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Review Article

Artificial Intelligence Applications in Healthcare

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ABSTRACT

Nowadays, the employment of artificial intelligence (AI) technologies in healthcare has provided useful outcomes related to decision-making, early diagnosis of diseases, and optimization of patient care services. AI technologies apply to a variety of data sources. The present paper has discussed the latest developments on Artificial Intelligence healthcare applications, AI technologies, benefits, challenges, and ethical considerations. It also has underlined the role of AI in the improvement of diagnosis, prediction, and personalized treatment. On the basis of the present research, it is claimed that the regulation of AI in healthcare is going to decide the fate of AI-ethics in healthcare for at least the coming decade. The ethical agoras on the regulation of AI-healthcare should instead stamp and remain as the imprint on possible and permissible moral and ethical philosophy of AI in healthcare shaped over the years.

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INTRODUCTION

Over the past few years, the use of artificial intelligence in healthcare has received quite much attention. The existing literature shows and proves that the integration of AI improves decision-making within the sector. Furthermore, the application of AI has been widely utilized in laboratory diagnosis where diagnosis of diseases at an early stage and prediction of potentially terminal diseases is made possible through a highly developed set of computations. It exhibits the potential of changing healthcare because it can perform numerous technically complex procedures, it aids in the flow of information between patients-physicians, and it relieves the hospital workers while enabling distant patient tracking.

The most used field of AI in Healthcare comprises of diagnostic imaging and radiology, speech, and image recognition, and electronic health record. AI is in a position to provide good support to medical practitioners by improving productivity and thus the utilization of patients' time in the course of treatment [4].

This paper is organized as follows; The opening section presents an overview of recent advancements and research concerning the use of artificial intelligence (AI) within the healthcare sector. The "AI Technologies in Healthcare" section offers a comprehensive overview of the diverse AI technologies currently available in the healthcare industry. The "Benefits of AI in Healthcare" section explores the advantages associated with AI application from multiple perspectives. The "Challenges in AI Implementation" section examines the various obstacles encountered during the integration of AI components into healthcare systems. Finally, the issue of ethics is discussed. In this section, ethical aspects in the application of AI are discussed, especially the main values and perceptions related to clinical decision-making and regulation.

Literature review and search strategy

The review process retrieved either non-duplicate or original articles, key characteristics of all articles, reported evidence, and other relevant sources. Search terms were applied to Google Scholar databases and the other online library websites, as the search criteria required that papers reported on the application of AI techniques in health.

Thirteen review articles on the application of AI in healthcare were identified. This paper describes the systematic review protocol including the development of the search strategy and article selection criteria, with the aim of summarizing the best available evidence on AI applications in healthcare practice in order to continuously develop and maintain AI applications in healthcare.

Inclusion and exclusion criteria

In this study, the participants are individual researchers who formed a research group with a knowledge in their field, and interventions are AI techniques. The researchers formulated inclusion and exclusion criteria for the selection of articles, where detailed information about the research question was predefined.

Inclusion criteria

Any paper with any kind of research method, i.e., qualitative study, quantitative study, literature review, systematic literature review, meta-analysis, methodology, conceptual paper, action research, case study, with any kind of participants, i.e., doctors, engineers, patients, nurses, software developers, data analysts, providers, and entrepreneurs, and/or with any kind of study applications conducted in the healthcare domain using any AI method, i.e.,

Exclusion criteria

The papers that did not fulfill the intervention or domain characteristics, study methods, and other study characteristics that met the exclusion criteria, such as papers that focused on researchers' evaluations related to healthcare applications of AI. In addition, the researchers applied an inclusion process, along with the application of criteria for selection, which identified potentially relevant documents according to the research theme. This process occurred in three consecutive stages. The first stage was the authors' independent reading of the title and abstract of the studies, aiming to verify candidate studies for critical evaluation.

In cases of doubt, the authors continued to the second stage, which consisted of the reading of the full text of the studies, paying attention to inclusion and exclusion criteria. The third stage was the critical appraisal phase of the included studies.

AI technologies in healthcare

AI technologies applied to healthcare nowadays are primarily represented by machine learning, regardless of the specific underlying model used. Machine learning is a subset of AI research, and the consequent field of machine learning research investigates the construction and study of systems that can learn from data (unlabeled data, labeled data, and/or iteratively).

The two most primary models in machine learning big data research in health informatics are predictive modeling and data-driven. In predictive modeling, traditional or non-traditional machine-learning-based predictive models are employed to infer an expected value given a set of health variables collected. On the other hand, classification, clustering, and association are commonly classified as fully data-driven approaches [13].

Recent technological advances have transformed the health informatics research landscape into a multi-faceted field, generating data and information from numerous data sources such as images, signals, videos, genomics, and health records. The multi-modality of datasets has enabled various data characteristics. In addition to machine learning, there are several AI technologies, such as Natural Language Processing (NLP) and Computer Vision (CV), which are widely used as a massive set of data analysis in the current healthcare sector, including genomics.

Very critically, the presented techniques indicate the current state of the art of the AI technologies available for free-text-based data sources used in genomic research and applications. Despite being conducted under different settings/institutions, they identify subcategories of genomics and thus lead to the development of a free-text classification system [1].

Machine learning

Machine learning (ML) is the application of AI that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. ML is a subset of AI that focuses on the use of data and algorithms to learn from. Systems can identify patterns and, as a result, make decisions with minimal human

intervention. ML is meant to offer benefit to healthcare systems in terms of patient care, processing, and management. One of the largest and most important uses for ML in healthcare is to identify lessons learned (in the form of algorithms) from diagnosing, treating, predicting, and outcomes. The breadth of ML applied in medicine can be split into several domains, including interpretation, assessment/diagnosis, and prognosis, treatment recommendation, and outcome predictions. Healthcare companies and authorities are positioning themselves to be on the leading edge of AI technology and software that enabled healthcare providers to interpret clinical data for a variety of medical imaging. It is also likely that if AI is integrated into various points of patient identification, diagnosis, treatment, and results, there is a pressing need to interpret those data because of not only the integrated data but also the volumes of data involved. In other words, AI is a foundational tool to be leveraged for process improvement, cost-effective data management, and sound clinical decision-making. Therefore, AI has been leveraged in all variety of forms to glean the most data possible to enable decision-making. Other examples where ML is being employed or thought to be employed within healthcare fields include one focus on using machine learning for healthcare data to assess developments in mental health, PTSD, and suicide prediction [7].

Natural language processing

Natural Language Processing (NLP) focuses on a form of artificial intelligence that enables machines to read, understand, interpret, and perform tasks using human language data. At its core, anyone who uses Siri or Alexa or Google Assistant is benefiting from NLP. It's huge for the enterprise, and it brings essential capabilities to healthcare.

In healthcare, NLP is being used to understand what's in that text so it's not just about mining the information - although that's very interesting. It's about being able to use a variety of different sources where human language data is the input to be transcribed, documented, or analyzed to get a better understanding of what the real business or data value is in that [3].

In healthcare, that might be the ability to perform medical transcription. Doctors can't type efficiently enough to meet the demands of patient care, so they dictate information. They would closely analyze the language. They may be conducting research in the lab using machine learning to further divulge different aspects of human language. It could be a way to explain what a pathology report says and what key points are contained in it. It might also be looking for interview content for a patient to find useful information that can streamline and augment care. This addresses the notion that 80 percent of valuable data in a patient record is unstructured - this NLP and these language capabilities resolve that issue [11].

Computer vision

In healthcare, the application of artificial intelligence techniques to understand and interpret the contents of image data is gaining popularity. This field is termed computer vision, where the primary goal is to give machines the ability to interpret visual data in a manner that the human eye does, making it an ideal technology area to solve a multitude of image-based medical problems [10]. Much of the most recent progress in computer vision was made possible by deep learning, or representation learning, beginning with pioneering work by Hinton, Salakhutdinov, and others. Several research findings show how manifold transferable capability in image analysis can be applied from general object and scene recognition to medical imaging and diagnosis.

BCI or Bionic Vision System is a proposed technology that applies the results of neurobiological research to the design of artificial vision systems. These systems convert visual images into electrical signals sent to the brain through microelectronic devices implanted within the visual pathways or directly on the visual cortex to restore the lost vision of blind individuals. The help of AI can make it possible to analyze the detail of the eye membrane, which helps in detecting diseases naturally. AI can perform real-time operation of cataract surgery, which reduced chances of human errors. Computer vision has enhanced the performance in ocular image biopsy in two major aspects: diagnostics and surgical operations. Approximately 200 terabytes of ocular imaging data are being analyzed every day in research to diagnose diseases in the field of eye psychiatry. This complex and voluminous data can be analyzed and annotated for accurate diagnostic decisions (of retina predictor and neurologist), reducing diagnostic error. Computer vision can also facilitate robot-assisted surgery, system-assisted tele-surgery, and microsurgery [6].

Benefits of AI in healthcare

Many benefits exist to incorporating AI into healthcare technology. Better health care delivery through improved navigation of care, administration, and treatment tops the list. The application of AI technologies in healthcare could prove very effective, often causing performances which outclass both healthcare professionals and scientists in a number of situations, for instance, when diagnosing a disease or analyzing medical imaging. They can also be very predictive,

offering an individualized treatment to patients based on their needs and preferences. AI could review data, assessing patient risks and passing the risk information to health professionals to give the best possible solution in every patient's quest for health and wellness [5].

Some of the incredible tools and benefits associated with AI can be noted when it is used in the medical field. Most AI-based tools can digest and analyze huge volumes of data to manage administrative tasks more precisely and effectively. This feature quickly grabbed the attention of hospitals, which began using AI technology for organizing personal files and handling finance and accounting tasks.

Several processes could be automated through AI technologies; it facilitates the general administration of low complexity services and physician sorting and routing as well. Additionally, AI aids healthcare practitioners in enhancing the speed and efficiency of handling healthcare data. For instance, while examining and diagnosing medical imaging, welfare practitioners, especially radiologists and pathologists, to be more accurate and quicker, use AI-based algorithms. The visual imaging is usually analyzed and interpreted with the assistance of a CAD system by the doctors. In addition, interpreting medical imaging is already a very time-consuming process because it involves the analysis of huge volumes of data. Active detection and diagnosis of the anomalies in the body should result in establishing this and providing the most effective care to the patient with an underlying condition [7].

Challenges and limitations of AI in healthcare

Of course, with any promising development, there are limitations to AI use in healthcare, some of them rather imposing. The next section presents current challenges and barriers to the increasing applications of AI in patient care.

Data privacy and security: Many countries legally protect personal data; no healthcare AI solution should allow the compromise of a patient's confidentiality or wellbeing. In many cases, it is not possible to explain which part of input data led to the particular diagnostic decision that an AI system made; hence it is non-transparent. The security of connected devices is another question, which has possible implications for cyber-terrorism and espionage.

Interpretability: Most AI algorithms function like "black boxes". On the input provided, it processes it and gives an output, which most of the time cannot be traced back by any human as to how the system arrived at this output. For example, with neural networks, it is pretty easy to understand most of the time how and why outputs were generated—just as, say, no exercise might be associated with high obesity—but in other cases it simply may be impossible to interpret the derived answers. Therefore, the explainability of AI life-saving decisions should be a precondition of acceptance for medical practice, but it seems that development of algorithms that balance the requirement of high predictive accuracy with the need for human-interpretable output is challenging [12].

Ethical considerations in AI healthcare applications

It is important to address ethical considerations in the application of AI in healthcare. Of course, these are the issues that are surrounding transparency and making AI accountable. Common ethical issues in this area are responsibility for errors in AI algorithms, such as black-box systems that produce variable reasoning steps that meanwhile already inspired part of ethicists to explain moral disputations with "black-box-thinking." Due to the fact that complex non-linear reasoning capabilities make AI systems vulnerable to manipulation and could be designed inadequately for the guidance of their ethicality, this may result in the problem of the responsibility for AI errors and its algorithms. AI algorithms could use databases contaminated by uncontrollable biases, or they could arrive at incorrect conclusions due to statistical aggregation problems when handling such data. These could lead to errors in diagnosis and algorithms for therapy but, more crucially, could skip the evaluation phase of AI in clinical practice to consider one ethnic race for cancer or to perform tests, for example, of a historically underrepresented gender in the AI field. The ethics of AI and health encompass the robust protection of privacy and of individual and community innovations, as well as discussion for the creation of ethical autonomy in autonomous systems, where the central scenario in this chapter is transparency and accountability [5].

Concerning the data protection and privacy, one should ask for access to data in the case that it is possible; otherwise, it has to be guaranteed by regulatory medication that personal data is used lawfully, fairly, and transparently. These principles imply that data on "health" ought to enable a sustainable remedy for a defined health problem, and compatibility of these data concerning research and tele-monitoring activities is guaranteed. This, in clinical practice, means that AI Pharmaceuticals against cancer serve as an example of how to collect big data on sustainability by design, based on a tele-monitoring application of the cancer patient who would otherwise not accept the phase-1 experimental therapy being used for treatment testing and therefore not be included in the treatment decision-making process regulated by ethical committees. This is the only way for the patient to access a cure, being an advanced third-line patient. It is, hence, very important to have a right to access and even receive the AI-derived decision of the monitoring of the cancer

disease, share data with pharmacies for access to the right drug combinations, and stores no medical insurance or a date of a cancer diagnosis should be publicly visible in social media. It follows that the use of the AI in such applications, too, falls under ethical informed consent, which must be appropriately documented.

AI-powered diagnostic tools

There is about to be a sea change in healthcare with the aid of AI-powered diagnostic tools. Such tools would bring considerable benefits to health care, including improving diagnostic accuracy by checking readings against images, catching hard-to-spot indicators of disease at early stages, and reducing errors to help improve patient safety.

Artificial Intelligence is already affecting healthcare in that it supports disease diagnosis by improving the process of diagnosis. AI analysis offers an efficient approach to extracting medical information from surprised sources, as it comprehends special clinical and non-clinical concepts, such as words, diagnoses, and medical events. It could mean that AI enables early detection of certain diseases by picking out hard-to-spot signals that can support diagnosis but are barely perceptible to the human eye. It analyzes data from the clinical trials to improve the development of drugs and the choice of treatments, reduces pathology errors, and refines predictive models, and it better predicts deteriorating patients to help in planning care. Advanced image analysis has enabled radiologists for including minute details about pathology and insights from such reports, which are also going to benefit along with the diagnosis of diseases. This application already proves useful in that it reduces diagnostic workload in primary care and fewer false-positive results are seen when repeating tests in conditions like eye wounds.

Key aspects of the current use of AI in AI-powered diagnostic tools include: the potential for rapid development, its context dependence and the sheer volume of the image or medical reports which AI is trained on. [5].

Although the tool is in its development phase, it is expected that such benefits to the wider system will be developed in the near future. Necessarily, the AI-powered diagnostic tool is a computer-based application able to analyze the medical data of a patient. It assists healthcare professionals to diagnose a patient by classifying and identifying unique problems. By learning from real data, an AI-powered diagnostic tool interprets the symptoms of a patient and identifies diseases. Consequently, a list of the most likely conditions for follow-up with the patient can be suggested.

AI in drug discovery and development

The most straightforward and wide-ranging application of artificial intelligence in the medical area is attending to chronic diseases and ensuring the longevity of its users. Another application of AI in healthcare involves using AI in the field of drugs. It has a combined market value of tens of billions of dollars yearly for AI-based drugs. Artificial intelligence applications in drugs spread from target identification to lead optimization and optimization in clinical trials. Drugs designed in such a manner with the help of artificial intelligence are small molecule-based and protein-based [1]. Artificial intelligence is used in target identification to accelerate the identification of new therapeutic targets, thus reducing the risks and potential costs of drug development. Many previous studies and ongoing projects have demonstrated the advantages of using artificial intelligence. Based on the large number of published papers and company-related news, at least a dozen AI-based startups have been used for the discovery of new drug targets. After the identification of new therapeutic targets, drugs are usually discovered, designed, and optimized using artificial intelligence. Computational methods such as structure-based docking have been embedded in the drug discovery and development process as early as the 1980s. There are many commercial vendors who provide structure-based drug design using artificial intelligence [13]. In addition to structure-based drug design, artificial intelligence is also used for ligand-based design based on a variety of chemical or biological properties. The use of artificial intelligence in structural biology research and computer-aided design of new drug targets is not widespread, with a total value of only a few billion US dollars. Since 2020, efforts to solve three-dimensional protein structures of COVID-19 proteins using multiple methods, including artificial intelligence-assisted approaches to determine the co-crystallization of many proteins, have highlighted this model.

AI in personalized medicine

Personalized medicine is a medical model that integrates clinical and molecular information of individuals in time. Within this concept is "predictive medicine," which seeks to identify the trend of the body to develop certain diseases. Personalized medicine can categorize patients according to the prognosis, predisposition to certain diseases such as cancer, and the chances of the individual responding to this or that specific treatment. Personalized medicine means the ability to classify individuals into subgroups through genetic characteristics or other biological aspects, giving rise to personalized preventive, diagnostic, or treatment strategies [12].

With AI techniques and tools, professionals in any health area are now able to predict the future of the genetic codes of their patients. Personalized medicine, also called precision medicine or P4 medicine, is a procedure that has the ability to predict, prevent, and, in the event of inconvenience, to operate more accurately at the point of malfunction. Thus, the individual can respond to a personalized treatment plan and also with early interventions not necessarily pharmaceutical or therapeutic. Several professionals have met and dealt with individualized human peculiarities, such as pharmacologists and nutritionists competent to make recommendations based on the SNPs of their patients. In dental medicine, the progress of genetic research has led to various associations with genes that influence malocclusions, soft tissue biology, and caries.

AI in telemedicine and remote monitoring

Telemedicine means the delivery of health care at a distance, including monitoring of physiological signals like EKG, blood pressure, and glucose levels, and also tele-presence and tele-robotic surgical interventions. This is very nearly the concept of ambulatory care delivery.

Telemonitoring refers to the remote measurement and collection of data from either a patient, animal, or human, then transmitted for review at a center. This is an approach applied to various healthcare settings.

Telesurveillance is the monitoring in absentia of a suspected person or any other person not physically available at a secure facility through the use of audio and video and all other recording devices. This method is often used, for instance, to provide safety and security within hospitals by monitoring locked mental health units.

Teletracking, refers to independent remote monitoring and intervention on a person regarding his or her location and physical movement in telecare. Basically, it involves a monitoring device that the individual carries, the data from which is sent back to a central computer for monitoring and triggering appropriate responses.

Teletriage is basically like a telephone system that is part of the healthcare system wherein it gives patients advice on the right level of care. These services, very often, are manned by nurses, paramedics, or people who know their triage [1].

AI in health data analytics

The key areas of application of AI in healthcare are in health data analytics, especially predictive analytics of early-year healthcare interventions. Applications of artificial intelligence in health data analytics gain more popularity with the availability of vast amounts of healthcare data. Healthcare data may be of many types, such as electronic health records data, traditional medicinal data, community healthcare data, and bioinformatics or genetic sequencing data. It can help in one or a combination of the following interests, including patient care (diagnosis, treatment assignment), public health (disease tracking, diagnosis, and control of infectious disease outbreak), predictive intervention, and intervention evaluation. It can also be used for operational or administrative interests by giving decision-support to health service providers pertaining to managing capacity, organizing staff, and various service logistics [2].

The insights derived from these vast amounts of health data continuously influence healthcare practitioners, operation staff, and other decision-makers. As the world is going to witness that healthcare data are becoming a significant area of big data, data analytics projecting on health data domains are in the process of development in many parts of the world. One of the data analysis techniques that have been adopted in the construction of solutions for health data domains is data mining. We applied techniques and technologies from databases, statistics, AI, machine learning, and image processing to extract target knowledge for quality healthcare. The techniques of data mining can answer inquiries based on historical data. In health care aspects, the questions would be: treatment protocol standardization, pathways development for provider practice, and condition/disease detection.

AI in hospital operations and management

With the wide penetration of AI in every sphere of human life, it is not difficult for us to imagine what AI applications are in hospital operations and management. Often applications within the said areas engage such models as:

- Predictive model, includes triage.
- Path modeling—for example, intelligent patients search for focused descriptions of symptoms.
- Recommendation models, such as medication reminders.
- Image processing models are inclusive of automatic lesion finding and tumor measurement [9].

Moreover, such hospital settings are unique and their responsible inputs can be either multiple baseline variables or descriptions or standard texts for the item (transcript for audio or video, sentence for paragraph, DNA for gene expression, whole slide for single cell, etc). In fact, mixed data models also apply: the integration of image features into your transcript model may help you nail down, with better accuracy, a possible lesion in an MRI scan.

AI applications in hospitals have achieved intelligent systems that help optimize clinical and operational performance. Hospital operations are a notable domain for supporting the application of AI technologies. For hospitals, AI has the potential to optimize processes, allocate resources, automate workflow, and advance operational outcomes. Healthcare organizations have employed AI in various hospital operations, including those of engineering, surgery, disaster, and synergetic hospital managements, to forecast the duration of hospital stay, pathways on cancer, sepsis, and diabetes mellitus, and to identify drug-drug–adverse event interactions. The application of AI to operational healthcare systems has been extensively reported. In their reviewing study, Elsasser and Kruse summarize research on emergency systems such as capacity management, appointment allocation, and dispatching emergency services, and provide an overview of AI techniques in hospital management, particularly in operations planning, scheduling, and patient admission. Although AI applications in the healthcare sector have achieved success, the patient volume forecasting of operational system evaluation has not been systematically examined.

AI in mental health and well-being

Mental health may also be considered as among the last applied domains on which AI research is conducted. Most recently, a large number of research on AI has been to use social media or digital footprints for the predictions on mental health—affecting many well-being and characterizations such as stress, loneliness, happiness, and assisting users for the selection of an effective online intervention, gaining deeper knowledge of affect, motivation, values, psychological processes, and personality traits. In addition, it has been used in manipulating physical activity with the aim of supporting mental health. The authors focus on four relatively new applications of AI in mental health: "assessment, intervention planning, crisis and emergency support or individualized mental health support" [6]. Despite the impediments and ethical concerns from using AI in mental health, developments and applications as pointed out in this section gesture toward some promising opportunities for the betterment and extension of mental health care [8].

AI has the potential to revolutionize mental health care. Early diagnosis, triage, and intervention can transform the trajectory of a mental illness and can result in substantial cost savings. Some of the tools developed in this area are also applicable to the general population and not just to clinical populations. Therefore, individuals not currently in the mental healthcare system may also benefit from this application of AI. Providing support for those at risk of mental illness is also important as estimates suggest that globally approximately 800,000 people die from suicide every year. It is also essential to provide the general public access to resources and support to help preserve positive mental health [6].

DISCUSSION

A systematic mapping study was conducted to identify and classify the work published in relation to artificial intelligence (AI) technologies in the healthcare field. The systematic analysis of the literature identified 13 relevant articles that were then classified using an analysis framework. Several papers were analyzed, classified by the following areas: application domain, sources of the data, types of contributions, evaluation strategies, and practical implications. The results of the paper were useful and valuable suggestions for developing new AI technologies in health areas, and research could explore other AI types.

Artificial intelligence (AI) and, in particular, machine learning (ML) and natural language processing (NLP), are rapidly evolving and increasingly spreading technologies within numerous sectors and across a wide range of applications. Additionally, the potential implications and applications of AI within healthcare are an important matter of investigation, which is the focus of this review.

A review of the applications of AI in healthcare can provide valuable insight for developing new AI solutions. Due to the different types of AI, the applicative areas of AI have been classified. Since both problems and data of the healthcare domain drastically differ from other classic operational scenarios, the literature exploration process led to the identification of research works and initiatives explicitly concerned with AI applications in the field of health, which had been carried out and tested in a real-world context. Many research contributions in the literature that applied AI technologies were identified, and a relevant distinction emerged related to the concrete domain of application.

CONCLUSION

This paper outlined how AI has proved been a game changer in both diagnosis and prediction in the health domain, lessening some burden on administration, and allowing discoveries in personalized medicine and treatment but, during the process, some of the problems and risks were also discussed. These concerns involved the risk of reinforcing discrimination or making disparities worse, possible vulnerability of the technology to adversarial attacks, and concerns with insufficient transparency, interpretability, and explainability of AI methods used in IoT health care. It has been

called for by an ethical analysis of when these risks are acceptable or shall be addressed. Thus, it is rather the ethical agora of AI-healthcare regulation that should leave its print on the potential and permissible moral and ethical philosophy of AI in healthcare that is destined to wash over the years. Public authorities in various countries are currently actively working on ethical considerations for AI in healthcare. Therefore, regulatory frameworks from our point of view could become the most significant AI-ethical factor going forward.

Acknowledgments
We would like to dedicate this work to everyone who considers AI a useful tool for humans in different domains and is using it for everything that is helpful.

Conflicts of Interest
Potential conflicts of interest are derived from decisions already made or that might be made depending on the results of this paper. It might include future employment, approval from a certification body, or the desire for their regulatory proposals to be widely adopted, which might be influenced by concerns about future meetings, court cases, or hearings. Intellectual interests concern religious beliefs about the action, its proponents, and its potential victims. Social and personal interests, such as desired recognition or protection, disseminate or conceal proofs to protect someone or to affect publications aimed to benefit or harm, should be also carefully evaluated. It is important to note that the influence involved in a conflict-of-interest or the mere appearance of influence does not assume that the authors judge incorrectly or consciously reflect their facts. Thus, it is rather the ethical agora of AI-healthcare regulation that should leave its print on the potential and permissible moral and ethical philosophy of AI in healthcare that is destined to wash over the years.

REFERENCES

1. Bohr A, Memarzadeh K. The rise of artificial intelligence in healthcare applications. Artificial Intelligence in Healthcare. 2020:25–60. doi: 10.1016/B978-0-12-818438-7.00002-2.
2. Abidi SSR, Abidi SR. Intelligent health data analytics: A convergence of artificial intelligence and big data. Healthc Manage Forum. 2019 Jul;32(4):178-182. doi: 10.1177/0840470419846134.
3. Park CW, Seo SW, Kang N, Ko B, Choi BW, Park CM, et al. Artificial Intelligence in Health Care: Current Applications and Issues. J Korean Med Sci. 2020 Nov 2;35(42):e379.
4. Lee D, Yoon SN. Application of Artificial Intelligence-Based Technologies in the Healthcare Industry: Opportunities and Challenges. Int J Environ Res Public Health. 2021 Jan 1;18(1):271.
5. Yin J, Ngiam K, Teo H. Role of Artificial Intelligence Applications in Real-Life Clinical Practice: Systematic Review. J Med Internet Res 2021;23(4):e25759.
6. Richardson J, Smith C, Curtis S. Patient apprehensions about the use of artificial intelligence in healthcare. npj Digit. Med. 4, 140 (2021).
7. Rubinger L, Gazendam A, Ekhtiari S, Bhandari M. Machine learning and artificial intelligence in research and healthcare. Injury. 2023 May;54 Suppl 3:S69-S73.
8. Li H, Zhang R, Lee YC, Kraut RE, Mohr DC. Systematic review and meta-analysis of AI-based conversational agents for promoting mental health and well-being. NPJ Digit Med. 2023 Dec 19;6(1):236.
9. Pillai A. AI-enabled Hospital Management Systems for Modern Healthcare: An Analysis of System Components and Interdependencies. Journal of Advanced Analytics in Healthcare Management. 2023;7(1):212-228.
10. Abdullah R, Fakieh B. Health Care Employees' Perceptions of the Use of Artificial Intelligence Applications: Survey Study. J Med Internet Res 2020;22(5):e17620.
11. Secinaro S, Calandra D, Secinaro A. The role of artificial intelligence in healthcare: a structured literature review. BMC Med Inform Decis Mak. 2021:21;125.
12. Alowais S, Alghamdi S, Alsuhebany, N. Revolutionizing healthcare: the role of artificial intelligence in clinical practice. BMC Med Educ 23, 689 (2023).
13. Faizal K, Alotaibi S. Applications of artificial intelligence and big data analytics in m-health: A healthcare system perspective. Journal of healthcare engineering. 2020;1:8894694.

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تطبيقات الذكاء الاصطناعي في الرعاية الصحية

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المستخلص

في الوقت الحاضر، قدم استخدام تقنيات الذكاء الاصطناعي في الرعاية الصحية نتائج مفيدة تتعلق باتخاذ القرار والتشخيص المبكر للأمراض وتحسين خدمات رعاية المرضى. تنطبق تقنيات الذكاء الاصطناعي على مجموعة متنوعة من مصادر البيانات. ناقشت الورقة الحالية أحدث التطورات في تطبيقات الذكاء الاصطناعي في مجال الرعاية الصحية وتقنيات الذكاء الاصطناعي والفوائد والتحديات والاعتبارات الأخلاقية. كما أكدت على دور الذكاء الاصطناعي في تحسين التشخيص والتنبؤ والعلاج الشخصي. على أساس البحث الحالي، يُزعم أن تنظيم الذكاء الاصطناعي في الرعاية الصحية سيقرر مصير أخلاقيات الذكاء الاصطناعي في الرعاية الصحية على الأقل في العقد القادم. بدلاً من ذلك، يجب أن تترك الأغورا الأخلاقية بشأن تنظيم الرعاية الصحية القائمة على الذكاء الاصطناعي بصمة على الفلسفة الأخلاقية الممكنة والمسموح بها للذكاء الاصطناعي في الرعاية الصحية والتي تشكلت على مر السنين.

الكلمات المفتاحية. الذكاء الاصطناعي، الرعاية الصحية، تقنيات الذكاء الاصطناعي، أخلاقيات الذكاء الاصطناعي.