Analysis of AI-based Tools Challenges and Opportunities for Public Health Care Solutions

Gopesh Kumar Bharti[1], Deshmukh Vaishnavi Jaikumar[2]

[1]*Assistant Professor, Department of CS & IT, Kalinga University, Raipur, India*
[2]*Research Scholar, Department of CS & IT, Kalinga University, Raipur, India,*

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ABSTRACT

Healthcare Systems are essential to maintaining people's health. Determining precise diagnoses is an essential step in this procedure. As sources point out, missed and incorrect diagnoses as a widespread problem, a solution needs to be found. Emergency rooms are known to be stressful workplaces, and diagnostic errors are frequently made there. Systems, products, and services are changing quickly due to technology advancements that today's companies must adapt to. One such technology that can help with diagnosis is artificial intelligence (AI), but it also presents ethical, legal, and technical difficulties. Therefore, the purpose of this study is to examine how AI can impact diagnosis accuracy and how the technical, ethical, and legal issues of its incorporation into healthcare are related. This study looks at the idea of patient empowerment and how it might be applied to enhance the provision of patient health care.

1. Introduction

A broad definition of empowerment is a process of empowering individuals or groups to take control of their environment and their own life. The word empowerment is derived from the Latin root passe, which is also the basis of the words power and freedom. In order to maximise each person's potential for wellbeing and health, patient empowerment in the context of healthcare refers to promoting autonomous self-regulation. The first steps in patient empowerment include education and information, which also include actively searching out information about one's own illness or condition and actively taking part in treatment decisions. A person needs to take charge of their own health and make decisions about their care based on the options that their doctor has suggested in order to feel empowered [1]. By adopting a patient-centric approach, the healthcare system may collaborate with patients and their families to make decisions that are in line with their needs, desires, and preferences. They can achieve this in a number of simple ways, like asking patients to comment on how well they understand certain treatments or conditions, offering easily absorbed podcasts, videos, and graphics about illness self-management at the patient's convenience, or sending messages encouraging patients to stop smoking.

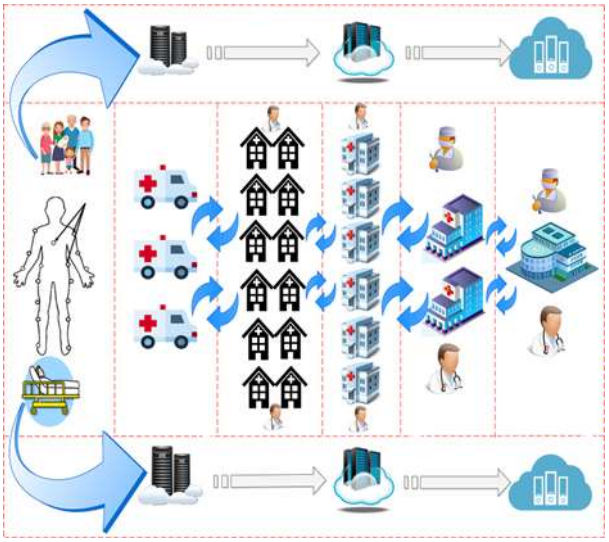

Figure 1. Architecture of health care system

The private doctor-patient connection constituted the majority of healthcare in the past, but it today

consists of a complex network involving both human and non-human players [7]. Databases, medical records, and hospital information systems are some of the components that make up this network [10]. Digital technology has improved features like connectivity, communication, and information flow, making it possible to operate complex networks efficiently [17]. Notwithstanding the technological advancements in the field, misdiagnosis and missed diagnosis persist, especially in emergency rooms. This department is known for resolving a wide range of problems quickly [9]. Those in charge of overseeing the healthcare sector have challenges due to declining outcomes. AI will play a critical role in the solution, according to scientists, legislators, and clinical entrepreneurs who are making this claim more frequently [12]. AI technology has shown to be quite helpful in many other sectors, including medical [2]. However, it has challenges in a minimum of three areas: technical, ethical, and legal factors By processing data to produce insights, improve judgement, and improve health outcomes, AI has increased patient safety. Medication delivery, patient stratification, and improved error detection are all possible with AI-powered systems. AI presents opportunities to support medical experts and people, reduce human error, and provide round-the-clock patient care. As medical imaging technologies progress, AI has the potential to be applied far more in the analysis of medical images, X-rays, and scans, diagnosis, and treatment planning. Artificially intelligent computer systems are heavily utilised in the medical sciences. Patient diagnosis, full drug development and discovery, improving patient-physician communication, transcribing medical records including prescriptions and remote patient treatment are among the frequently used applications. Globally, healthcare administrators face similar challenges, such as the growing demand for healthcare services, improving the quality of patient care, creating more flexible institutions, and managing costs.

Figure 2. Role of AI in Healthcare

AI offers a wide range of administrative uses in the medical field. A stressful workplace is indicated by a high workload, which eventually has an impact on patient outcomes and care quality. Studies have indicated that administrative duties significantly add to the strain and stress of healthcare professionals [3]. AI can be used in many different contexts to streamline the procedures involved in managing and documenting medical information, which will lessen the administrative pressure. AI has being utilised by researchers to predict health occurrences. AI has been utilised in several research to create models that forecast disease outbreaks. Prediction models for dengue disease epidemics, for instance, are constructed using various machine learning algorithms and sensing data, such as local (based on rainfall, for example) and remote (from aircraft or satellite sensors). AI has also been utilised by researchers to anticipate Zika and malaria virus epidemics with an accuracy rate of more than 85%. This study looks at the idea of patient health care and how it might be applied to enhance the provision of patient health care.

2. Literature Review

Machine learning (ML) is a component of AI. It is employed to comprehend data and identify trends. These patterns can be applied to comprehend many medical scenarios, such as making a diagnosis

based on the provided information. With machine learning (ML), programmes can train and learn from data without the need for conventional programming by using mathematical models based on probability and statistics. Learning is facilitated by learning algorithms, and machine learning (ML) is the ability to learn through pattern recognition in large datasets. A dataset consists of several data points, each representing a unit to be analysed in order to extract unavailable data later on [13]. Different criteria can be used to categorise the learning of these algorithms. Connecting input variables to a predetermined output is one type. The human labelling of the data is what makes this process time-consuming. Supervised learning can be applied in the healthcare setting to create links between the patient's attributes (as input) and the intended outcome (as output). After the labelled data has been used as a foundation, the learning algorithm or programme can next be given unlabelled data to make predictions. There are a number of methods, but in the end, feeding the programme a lot of data allows it to figure out how to provide the answer that is statistically most accurate[4]. There are numerous categorization or learning models within machine learning (ML); however, the most widely used ones are deep learning (DL), natural language processing (NLP), and artificial neural networks (ANNs) [14]. A particular kind of machine learning (ML) called "deep learning" is comparable to artificial neural networks (ANNs) but requires additional layers before presenting the results [20]. DL can handle a wide variety of structured data and high complexity. Enough training examples are needed, such as when the system is given millions of x-ray images and each one is labelled with the selected response, like if a tumour or nodule is present [19]. The algorithm may then effectively identify a nodule in an image once the system has received enough training [18]. Particularly for material like photos, audio, and video, DL is adequate [5]. With this in mind, the study's goals are as follows: Investigation of various uses and challenges in application of AI as a decision using in developing nations. To identify the health sector key challenges in adopting intelligent and smart technologies. The rest of the paper is organized as: section 1 presents the introduction about the AI systems Section 2 covers the basis and related work, Section 3 presents the overview of AI systems in health sectors, Section 4 discusses the presenting rules of proposed models and discuss the patient health care decision and Section 5 remembers the conclusions and follow-up work.

3. Results and discussion

The science of artificial intelligence (AI) is developing rapidly and its applications to a variety of medical specialties and worldwide pandemics have the potential to revolutionise the way this chronic ailment is diagnosed and treated [6]. Since "intelligence" lacks a universally accepted concept, there is no consensus on what constitutes "artificial intelligence" [15]. However, Encyclopaedia Britannica simply defines artificial intelligence as "the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings." The expression is allegedly frequently used to characterise the development of artificial intelligence (AI) systems that possess human-like thinking, the ability to discern meaning, the capacity for generalisation, and experience-based learning. Massive data is used to make this happen. As human talents are broad in nature, artificial intelligence (AI) can also be described as shown in Figure 3. Artificial intelligence (AI) may be used to analyse vast volumes of medical data and find patterns that can help prevent and predict diseases before symptoms appear. Additionally, by combining genetic, lifestyle, and environmental data, AI may help identify complicated illnesses. The primary illnesses that AI is used to detect are the following ones:

1. Timely Identification of Fatal Blood Illnesses
2. Chatbots for customer service
3. Electronic Health Aid Providers
4. Handling Uncommon Illnesses
5. Specific Intervention
6. Automating Duplicate Medical Tasks
7. Medical Record Management
8. Diminished Dosage Inaccuracy
9. Surgery with Robot Assistance
10. Automatic Image Diagnosis
11. Fraud Identification

12. Taking Part in Clinical Trials
13. Creation of Novel Pharmaceuticals
14. Better Access to Healthcare
15. Correct Diagnosis of Cancer

To ascertain if a patient may have a particular health concern, the algorithms employ data, frequently from electronic health records, including lab results, vital signs, and demographic and health history. The more doctors report on the accuracy of the algorithm's assessment, the more advanced the technology becomes. In clinical settings and contemporary research, artificial intelligence (AI) algorithms and other AI-powered technology assist medical practitioners. The two most popular applications of AI in medical settings at the moment are image analysis and clinical decision support.

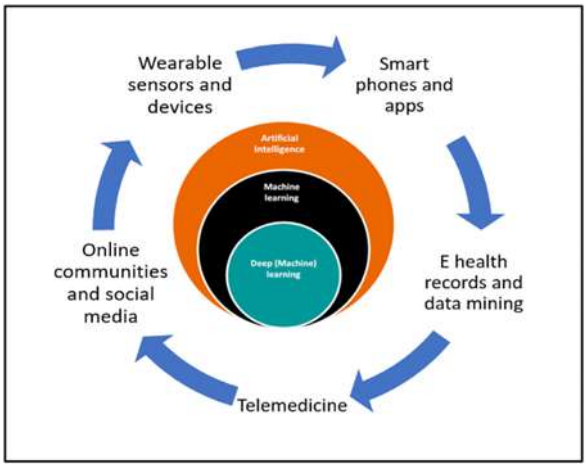

Figure 3. Applications of artificial intelligence in health care

Even though artificial intelligence (AI) technology has many advantages, there are obstacles and limitations that must be addressed before it can be widely used. Concerns abound over things like safety, a lack of transparency, how results are interpreted, and interactions between AI and users. Concerns exist over the technology itself, namely that the system can malfunction or fail to function as intended, leading to undesirable outcomes. Even now, there are still some areas where AI systems are in risk, such as in the case of a hacker assault that might cause catastrophic mistakes. AI programmes that are unable to distinguish between inputs and outputs may experience unexpected faults and untraceable attacks. As a result, the mistakes may endanger patient safety and result in harm or even death. Barriers to patient-machine communication may develop when AI tools are used in healthcare. Additionally, this will decrease in-person interactions between medical professionals and patients. Some patients might not wish to alter the established doctor-patient relationship and may simply want to engage in human social interaction during visits. To ensure effective healthcare delivery, patients must lessen their fear of AI gadgets, and physicians must learn how to communicate with AI systems.

Types of Health care systems

An expert in the relevant discipline must supply information regarding prior knowledge for an AI to operate correctly. This indicates that the model designer ensures the model learns in the best possible way by incorporating his or her experience into the model architecture. This is challenging since complex and ill-defined healthcare cases are one of the issues. It is a difficult effort for a model creator to direct AI because medical thinking does not adhere to a set protocol [8]. Furthermore, the training data's real-world examples are helpful. As a general model to conform to the observed facts, the AI model is offered. Even with ambiguities, this can be managed well by using the training data to identify statistical patterns. In this manner, the AI model's domain expert's algorithm is updated to account for the flaws. The healthcare application's data aren't always comprehensive, though. They may be hard to come by, which could create a distorted perception of reality and lead to models that aren't always representative of all patients. The various approaches and applications of AI in healthcare:

- Powered Diagnostics and Imaging.

- Robotics in Surgery.
- Telemedicine and Remote Patient Monitoring.
- Medical Records Management.
- Chatbots in Communication.
- Reduction of Medical Errors.
- Automated Decision-Making.
- Early detection and Diagnosis using AI.

The architecture, cost of implementation, and power needed to run the healthcare system differ depending on the health care network, i.e., whether an organisation or an individual is implementing it. The requirements of a health care system can be broadly classified into two groups: nonfunctional requirements and functional requirements. The needs particular to an individual or an organisation are identified by the functional category. On the other hand, the other one is not as specific. Based on these criteria, a handful of the most significant health care systems are discussed below.

Electronic and personal health records

The medical data pertaining to hospitals and other healthcare facilities must be stored in electronic health records (EHRs). Furthermore, it allows for the electronic exchange of data between authorised medical users. Users of personal health care systems can access their data and freely update their medical records and other pertinent data.

E-health care system

The ability to interact with individual patients and use available data on diagnosis and treatment to provide care without requiring hospital visits is essential to the future of e-medicine services. Advances in data and correspondence have resulted in advancements in various facets of health care. By using an e-health framework, medical errors have decreased, regulatory efficiency have increased, printed material has decreased, and social insurance benefits are now more widely available at a reasonable cost. The e-health framework's growing popularity and application serves as an example for countries with limited resources.

Smart health care system

Despite the medical systems' advanced technology and organisational design, the general public cannot afford them due to their exorbitant pricing. Smart health care systems have many goals, but the most important one is to raise people's consciousness about their health by raising awareness of the general well-being of humanity. Users of smart health care become self-sufficient in managing and adapting to urgent medical situations. It also seeks to improve customer satisfaction and experience. Smart health care helps make the most of the resources that are available by exploring their full potential. To reduce the costs associated with therapy, it offers the ability to remotely analyse patients. People receiving medical care are enabled to offer advice and assistance whenever, whenever, and in any manner regardless of distance.

Connected health care system

The phrase "connected health" describes the ongoing provision of medical care to remote locations through the use of digital health solutions. In addition to providing continuous health monitoring, it helps collect data on telemedicine and mobile health. With the use of this continuous health monitoring technique, any emergency medical condition involving a patient can be recognised and the relevant parties informed. Through self- and remote care, connected health care aims to raise the standard and accuracy of the current healthcare systems. Smart health care systems explain how to build an autonomous solution, while connected health care services allow consumers to obtain prescription drugs and professional supervision.

Challenges Faced by AI Utilization in Healthcare

Ethical and Social Challenges

The growing use of artificial intelligence (AI) in healthcare brings up a number of moral and societal questions, reflecting larger problems with technological adoption. Concerns about decision-making accountability, the potential for inaccurate judgements, data authenticity, and the protection of private

data arise as AI becomes more advanced. In addition, biases present in AI training data have the potential to lead to biassed outcomes and erode public trust [16]10]. AI systems need to be accountable, transparent, and able to justify their behaviour in order to address these issues. Explainable artificial intelligence (XAI) approaches aim to make AI decision-making processes understandable and transparent, hence fostering human acceptance and confidence. But there are still issues with data scarcity, biases, and privacy, which highlights the importance of integrating AI into healthcare systems while adhering to ethical concepts like beneficence, autonomy, equity, and non-maleficence.

Figure 4. legal and ethical consideration

Governance Challenges

The application of AI in healthcare raises ethical, trust, and regulatory concerns that must be addressed with proper control. Sophisticated governance frameworks are required to guarantee patient safety, professional trust, and accountability, both within hospitals and within the healthcare system. Regulations at the national and international levels, such as the Artificial Intelligence Act (AIA) and the General Data Protection Regulation (GDPR) of the European Union, are essential for controlling AI applications in healthcare and reducing related dangers.

Technical Challenges

The complexity of AI models, a lack of IT infrastructure, and the high costs of data validation and storage are some of the technical obstacles to using AI in healthcare. Due to potential flaws like bias and brittleness, AI systems must carefully take into account factors like interpretability, generalizability, and dataset alterations. Explainable AI solutions have the potential to increase end-user confidence and promote broad adoption. Healthcare providers, however, need to address the issues of hazards, reliability, workload, and training that affect physicians' opinions of AI. Making sure it's user-friendly. Overcoming technical obstacles and encouraging the proper application of AI in healthcare need the creation of AI interfaces and the involvement of stakeholders in the process.

Large datasets are required for precise task classification and prediction when applying machine learning and deep learning models in the healthcare industry. Nonetheless, patient privacy and healthcare organisations' (HCOs') unwillingness to share health data provide obstacles for the healthcare industry when it comes to data accessibility. Furthermore, corporate opposition frequently impedes continued access to updated datasets after an algorithm has been initially trained with data. Furthermore, as health records are a popular target for hackers during data breaches, AI-based applications pose issues about data security and privacy. Significant obstacles are also presented by problems including overfitting, data leakage, and the inability of deep learning algorithms to explain their results. When algorithms inadvertently find artificial correlations between patient features and outcomes, it's known as overfitting, and it results in incorrect predictions [11–13].

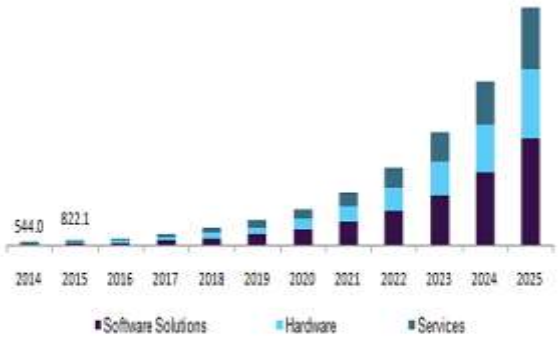

Figure 5. Growth rate of AI in health care plot

The term "data leakage" refers to the issue wherein algorithms make predictions about events that are not included in their training dataset, therefore jeopardising the accuracy of those predictions. Furthermore, the public's confidence in healthcare systems may be damaged by the opaque nature of AI forecasts, which also poses legal issues. Healthcare workers are concerned about job displacement and the necessity for retraining as a result of AI's incorporation into the industry. In addition, the time and money needed to train medical staff members to use AI raises the entire cost. Further impeding the widespread use of AI-based therapies in healthcare settings is a lack of empirical data proving their efficacy. Furthermore, the perceived quality of research in this field and the absence of strong empirical proof are contributing factors to institutions' reluctance to adopt AI solutions. All things considered, the drawbacks of AI in healthcare include expensive research expenses, the possibility of job displacement, dependence on high-quality data, and the technology's limited ability to replicate human traits like compassion and inventiveness.

4. Conclusion and future scope

AI is attracting the attention of healthcare administrators more and more. AI enables us to reconsider healthcare, rethink how diseases are treated, and reconsider prevention measures. It is endorsed to utilise AI in prediction models to estimate the probability of medical illnesses and the issues that go along with them. This will facilitate the introduction of a customised care component in the treatment of medical conditions. Patients are now empowered to take charge of their own health care, and thanks to technological platforms, doctors may intervene quickly and precisely when needed. Because data can be gathered remotely and typical clinic visits are being replaced by virtual management, these advancements save time and money. AI has brought about a revolutionary shift in healthcare disorders and is only going to become better. Furthermore, more knowledge gained from the ongoing use of AI will contribute to the standardisation of the functionality and usefulness in the treatment of medical conditions.

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