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Artificial Intelligence (AI) in healthcare

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ABSTRACT :

Artificial Intelligence's role in healthcare is crucial, as it is reforming the field through improved diagnostic methods, tailored treatment options, and the enhancement of comprehensive patient care. The study focuses on delivering a comprehensive narrative review of healthcare services wherein artificial intelligence driven solutions are integrated into operational frameworks and critically evaluate fundamental components necessary for the successful establishment of AI-based services within the healthcare domain. The advantages of AI in the healthcare context are assessed based on its effectiveness in enhancing healthcare outcomes, supporting healthcare providers in their duties, and diminishing overall healthcare expenditures. The artificial intelligence market within the healthcare domain demonstrates substantial market potential, marked by a 28 percent global compound annual growth rate. This will blend findings from various perspectives of the healthcare sector, covering financial aspects, health improvements, and care outcomes, while also proposing essential elements and factors for the effective implementation of AI.

Keywords: Healthcare Diagnostics, Clinical Decision Support Systems (CDSS), Machine Learning (ML) in Medicine, Natural Language Processing (NLP), Healthcare Cost Reduction, Data Privacy in Healthcare AI, Personalized Medicine, Predictive Analytics in Healthcare, Remote Patient Monitoring, Robotic Surgery

1. Introduction :

The origins of AI can be traced back to more than 70 years ago, specifically during World War II. It was during this time that mathematician Alan Turing developed The Bombe, an electro-mechanical computer spanning almost 50 square feet in size [Haenlein, M.; Kaplan, A (2019)]. A remarkable feat at the time, The Bombe successfully broke the Enigma code, a task previously believed to be impossible even for the most brilliant human mathematicians [Bekbolatova, M., Mayer, J., Ong, C. W., & Toma, M. (2024, January)]. Artificial Intelligence encloses a range of technologies, including machine learning (ML), natural language processing (NLP), deep learning (DL) and computer vision, which are increasingly being utilized in healthcare. The healthcare sector is currently experiencing a significant transformation. The factors for this transformation include the persistent evolvement in overall expenditures associated with healthcare and the increasing deficiency of healthcare professionals. This scenario compels the healthcare sector to embrace innovative Information Technology solutions and advanced technological processes (for example- AI) that have the potential to mitigate costs and address these emergent challenges. The benefits of artificial intelligence have been thoroughly examined within the writings of medical literature. AI uses highly developed algorithms to learn features from a large volume of healthcare data, and then use the obtained insights to assist clinical practice. It can also be equipped with learning and self-correcting abilities to improve its accuracy based on feedback.

An AI system can assist physicians by providing up-to-date medical information from journals, textbooks and clinical practices proper patient care. Prior to the year 2010, enterprises within the healthcare technology domain were predominantly concentrated on innovations derived from medical products. Commencing in 2010, developmental efforts have shifted towards real time medical platforms and outcome-oriented care. Beginning in 2020, technological advancements are progressing towards medical solutions that furnish intelligent responses for evidence- and outcome-driven health, with an emphasis on collaborative and preventive care [Jiang et al. (2017)]. The achievement of these intelligent solutions can be realized through the implementation of robotics, virtual reality, and artificial intelligence. The projected annual savings potential from the utilization of AI in healthcare is expected to reach $150 billion by the year 2026 in the United States alone, which should be regarded as a motivating factor for increasing the integration of AI within the healthcare sector. There exists a multitude of subdomains within the healthcare field where AI-driven services are being employed including surgery, nursing assistance, medical consultation and many more [Väänänen et al. (2021)].

2. Literature Review :

Increased Demand for AI: We discovered that AI has incredible potential to decrease healthcare expenses, offer proactive healthcare services, alleviate healthcare workers' workloads, and deliver quicker and more accurate diagnoses. The increasing healthcare costs create a demand for AI services.

Advantages of AI: The article explores the moral implications of AI in the healthcare sector, addressing concerns regarding consent, responsibility, and openness. Makes sure that its applications are used in a proper manner and the process for decision making is clear.

Generative AI models are in place in clinical decision support systems (CDSS), and they support healthcare professionals in their decision-making processes, by increasing their diagnostic accuracy. Generative AI models are being integrated into clinical decision support systems (CDSS) to help healthcare professionals to take informed decisions diagnostics [Abbasi, N., Nizamullah, F. N. U., Zeb, S., & Fardous, M. D. (2024)].

Rising Healthcare Costs: Cost is rising because of factors such as aging populations, high rates of chronic disease, and advancements in technology. The financial pressure highlights the importance of finding affordable ways to handle and lower costs.

Insufficient Healthcare Workers: The increasing need for healthcare services is not in line with the number of healthcare professionals available. The divide is worsened by elements like exhaustion, the advancing age of medical staff, and inadequate preparation of incoming professionals. Cutting-edge technologies such as AI help bridge this divide by enhancing human abilities and enhancing effectiveness.

AI's role and abilities involve employing advanced algorithms to examine extensive healthcare data, extracting valuable insights that can guide clinical decisions and enhance patient outcomes. And can constantly acquire new knowledge and improve through feedback, resulting in increased precision and efficiency as it evolves. AI offers doctors current medical information from diverse sources like journals, textbooks, and clinical databases, leading to precise and knowledgeable patient care [Bresnick, J. (2018)].

The assimilation of artificial intelligence within Ayurveda presents significant potential for improving the field by blending traditional wisdom with modern technological advancements. This strategy may enhance the personalization, effectiveness, and accessibility of Ayurvedic therapies, all while honoring the fundamental principles of this time-honored practice. The machine learning approach is used to identify the *Prakriti* of the person [Jamdaade, K.M., Patil, H.Y. (2023)]. The preventive and personalized treatment could be possible with the help of *Prakriti* identification [Sharma R, Prajapati PK (2020)].

3. Design :

The adoption and implementation of Artificial Intelligence (AI) in healthcare present a diverse and evolving landscape across the globe, reflecting varying levels of technological advancement, regulatory environments, and healthcare needs [Bozkurt and R. C. Sharma (2023)]. In developed countries, AI integration into healthcare systems is often characterized by advanced technological infrastructure and substantial investments in research and development. For instance, in the United States, AI is extensively utilized in diagnostic imaging, personalized medicine, and predictive analytics [Chen, X. (2024)]. While designing this paper some problems were faced such as despite progress in AI technologies in healthcare, there is a lack of proof of its actual impact on enhancing diagnostic accuracy, customizing treatments, and improving patient results. Furthermore, obstacles like privacy of data, biased algorithms, and moral issues hinder the effective execution of these technologies.
This research aims to:
Evaluate AI’s impact on healthcare practices and address the critical barriers to optimize its integration and effectiveness.
Assess how well AI technologies work in diagnostic imaging and make predictions in healthcare environments.
Identifying challenges and limitations in artificial intelligence's role in healthcare and providing suggestions to overcome them.

4. Discussion :

Information has been collected for the research paper with help of methods such as:
Data Collection Methods: Surveys, interviews, and analysis of healthcare records. Instruments will include structured questionnaires and semi-structured interview guides. Data collected through interviews with healthcare professionals and analysis of institutional records. And used tools such as: connectedpaper.com, scispace.com, chatpdf.com to find relevant literature and identify gaps in the field.

Data Analysis: Statistical analysis for quantitative data and the combination of these methods will provide a complete understanding of AI’s impact in healthcare.

Qualitative Analysis: Collect and analyze data from healthcare institutions using AI technologies. Some scientific methods can also be used to assess the effectiveness and performance of AI systems.

For better understanding a survey containing structured questionnaire was prepared using google forms to gather opinion/responses regarding Artificial Intelligence (AI) in healthcare sector and was circulated to professionals in the healthcare field as well as to general public.

The questions were designed in such a way that they point out some key areas such as:

- Knowledge about usage of AI tools in the Healthcare sector.
- Effectiveness of AI in improving diagnostic accuracy.
- Primary concerns regarding use of AI in Healthcare.
- In what areas of the Healthcare sector will AI benefit the most?
- Will AI take over the healthcare sector in the upcoming 5-10 years?
- Which techniques would you believe in, traditional or modern AI tools?

5. Results :

Following are some diagrams of pie charts & bar graph that helps to understand and analyze the survey:

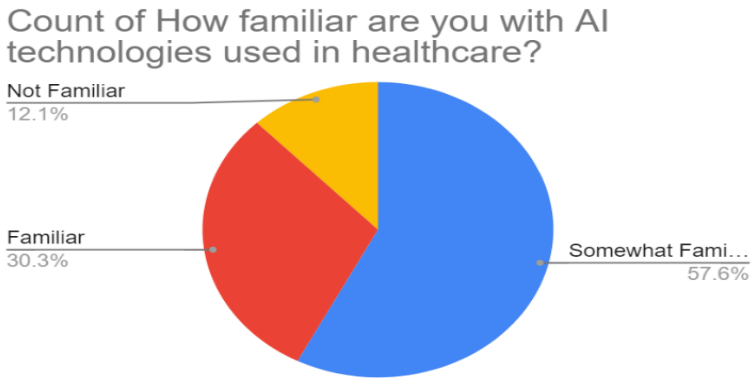

Figure 1: % of familiarity with AI technologies used in healthcare.

The analysis of the question - How familiar are you with AI technologies used in healthcare? is shown in Fig. 1.
Blue indicates that the people have answered - Somewhat Familiar (57.6%).
Red indicates that the people have answered - Familiar (30.3%).
Yellow indicates that the people have answered - Not Familiar (12.1%).

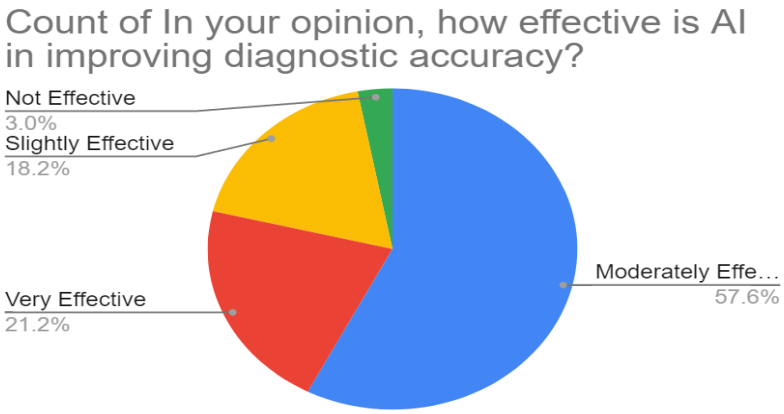

Figure 2: % of opinion for effectiveness of AI in improving diagnostic accuracy.

The analysis of the question - How effective is AI in improving diagnostic accuracy? is shown in Fig. 2.
Blue indicates that the people have answered - Moderately effective (57.6%).
Red indicates that the people have answered - Very effective (21.2%).
Yellow indicates that the people have answered - Slightly Effective (18.2%).
Green indicates that the people have answered - Not Effective (3.0%).

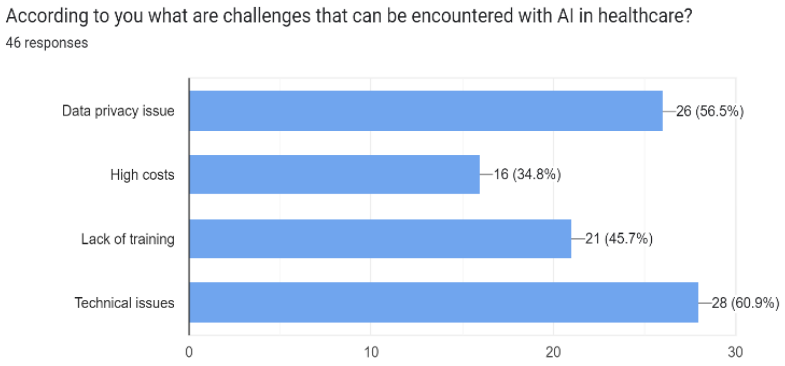

Figure 3: Challenges encountered with AI in healthcare

The analysis of the question - What is/are the challenge/s we can encounter with AI in healthcare? is depicted in Fig. 3.
For Technical Issues maximum people have voted (60.9%).
For Data Privacy some people have voted (56.5%).
For Lack of training some people have voted (45.7%).
For High costs least people have voted (34.8%).

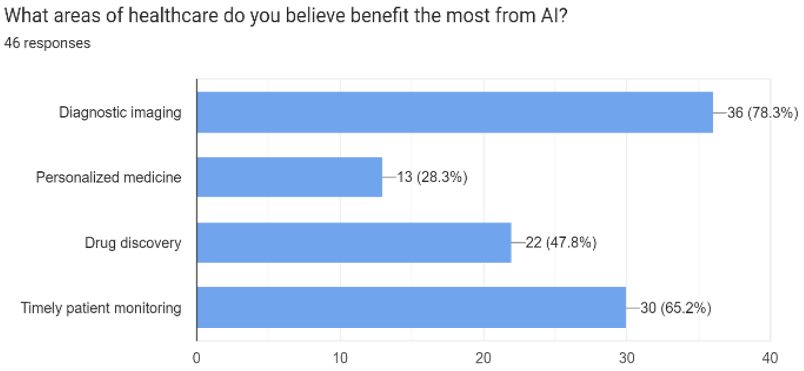

Figure 4: Areas where AI will benefit the most in healthcare

The analysis of the question - What area/s do you believe will benefit the most from AI? is depicted in Fig. 4.
For Diagnostic Imaging maximum people have voted (78.3%).
For Timely patient monitoring some people have voted (65.2%).
For Drug Discovery some people have voted (47.8%).
For Personalized medicine least people have voted (28.3%).

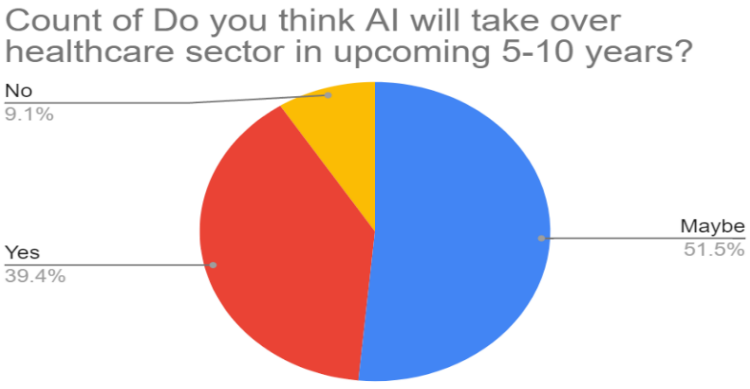

Figure 5: % of opinion of AI taking over the healthcare sector in upcoming 5-10 years.

The analysis of the question - Do you think AI will take over the healthcare sector in the upcoming 5-10 years? is shown in Fig. 5.
Blue indicates that the people have answered - Maybe (51.5%).
Red indicates that the people have answered - Yes (39.4%).
Yellow indicates that the people have answered - No (9.1%).

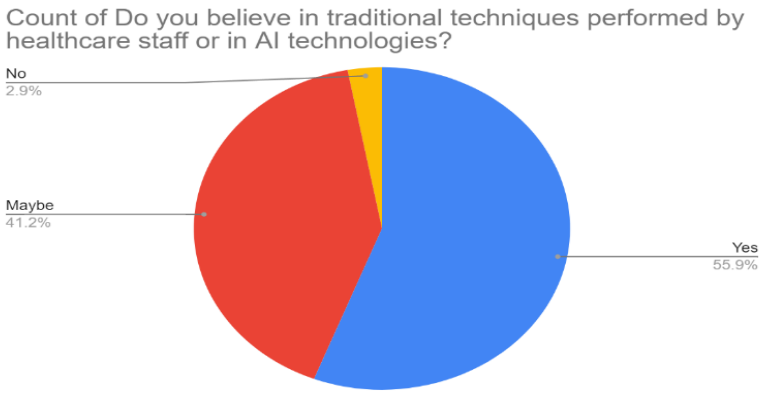

Figure 6: % of opinion of believe in traditional techniques or AI technologies.

The analysis of the question - Do you believe in traditional techniques performed by healthcare staff or in AI technologies is shown in Fig. 6.
Blue indicates that the people have answered - Yes (55.9%).
Red indicates that the people have answered - Maybe (41.2%).
Yellow indicates that the people have answered - No (2.9%).

6. Conclusion :

Effectively merging AI into healthcare systems has the potential for significant benefits, but it is essential to first tackle and resolve the various obstacles associated with its incorporation.
Future studies should focus on the following topics:
Implementing thorough measures to protect data privacy: Ensuring patient confidentiality alongside utilizing AI technologies efficiently.
Dealing with Algorithmic Bias: Ensuring transparency and diverse training data for AI systems to avoid perpetuating health inequalities.
Creating ethical standards and regulations to oversee the use of AI in healthcare, ensuring compliance with moral guidelines.

Despite notable advancements, the utilization of AI in healthcare is still in its evolving phase. Ongoing research consistently enhances the technology, leading to significant breakthroughs in various industries in the future [Saxena, A. K., Ness, S., & Khinvasara, T. (2024)]. The integration of AI tools into healthcare holds immense potential for enhancing patient outcomes, streamlining processes, and driving cost efficiencies [Olawade, D. B., David-Olawade, A. C., Wada, O. Z., Asaolu, A. J., Adereni, T., & Ling, J. (2024)]. AI facilitates remote patient monitoring, allowing healthcare workers to track patients' vital signs and health metrics in real-time. This not only enhances patient safety but also reduces hospital readmissions and healthcare costs [Rana, M. S., & Shuford, J. (2024)].
The increasing scope of AI in healthcare is highly positive as it helps the healthcare process in numerous ways, be it decision making, administrative tasks, record maintenance or robotic surgery. Due to its high efficiency and excellent rate of error reduction, it has proved to be a reliable tool for the process. One of the fields of healthcare which benefitted greatly from this is the disease diagnostics [Kalra, N., Verma, P., & Verma, S. (2024)].
From above it is clear that AI will play a pivotal role in shaping the future of healthcare. By addressing the challenges and adhering to the recommendations outlined, stakeholders can ensure that AI technologies are implemented responsibly and effectively, leading to improved healthcare outcomes, greater efficiency in healthcare delivery, and a more equitable healthcare system for all [Udegbe, F. C., Ebulue, O. R., Ebulue, C. C., & Ekesiobi, C. S. (2024)]. The journey towards AI-enabled healthcare is complex and ongoing. The ultimate goal is to harness AI's transformative power to benefit patient care while safeguarding patient rights and promoting equitable healthcare practices [Williamson, S. M., & Prybutok, V. (2024)].

Acknowledgements

Appendix A. Survey: A detailed list of questions for healthcare professionals regarding AI usage in their sector.

Appendix B. Interviews: Prepared questions and watched qualitative interviews of professionals in this field.

Appendix C. Google forms: Google forms circulation to the people and professionals who are around us to know their opinion on usage and applications of Artificial Intelligence in the healthcare field.

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