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Ethical Concerns about the Applications of Artificial Intelligence in Healthcare Practices: An Explanatory Review

Hassan, Ismail Bile,[1] Hashi, Abdurezak Abdulahi[2]
[1] Department of Computer Science and Cybersecurity (CSC), College of Sciences, Metropolitan State University
[2] Department of Biotechnology, Kulliyyah of Science, International Islamic University Malaysia,

Abstract
Modern advances in machine learning and artificial intelligence (AI) have greatly improved certain healthcare services both in prevention and treatment of given ailments. Artificial intelligence technologies that benefited healthcare include machine learning, natural language processing, rule-based expert system, physical robots, and robotics process automation. AI has aided medical researchers in modeling research, clinical laboratories, anatomic pathology and reading huge data and designing drugs with reliable accuracy. It helped medical doctors' interpretation of medical images that are designed to diagnose given illnesses, such as imaging practices of X-ray, MRI and ultrasound diagnoses. Though the use of artificial intelligence and machine-learning algorithms is rapidly growing in various healthcare practices with promising potentials, however the use of computer-generated applications in healthcare sector have raised certain ethical concerns about the safety and reliability of these applications. Similar concerns are made about matters of privacy, security, accountability, fairness, and rights. This paper uses an analytical method and reviews these concerns.
Keywords: *Healthcare, Artificial intelligence, Ethical issue, Analytical review*

Abstrak
Kemajuan moden dalam pembelajaran mesin dan kecerdasan buatan (AI) telah memperbaiki perkhidmatan kesihatan tertentu terutamanya dalam pencegahan dan rawatan penyebab penyakit. Teknologi kecerdasan buatan yang memberi manfaat kepada penjagaan kesihatan termasuk pembelajaran mesin, pemprosesan pengaturcaraan semula jadi, sistem pakar berdasarkan peraturan, robot fizikal, dan automasi proses robotik. AI telah membantu penyelidik perubatan dalam memodelkan kajian, makmal klinikal, patologi anatomi dan menafsir limpahan data dan mereka bentuk ubatan dengan ketepatan yang boleh dipercayai. Ini membantu interpretasi doktor perubatan terhadap imej perubatan yang direka bentuk untuk mendiagnosis penyakit tertentu, seperti amalan pengimejan sinar-X, MRI dan diagnosis ultrabunyi. Walaupun penggunaan kecerdasan buatan dan algoritma pembelajaran mesin berkembang pesat dalam pelbagai amalan penjagaan kesihatan dengan potensi yang diharapkan, namun penggunaan aplikasi yang dihasilkan oleh komputer di sektor penjagaan kesihatan telah menimbulkan kebimbangan dalam etika tertentu yang melibatkan keselamatan dan kebolehpercayaan aplikasi ini. Keprihatinan yang sama telah ditimbulkan dalam masalah privasi, keselamatan, kebertanggungjawapan, keadilan, dan hak. Kajian ini menggunakan kaedah analitik dan ulasan mengenai permasalahan ini.
Katakunci: *Perkhidmatan Kesihatan, Kecerdasan Buatan, Isu Etikal, Ulasan Analitikal*

**Corresponding author:*
Ismail Bile Hassan
Assistant Professor Department of Computer Science and Cybersecurity (CSC), College of Sciences, Metropolitan State University
Email: ismail.bilehassan@metrostate.edu

Introduction

In today's digital age and innovation-based economy, artificial intelligence (AI) has captured the human imagination, and it has affected all aspects of life affairs including managing healthcare services. Conceptually, AI is understood as "the ability of machines to carry out

tasks by displaying intelligent, human-like behavior e.g., machine learning, computer vision, speech recognition, and natural language processing, (Russell & Norvig, 2016, Shuili & Chunyan, 2020). It functions as a machine-based algorithm that is "programmed to self-learn from data and displays predictions and intelligent behaviors through artificial neural networks, automated machine learning, robotic process automation, and text mining" (Huang et al., 2018, Yichuan et al., 2020). It helps in various ways, with the aim of providing supportive software systems that are designed to perform different roles in the intended areas of life. AI has increasingly become an important section of ever expending computer sciences, a "part of digital technology that denotes the use of coded computer software routines with specific instructions to perform tasks for which a human brain is normally considered necessary" (Zandi et al., 2019, Kristine et al., 2020).

Artificial Intelligence (AI) has in recent decades became a multidisciplinary domain that covers many disciplines, such as computer science, business, engineering, biology, psychology, mathematics, statistics, logic, philosophy, and linguistics, (Weiyu & Keng, 2018). AI embodies paradoxes that promise scientific miracles, efficiency, and freedom on one hand, and fore-shadow human dependence, passivity, and obsolescence on the other hand (Shuili & Chunyan, 2020). However, there are many ethical challenges and concerns associated with AI technologies including biases, ethical/moral judgment and decision making, cybersecurity, unemployment due to market automation, goal alignment between AI and human beings, and so on (Shuili & Chunyan, 2020). Such ethical dilemmas and concerns, if they are not well addressed when developing AI initiatives, would lead to the potential loss of credibility for products and brands and hamper the company's reputation in the marketplaces (Yichuan et al., 2020). The primary objective of AI applications in healthcare is to analyze relationships between prevention or treatment approaches and patient outcomes. AI technologies can save cost and time for the diagnosis and management of disease states, thus making health care more effective and efficient. For instance, AI enables fast and comprehensive analysis of huge data sets to effectively enable decision-making with speed and accuracy (Samer et al. 2019).

Artificial Intelligence applications in healthcare services can be categorized into virtual and physical types; virtual AI includes informatics from deep learning applications, such as electronic health records (EHRs) and image processing, which can assist physicians with the diagnosis and management of disease states. Physical AI includes mechanical advances, such as robotics that are set to assist healthcare activities like surgery and physical rehabilitation. Algorithms have been developed to train data sets for statistical applications to enable data processing with accuracy (Samer et al. 2019). These algorithms underlie machine learning (ML), which enables computers to make successful predictions using past experiences (Baştanlar & Ozuysal, 2014, Deo, 2015). Although both AI and ML can provide these advances, in application to solve real-life problems like those of healthcare issues, such technology raises safety concerns, which may cause serious issues for both patients and all other health care stakeholders. The reason is that most AI applications rely on a huge volume of data to make better decisions (Samer et al. 2019). Therefore, using AI applications such as machine learning, natural language processing, rule-based expert systems, physical robots, robotic process automation in healthcare practices are all subjects of ethical and regulatory concerns, in terms of reliability, safety, security, privacy, transparency, fairness, and accountability. For instance, X-rays and MRI are among useful medical imaging practices that are common in healthcare sectors, yet the question is, is it safe to use machines-based scans and rays that penetrate cells and tissues of the body? AI indeed helps healthcare providers to store large data and information about the patients, so that given patients' health records are timely accessed for the sake of providing early cure and intervention in real times whenever needed. The security of healthcare databases which sometimes contains personal information, the DNA codes, and genetic information of given patients constitutes another real concern of ethical accountability. This paper aims to review the relevant literature and obtain a broader overview of what are the ethical concerns

about the applications of artificial intelligence in healthcare practices. The discussion of this paper is divided into two major sections: illustration of AI applications in healthcare and the ethical discussion of such applications.

AI in the Healthcare Context

Artificial intelligence is not one technology, but rather a collection of various computer programs that are set to perform certain tasks in the areas of demand. Most of these technologies have immediate relevance to the healthcare fields, but the specific processes and tasks they support vary widely. Some of the widely AI technologies used in healthcare are machine learning, natural language processing, rule-based expert system, physical robots, and robotics process automation (Thomas & Ravi, 2019).

First, one of the widely used AI functions in healthcare settings is machine learning, neural networks that together form a statistical technique for fitting models to data and to 'learn' by training models with data. In healthcare, the most common application of traditional machine learning is precision medicine – predicting what treatment protocols are likely to succeed on a patient based on various patient attributes and the treatment context (Lee Si, et al., 2018). The great majority of machine learning, and precision medicine applications require a training dataset for which the outcome variable (e.g., the onset of disease) is known; this is called supervised learning. As a result, the explanation of the machine learning model's outcomes may be very difficult or impossible to interpret (Thomas & Ravi, 2019).

Second, another AI application that is used in a healthcare setting is natural language processing (NLP), which includes applications such as speech recognition, text analysis, translation, and other goals related to language. In healthcare practices, the dominant applications of NLP involve the creation, understanding, and classification of clinical documentation and published research. NLP systems can analyze unstructured clinical notes on patients, prepare reports (e.g., on radiology examinations), transcribe patient interactions, and conduct conversational AI (Thomas & Ravi, 2019).

Third, the rule-based expert systems, which are based on collections of '*if-then*' rules, were the dominant technology for AI in the 1980s and were widely used commercially in that and later periods. In healthcare, they were widely employed for 'clinical decision support' purposes over the last couple of decades (Vial A et al., 2018) and are still in wide use today. Many electronic health records (EHR) providers furnish a set of rules with their systems today. However, when the number of rules is large (usually over several thousand) and the rules begin to conflict with each other, they tend to break down. Likewise, if the knowledge domain changes, changing the rules can be difficult and time-consuming; they are slowly being replaced in healthcare by more approaches based on data and machine learning algorithms (Thomas & Ravi, 2019).

Fourth, one of the AI applications is the use of physical robots, which often perform pre-defined tasks like lifting, repositioning, welding, or assembling objects in places like factories and warehouses and delivering supplies in hospitals. More recently, robots have become more collaborative with humans and are more easily trained by moving them through the desired task. They are also becoming more intelligent, as other AI capabilities are being embedded in their 'brains' (really their operating systems). Over time, it seems likely that the same improvements in intelligence that we have seen in other areas of AI would be incorporated into physical robots. Surgical robots were initially approved in the USA in 2000, and provide '*superpowers*' to surgeons, improving their ability to see, create precise and minimally invasive incisions, stitch wounds, and so forth (Davenport & Glaser, 2002).

Fifth, closely related to a physical robot is the functions delivered by the robotic process automation; a technology that performs structured digital tasks for administrative purposes, i.e., those involving information systems as if they were a human user following a script or rules. Compared to other forms of AI they are inexpensive, easy to program, and transparent in their actions. Robotic process automation (RPA) does not involve robots–only computer programs on servers. In healthcare,

they are used for repetitive tasks like prior authorization, updating patient records, or billing. When combined with other technologies like image recognition, they can be used to extract data from, for example, faxed images to input them into transactional systems (Hussain et al., 2014).

The above-mentioned examples and other AI applications in healthcare practices, such as machine learning algorithms, robot automation, and medical imaging, form significant ethical and moral dilemmas, some of which are stated in the following section.

Ethical Dimensions of using AI in Healthcare

With regards to the ethical concerns about AI applications in healthcare services, which is the subject of this article, two major concerns have been made: ethical dimensions of making, designing, and using artificial intelligence. The other area of concern is the behavior of machines and issues of machine ethics as well as matters of superintelligence. The former concern is about the construction and formation of human-like intelligent-machines, while the latter is about its usage and benefits in real-life affairs like healthcare services. In the formation of AI applications for healthcare services, major concerns are made about the necessity and the moral justifications of developing these software applications in healthcare services. Among the many questions raised in these regards is, are AI applications important in healthcare services? Does computer-generated software significantly contribute to the competence of healthcare services? Is the aim of developing AI applications for the healthcare sector is to replace doctors and nurses with robot automated services? If so, is it ethical to use emotionless robots in healthcare services, which is a sensitive subject that requires empathy and compassion? This is to say that, as machine-learning applications can only provide a cold and passive relationship with patients, what is the ethical merit of replacing human services with compassionless machines in empathy-loaded healthcare services? Perhaps AI applications can assist in healthcare services like surgery and diagnosis, and thus ethically justified. But can AI applications in healthcare services help us in the areas of counseling and psychotherapy? Besides the ethical questions about the AI applications in healthcare practices, various questions about the safety of such applications are also raised. Are AI applications error-free and thus do not cause unintended harm to the patients? Does machine-learning-based service in healthcare practices provide accurate and precise readings and interpretation of intended information and images? Is it true that robot automation processes would not in any way exceed the set limits of their services? What happens if machine-based services cause any intended damage to patients? Who bears the responsibility for such potential errors? Are robots, who are not moral agents, blamed for given machine errors in healthcare services? There are many moral questions raised to the formation and application of AI applications in the healthcare sector, some of which are analyzed in the following section of this paper.

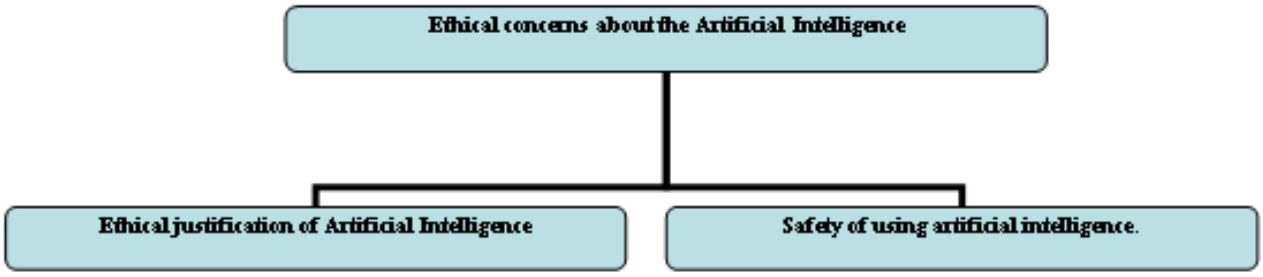

Figure 1: types of ethical concerns

The application of AI in healthcare resulted in significant ethical concerns that include the moral justifications of using it in the healthcare sector, efficiency, privacy, security, reliability, safety, fairness, inclusivity, and transparency as well as accountability.

First, as machines are set to perform various tasks related to human life, including healthcare practices of diagnosing and treating

given ailments, wrongly programmed machines can cause lasting harm to the health of the patient. Indeed, manufacturing companies and software designers often confirm the safety of their product, yet the truth is, these systems are made by human intelligence; an intelligence that is prone to make errors. So, the question is, if human intelligence is prone to make errors, can we trust software systems that are designed by man, to handle sensitive services like healthcare services? Are machine-based software systems 100% error-free, and thus constitute no threat to the life of the patients? While these concerns do not in any way question the ability of human intelligence to develop and manage life, yet the behavior of discovering new knowledge through trial and error is not welcomed in sensitive areas like healthcare services, where the life of patients are placed in the hands of healthcare providers. Indeed, AI applications often undergo through training phase to learn and detect the right patterns, then a trial phase to test the accuracy of its performance. Though errors are not anticipated, in real-world mistakes that might occur, the system: "can be fooled in ways that humans would not be. For example, random dot patterns can lead a machine to "see" things that aren't there" as per Julia's (October 21, 2016) *Top 9 Ethical Issues in Artificial Intelligence* article published at the *World Economic Forum* website. This fact about the process of developing a software system for healthcare services and the potential errors that might occur in real-world practices generate real questions about the rationale of using AI applications in this sensitive area of life. Though these questions reflect real concerns about the justifications of using AI applications in healthcare services, at least at the theoretical level, however, in reality, these applications had in many ways aided man's ability to visualize intended subjects better and thus make precise decisions. Therefore, as the applications of machine-based systems are now widely used in healthcare practices, the developers and designers of these systems have an ethical and legal responsibility to develop these systems with precision, error-free, and rigorously checked for reliability, so that machine-errors with devastating consequences in healthcare services are duly avoided.

Second, one of the observable ethical challenges of AI application in healthcare is, related to *privacy and security*, and the challenges of how to keep databases used in healthcare practices in a safe place? While storing given information of patients in given healthcare databases is ethically justified, safeguarding such information in safe and secure places too is ethically required. This is so because, with the application of AI, millions of data are stored in a given computer, or remote servers, or databases, which if not safeguarded can lead to a serious breach of many patients' privacy. AI technology used in research and clinical practices should therefore adhere to privacy and security requirements of patients' data. An AI technology system should require both, as it will access the massive amounts of protected health information and data that will ultimately improve human health and well-being (Molly, 2019). In line with this principle, the National Institutes of Health (NIH) Data Sharing Policy and Implementation Guidelines states that data should be widely and freely available, yet simultaneously safeguard the privacy of participants, and protect confidential data (Menikoff et al., 2017). Ultimately, the protection techniques available today will enhance the privacy and security of a patient's data while enabling actionable insights for the researcher and clinician (Molly, 2019).

*Third***,** another essential ethical issue for consideration is the *reliability and accuracy* of AI technology in making the right choice and decisions, as it may impact research and clinical decision making including differential diagnosis (Molly, 2019). For example, AI uses in emergency departments may include critical and time-sensitive applications such as clinical image analysis, intelligent clinical monitoring, algorithms for clinical outcome prediction, population, and social media analysis such as public health and disease surveillance (Stewart J et al., 2018). Besides, there is a lack of publication and reporting guidelines for AI in health which further exacerbates the evaluation and adoption of such technology (Stewart J et al., 2018). Research and collaboration among industry, government, and academia are needed to develop guidelines for use of reliable and safe

AI technology systems and applications (Molly, 2019). Fundamentally, these two components will significantly influence whether a researcher or clinician develops trust in technology. The data feeding the AI system and the data collection process, regardless of the technique, depends on reliable data collected from reliable methods (Menikoff et al., 2017). Though developing AI aided healthcare practices and clinical research is not only morally commendable but necessary; yet the problem is empowering AI technology with the ability to be autonomous and being self-sufficient, risks the possibility of AI replacing humanity in crucial and sensitive areas of healthcare that require care and respect such as therapeutics and home nursing for aging elders. These services require genuine and authentic feelings of understanding and emotional connectivity that is not available to AI technology. For the AI systems are unable to simulate necessary empathies in these services, depending on AI in these crucial services in healthcare, leads to the state of being alienated and devalued, which is tantamount to dishonored basic features of humanness. German American computer scientist Weizenbaum reminds us to make a crucial difference between deciding and choosing (Weizenbaum, 1976). In his book titled: *Computer Power and Human Reason: From Judgment to Calculation*, he argues that "deciding is a computational activity, something that can ultimately be programmed. It is the capacity to choose that ultimately makes us human. Choice, however, is the product of judgment, not calculation. Comprehensive human judgment can include non-mathematical factors such as emotions." While expressing serious precautions about AI, he contends that though having artificial intelligence may be possible, but it should "never allow computers to make important decisions because computers will always lack human qualities such as compassion and wisdom" (Weizenbaum, 1976). As reliable and efficient healthcare services are achieved through professional conducts of treatments of given illness and emotional connectivity between the patients and healthcare providers, the reliability of machine-based systems in healthcare services is, therefore, a matter of serious ethical concerns.

Fourth, the development and application of AI systems in healthcare practices raise concerns of *inclusivity*. For now, most of the AI applications are developed by software developers and computer engineering companies, some of which lack basic features of inclusivity. These companies are indeed familiar with the technological requirements of computer-based software needs. As the needs of computer-based programs are different from the needs of other professional sectors like healthcare services, software engineers, developers, and coders should be not only practicing inclusive behaviors but must include input and feedback from people with research, clinical, administrative/operational backgrounds, as this will mutually benefit the patients and ultimately adapt to such technology (Molly, 2019).

Fifth, the automation of healthcare services though comes with observable challenges of *job-losses and fairness* among healthcare providers. On the one hand, the automation of healthcare services risks to layoff millions of employees and replaced with machines. For instance, in the instants in which healthcare services are automated, then what happens to the healthcare services like recording, profiling, and tracking patients' information? Though some might argue that automation of recording patient's information would eventually reduce the risks of misplacements and other human errors, yet it risks the jobs of millions of healthcare workers worldwide. On the other hand, like other fields of the labor market, labor automation in healthcare services also leads to a situation in which healthcare providers will assume more complex roles, whereby their task would mainly be to coordinate machine dominated healthcare services, in which human roles are limited to merely supervisory roles. Instead of physical employment, AI application brings in cognitive labor that is limited to strategic administrations, which eliminates skill-based jobs that traditionally functioned as a source of income for millions. Furthermore, for the automation of healthcare services leads to domination of machine-based services and the elimination of skill-based jobs, matters of fairness in the distribution of income in modern skill-based economy form serious challenge.

This is so because, in our current labor markets, employees are selected based on expertise and educational qualifications. Wages are then based on individual employee's contributions to the company; a contribution that is assessed based on the working hours and amount of services and products that are produced. If let us say we opt for automation of labor markets in healthcare services, wherein wealth is generated by AI, then how fair distribution of incomes is achieved. Based on what criteria the wealth is equally shared? As companies opt for artificial intelligence, the number of human workforces will drop drastically. Fewer people will then have the opportunity to work, while the generated revenues will go to the owners of AI companies, which eventually leads to an imbalanced economic distribution of the society. Therefore, the question is, if we are determined to the automation of labor markets, then what is the structure of fair wealth distribution in the society?

Sixth, another ethical concern of the applications of AI in healthcare has related to the norms of *transparency* and *accountability*. As AI systems are used to help to make decisions that impact patient's lives and health, understanding how those decisions were made must be transparent to researchers, clinicians, and patients (Molly, 2019). Similarly, transparency is required also in the interpretation of computer-generated codes or images. Many AI algorithms – particularly deep learning algorithms used for image analysis – are virtually impossible to interpret or explain. If a patient is informed that an image has led to a diagnosis of cancer, he or she will likely want to know why. Deep learning algorithms, and even physicians who are generally familiar with their operation, may be unable to explain (Thomas & Ravi, 2019). Mistakes will undoubtedly be made by AI systems in patient diagnosis and treatment and it may be difficult to establish accountability for them. There are also likely to be incidents in which patients receive medical information from AI systems that they would prefer to receive from an empathetic clinician. Machine learning systems in healthcare may also be subject to algorithmic bias, perhaps predicting a greater likelihood of disease based on gender or race when those are not causal factors (Thomas & Ravi, 2019).

Sixth, another concern is the need for standard characterization of AI, whereby it acts as a rational agent with the necessary ability to make preferable choices to achieve the optimal outcome of given tasks. In this process, AI technology is expected to be capable of acting based on right or wrong, with the ability to make decisions that are in the interest of the patient in terms of harm prevention and elimination of healthcare risks.

Seventh, biomedical machines are set to read, scan and analyze intended parts of the body with self-sufficiency and autonomy, the degree of threat posed by such machine autonomy on human life is indeed a serious moral concern. In his article published in New York Times, on the July 25TH, 2009, titled "*Scientists Worry Machines May Outsmart Man*", John Markoff, reports worries of the scientists whether there should be "limits on research that might lead to loss of human control over computer-based systems that carry a growing share of society's workload, from waging war to chatting with customers on the phone" (Markoff, 2009). The question is, are the advances in this field independent enough to cause "profound social disruptions and even have dangerous consequences" (Markoff, 2009). If indeed, AI technology is possibly going to act smartly with autonomy, what are the ethical merits of overpowering man, and instead empowering machines?

Eighth, human beings are equipped with the will and tendencies to make intended choices in life. With the faculty of making the will and choice, human beings interact and exchange ideas and thoughts, thus carry on their life. But with the automation of life as suggested by AI applications, would human interactions and conversations be affected. For instance, with the expansion of smartphones and the behavior of internet addiction in our modern times, family relationships are already souring, wherein families are no longer enjoying the close connections that are prevalent in the pre-WIFI era. As complaints of broken family relationships are widely reported due to WIFI and Internet addictions, what happens to human-to-human interaction when AI is widely applied to crucial aspects of life? Similarly, as human beings act willfully, would humans be

ready to interact with machines as if they are humans? As human efforts are truly appreciated in endeavoring and working hard, would AI application lead to a lazy culture that is generally tech-addicted or machine-dependent?

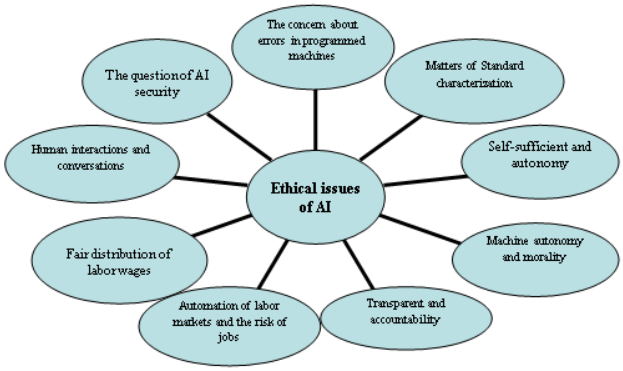

Figure 2 : Ethical issues of AI

Conclusion

Artificial intelligence (AI) is a rapidly growing field, which has potentially far-reaching implications in life. Though in the general outlook, AI presents promising applications that are set to facilitate life and bring it into a new level of technology-based lifestyle; yet future AI applications have also raised various ethical concerns. Some of these concerns are made about the long-term implication of AI on humanity, particularly on whether or not AI applications are set to operate with self-sufficiency with the autonomy of making a life decision, and thus overtake humanity. If that is the case, then AI application risks having decisions making agents that are not spiritually and morally guided, and thus it forms a real threat to humanity. Another great area of concern is related to matters of accountability, transparency, labor markets, distribution of wages, and the challenges of human-machine interaction, which brings limitations to the freedom and privacy of everyone. We are likely to encounter many ethical, medical, occupational, and technological changes with AI in healthcare. It is important that healthcare institutions, as well as governmental and regulatory bodies, establish structures to monitor key issues, react responsibly, and establish governance mechanisms to limit negative implications. This is one of the more powerful and consequential technologies to impact human societies, so it will require continuous attention and thoughtful policy for many years (Thomas & Ravi, 2019).

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