health Sector for a purpose of a research study with Microsoft. This survey is used by the researcher to know more about the use of Artificial Intelligence in public and private hospitals and the challenges encountered.

Hospital Name: ………………………

Position of Respondent:	☐ Medical Doctor ☐ Radiologist ☐ Technician ☐ Nurse		
I- Knowledge of AI	Agree	Disagree	Neither Agree nor Disagree
Q1) I am familiar with the use of Artificial intelligence.			
Q2) I use frequently Artificial Intelligence.			
Q3) Artificial Intelligence (AI) can replace the doctor in certain medical procedures.			
Q4) Artificial Intelligence can replace the medical doctor with a minimum error.			
II- Advantages of AI	Agree	Disagree	Neither Agree nor Disagree
Q1) Artificial Intelligence (AI) can speed up the process and procedure in the medical sector.			
Q2) Artificial Intelligence (AI) is faster in processing and analysing data.			
Q3) Artificiel Intelligence (AI) gives accurate information.			
Q4) Artificial Intelligence gives right diagnostic.			
III- Challenges and threat of Artificial Intelligence (AI)	Agree	Disagree	Neither Agree nor Disagree
Q1) Artificial Intelligence (A) will replace the doctors.			
Q2) Artificial Intelligence (AI) will reduce the number of staff in the medical sector.			
Q3) Artificial Intelligence (AI) violates the privacy of the patients.			
Q4) The ethical use is considered before using the Artificial Intelligence (AI).			
IV- Acceptance of AI to be part of the Society	Agree	Disagree	Neither Agree nor Disagree
Q1) Do you think Artificial Intelligence could become a part of society.			
Q2) Would you personally accept an AI as part of the Society?			
Q3) Do you think Artificial Intelligence could be dangerous.			