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A critical review of the applications of artificial intelligence in healthcare

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Abstract

This paper primarily focused on the critical evaluation of six papers related to AI applications in healthcare. Four of these papers discussed AI applications for predictive analytics. The remaining two discussed AI applications in healthcare in general and the opportunities and challenges of using AI in healthcare. In the first paper, Ramirez (2024) describes the methodology adopted to reach conclusions. But no details are given. Some references were listed at the end, but not cited in the paper. The second paper of Shaheen (2021) qualitatively reviews the topic but uses very few references. The review is only a generalised discussion without any recommendations to address the challenges or future research. The third paper is a good research paper. Lin et al. (2017) developed a Bayesian multitask learning (BMTL) to enhance risk profiling of chronic patients. The model was validated through experiments. All the required details have been given with tables and figures as required. In the fourth paper, a qualitative review is done by Lee and Yoon (2021). They approach the topic from an industry perspective. Some real-world examples of AI applications provide strength to this paper. However, the paper is mostly textual with only one diagram of the historical progress of AI technology. Amarasingham et al. (2014) discuss the considerations and challenges of implementing AI for predictive analytics. In this fifth paper, descriptions are good, but there is only one table of challenges and actions. More tables and figures would have enhanced the quality of the paper. The sixth paper of Nithya and Ilango (2017) wasted a lot of paper space in presenting basic ideas about ML methods. There are several papers which describe these basic details. Discussions focusing on predictive analytics of cardiovascular disease, diabetes, hepatitis and cancer were good. Adequate citations are also provided. The detailed description of ML methods lowers the quality of the paper. Two reviews on the topic were used to examine what others say. Mostly, these papers concur with the points highlighted in the six papers reviewed.

Keywords: Artificial intelligence, Healthcare, Predictive analytics, Machine learning, Health informatics

Introduction

Artificial Intelligence (AI) has revolutionised the healthcare industry by enabling predictive analytics and data-driven decision-making. In this context, AI algorithms analyse vast amounts of medical data to forecast outcomes, optimise treatment plans, and enhance patient care. Through its ability to uncover patterns and insights from data, AI empowers healthcare professionals to make more informed decisions, leading to improved patient outcomes and operational efficiencies. AI can help in health

services management, predictive medicine, patient data and diagnostics, and clinical decision-making, predicting the spread of diseases and customising treatment paths (Secinaro, et al., 2021; Faiyazuddin et al., 2025; Grigoris et al., 2025; Rajaram et al., 2025; Singh et al., 2024; Wang et al., 2025).

In this paper, the following papers are discussed with the support of some related papers.

1. Ramírez, J. G. C. (2024). AI in Healthcare: Revolutionizing Patient Care with Predictive Analytics and Decision Support Systems. *Journal of Artificial Intelligence General science (JAIGS), 1*(1), 31-37. Doi: 10.60087/jaigs.v1i1.p37.

This paper provides brief descriptions of how AI is transforming healthcare with its capabilities of predictive analytics and decision support systems for better quality patient care. Early diagnosis and prevention of diseases are facilitated by AI through its ability to identify trends and risk factors. This leads to better and cost-effective patient outcomes. Machine learning helps to plan personalised treatment by leveraging the data of specific patients. This improves efficacy and reduces medical errors. To enhance diagnostic accuracy, AI-driven algorithms can be used in medical imaging. This helps with rapid and precise diagnostic evaluation. AI-powered decision-support systems can streamline healthcare workflows. This enables real-time insights into patient conditions, leading to evidence-based patient care. AI also facilitates remote patient monitoring, leading to proactive interventions through the timely identification of potential health problems in real-time. However, these benefits from AI are accompanied by certain challenges and problems, such as data privacy, algorithm bias, and the need for regulatory frameworks for responsible and equitable use of AI. There is a need to strike a balance between innovation and ethical considerations to build trust in AI-driven healthcare solutions.

To arrive at the above conclusions, the author used secondary data from various healthcare institutions, some relevant case studies, expert interviews, quantitative analysis and evaluation of ethical issues. Based on these analyses, the author recommends some directions for future research. However, the details of these methods have not been given. For example, the details on the number of experts interviewed and the specific case studies used were not given. Although a list of references is given, none of them have been cited in the text. The whole paper appears to be a collection of summaries from different sources. On these grounds, the quality of the paper is poor.

2. Shaheen, M. Y. (2021). Applications of Artificial Intelligence (AI) in healthcare: A review. *ScienceOpen Preprints*. Doi: 10.14293/S2199-1006.1.SOR-.PPVRY8K.v1.

The paper focuses on AI-led drug discovery, clinical trials, and patient care. The first two are beneficial to pharmaceutical companies, and patient care is related to healthcare providers. The author highlighted certain problems in healthcare, including a lack of access, high costs, waste, an increasingly older population, a lack of protective equipment, insufficient or erroneous diagnostic tests, overworked physicians, and a lack of information exchange. These problems are interconnected and were exacerbated by pandemics like COVID-19. Although AI provides solutions to many of these problems, its uptake in healthcare is slow. Clinical trial cooperation among researchers was a landmark during the COVID-19 pandemic. This collaboration resulted in pooling large volumes of clinical trial data on COVID-19 and the development of preventive vaccines within a short time. AI-powered robots and stethoscopes are available now for various uses in healthcare.

Considering the rapid progress and availability of numerous papers on the topics dealt with by the author, the papers included in the review are too few. The paper provides only some generalised discussions on each topic. There is no recommendation on addressing challenges and future research. Overall, the quality of the paper is poor.

3. Lin, Y. K., Chen, H., Brown, R. A., Li, S. H., & Yang, H. J. (2017). Healthcare predictive analytics for risk profiling in chronic care. *Mis Quarterly*, *41*(2), 473-496. Doi: 10.25300/MISQ/2017/41.2.07.

Contrary to the above two papers, this paper is a research paper. The authors developed a Bayesian multitask learning (BMTL) to enhance risk profiling of chronic patients. The model was validated through experiments.

Accurate assessment and prediction of risks of future adverse health events can lead to personalised preventive interventions to address them. For these purposes, the authors used electronic healthcare data of a large number of patients and developed a Bayesian multitask learning (BMTL) approach to predict patients' risks of adverse health events. Two ways to develop predictive models are using specifically designed trial data and using existing clinical data like EHRs, insurance claims, and clinical registries. Although predictive models can be used for various purposes, their actual use is limited due to inadequate integration of the model with existing clinical workflow, the requirement of expensive-to-get or inaccessible variables and the need to adapt the models from the study population to the local population. EHR can solve some of these problems. Predictive analytics can be used for decision-making. The BMTL model only improves predictive accuracy. Compared to many other models, the BMTL approach does not have a sequential dependency but uses a hierarchical correlation structure to coordinate multiple baseline models. BMTL can be used to address multiple adverse health events in chronic care.

Multitask learning is an ML strategy in which multiple related tasks are trained jointly instead of independently to improve the overall performance of learning. It is based on a shared computational structure to join individual tasks together in a unified training process. This allows training signals to be passed across models as an inductive bias. This improves the generalisability of each trained model. The author describes three approaches to multitask models. The ANN-based models have each node in the output layer as a task with learning as an optimisation problem. The second approach of minimising (or maximising) an appropriate regularisation function over all tasks can use baseline models like regressions, SVM and tree-based models. In the third approach, common prior distributions over tasks in a Bayesian framework are imposed. The Bayesian framework can be applied to almost all ML methods. All three approaches have their problems and limitations. BTML was modelled as a unique hierarchical correlation structure across the tasks. The authors have explained their model in detail with diagrams and tables. In the validating experiment, the authors used simultaneous modelling and prediction of risks of three adverse events (stroke, acute myocardial infection, and acute renal failure) for diabetic patients. De-identified EHR data from 14,782 adults with type 2 diabetes at a Taiwanese hospital were used. According to the records, 2,370 (16%) had a stroke event, 722 (5%) had an acute myocardial infection event, and 1,006 (7%) had an acute renal failure event. The experimental details are described with diagrams and tables. Results showed consistently better performance of BTML over single-task and multitask models.

Overall, this research paper has explained the basic concepts and their applications and specific details of the BTML multitask model developed by the authors with support from extensive literature. The experimental design and its results have been explained well. The use of appropriate tables and figures enhances the quality of the paper. The limitations of this research have been recognised and are to be addressed in future research. The quality is good.

4. Lee, D., & Yoon, S. N. (2021). Application of artificial intelligence-based technologies in the healthcare industry: Opportunities and challenges. *International journal of environmental research and public health*, *18*(1), 271. Doi: 10.3390/ijerph18010271.

In this qualitative review, the authors discussed the status of AI-based technology applications in healthcare and their impact on the industry. Many real-world examples of AI applications in healthcare have been discussed to demonstrate their usefulness, limitations and problems. The review shows that AI-enabled systems enhance medical staff in patient diagnosis and treatment for a wide range of diseases. The efficiencies of physicians, radiologists, nurses and other medical professionals in hospitals are improved by AI applications of various types. AI also helps to coordinate and improve the management of hospitals. Many opportunities and challenges are experienced when an AI application is implemented in a hospital. The authors have discussed these opportunities and challenges in detail. Rapid advances in AI and related technologies will help to create new value for patients and improve the efficiency of their operational processes. However, this can happen only if all stakeholders collaborate from concept to practice of AI solutions to healthcare problems. This will also address the sociological issues related to AI applications in healthcare.

Overall, compared to the first two papers, this review has better quality as it provides many examples of real-world AI applications, with detailed discussions of opportunities and challenges to provide a balanced view. Appropriate literature has been cited wherever necessary. However, except for one diagram of the historical progress of AI technology, the paper is limited to a textual description. This reduces the quality of the paper.

5. Amarasingham, R., Patzer, R. E., Huesch, M., Nguyen, N. Q., & Xie, B. (2014). Implementing electronic health care predictive analytics: considerations and challenges. *Health Affairs*, *33*(7), 1148-1154. Doi: 10.1377/hlthaff.2014.0352.

This is a discussion paper. The authors observed that the development and validation of predictive models need to be followed by mainstream implementation for predictions at real-time points of care across hospitals. This requires thorough planning in which all stakeholders need to be involved. The challenges include ensuring the privacy of patients and obtaining informed consent from patients for using AI applications on them and their data. There is also a need to include AI technology and its healthcare applications in the medical education curriculum. AI applications should not crowd out medical professionals from decision-making. They should only be used to aid better decision-making. Going into some details, practical challenges in testing AI for predictive analytics in a real-world setting include ensuring appropriate management and control, stakeholder engagement to ensure its successful and sustainable integration into the clinical workflow, the rigorous implementation of patient privacy and informed consent policy and procedures, and data quality assurance. There is no specific framework to obtain informed consent from the patient in the case of AI

applications. The authors gave many examples to show how critical this issue is. Other challenges are adequate validation, impact analysis, scalability from pilot tests, development of standards and incentives, development of best practices for AI applications, interoperability between the new AI applications and the current IT system of hospitals, and transparency. The long-term challenges include the influence of AI-predictive analytics on the relationship between doctors and patients and the over-reliance of doctors and patients on AI applications for interventions.

Overall, the points have been well presented in this paper. There is only one table of challenges and actions. Otherwise, this is only a textual description. Some more tabulated data or diagrams to illustrate the main points would have increased its usefulness. Thus, the quality of this paper is not sufficiently good.

6. Nithya, B., & Ilango, V. (2017, June). Predictive analytics in health care using machine learning tools and techniques. In *2017 International Conference on Intelligent Computing and Control Systems (ICICCS), 15-16 June 2017, Madurai, India* (pp. 492-499). IEEE. Doi: 10.1109/ICCONS.2017.8250771.

This paper first provides a general discussion of Machine Learning methods, applications in various disciplines, and a tabulated statement of its categories, tools and features. After the general discussions, ML applications in healthcare, like genomic measurements, diagnostics, predictions, decision-making, and diagnostic image processing to identify diseases, are discussed. Detailed discussions on AI applications in the prediction of cardiovascular diseases, diabetes, hepatitis and cancer are made with the help of cited literature. In all, 32 papers have been cited in this paper.

Overall, the paper provides a general idea about various ML and AI applications in healthcare, especially in the prediction of chronic diseases. Thus, the quality of the paper is mediocre.

Discussion

The quality of papers was assessed above as in Table 1.

Paper	Quality
Ramirez (2024)	Poor
Shaheen (2021)	Poor
Lin et al (2017)	Good
Lee and Yoon (2021)	Medium
Amarasingham et al. (2014)	Medium
Nithya and Ilango (2017)	Mediocre

The focus of four out of the six papers reviewed above was predictive analytics in healthcare. There are other ML methods of predictive analytics and other uses of AI. These are discussed below.

In a review, Badawy, et al. (2023) surveyed the existing machine learning and deep learning approaches used in healthcare predictions and identified the inherent obstacles to applying these approaches. The authors presented various data sources

usable in healthcare (Fig. 1). Even mobile phones, social media and environmental factors can contribute to healthcare.

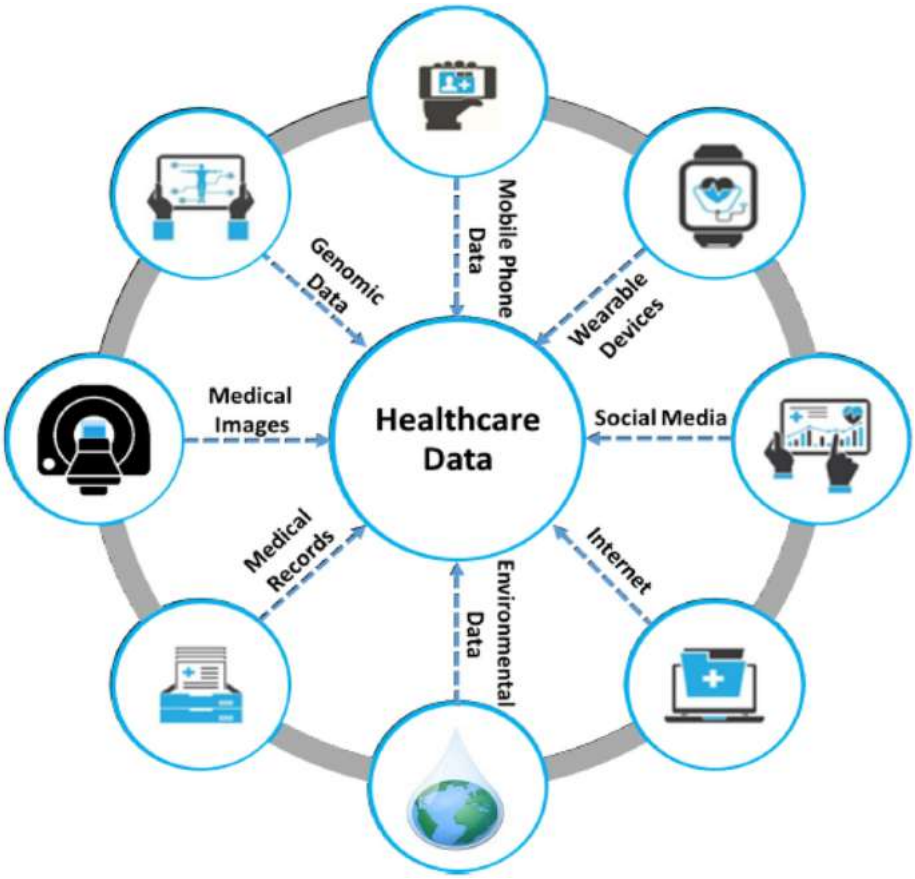

Figure 1: Data sources usable in healthcare (Badawy, et al., 2023).

Machine learning and deep learning are considered subsets of AI. A summary of various ML methods is available in Fig. 2.

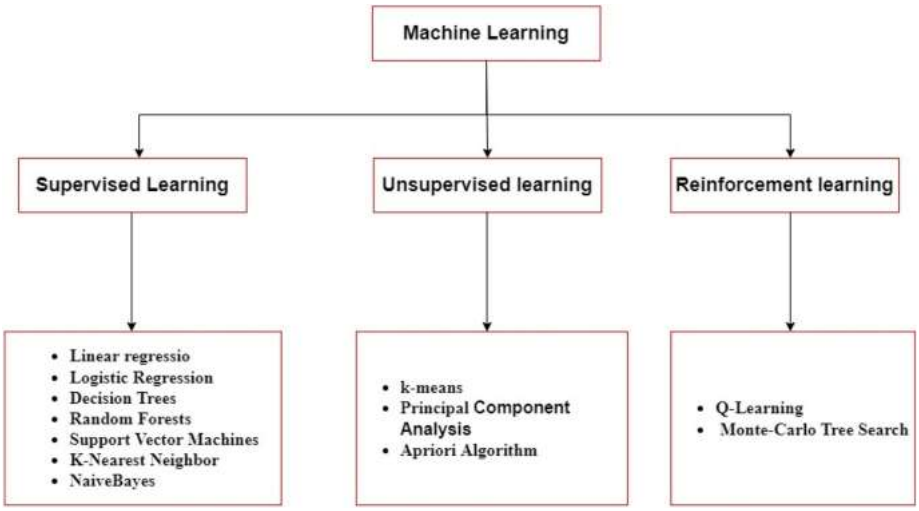

Figure 2: A summary of various machine learning methods (Badawy et al., 2023).

ML-based predictions have been made using and comparing different algorithms in the case of diabetes patients, COVID-19, a healthcare management system to schedule appointments with doctors and verify prescriptions usable by patients, heart diseases, use symptoms to predict the disease, a decision-making system to help practitioners in

anticipating cardiac problems in exact classification, breast cancer among women, liver disease, coronary heart disease. DL-based predictions include cases of inveterate diseases, chest radiography images to differentiate between patients with mild pneumonia and COVID-19 infections, providing a valid mechanism for COVID-19 diagnosis, diabetes, multi-disease prediction for intelligent clinical decision support, and disease (heart and diabetes) detection systems for smart healthcare, and stroke. In this case, different algorithms were compared by the researchers. Effective ways of sorting, storing, collating and analysing large volumes of new data emerging daily are a challenge. The other challenge is that there are not enough patients to collect all relevant data on any disease and use them for prediction.

Patient-centric approaches involve the utilisation of individualised health data to tailor treatment plans, predict disease outcomes, and optimise preventive measures. Ibeh, et al. (2024) reviewed the methodologies employed in patient-centric data analytics. They examined the use of various machine learning algorithms, predictive modelling, and AI to develop personalised healthcare interventions. The authors also reviewed the transformative impact of data analytics on healthcare delivery. The optimisation of operational processes, resource allocation, and the identification of cost-effective interventions are important aspects of healthcare management. The power of data analytics can be controlled to streamline healthcare operations, reduce inefficiencies, and more effectively allocate resources. Predictive analytics helps to forecast disease outbreaks and enable proactive measures for containment and resource allocation. The ethical challenges are associated with the implementation of data analytics in healthcare. They include patient privacy, data security, and the responsible use of sensitive health information.

Conclusions

AI applications can be used in healthcare for many purposes. These include the prediction of disease outbreaks, the progress of the health conditions of individual patients, personalised care, diagnostics including precise image interpretations, decision-making systems, scheduling appointments with doctors and verifying prescriptions usable by patients, optimisation of healthcare management systems for greater efficiency, cost reduction, better care delivery, and better patient outcomes, all adding value to patients.

The reviewed papers also discussed the problems and challenges. These are mostly related to patient privacy, getting informed consent from patients when AI applications are used, data security, accountability and responsibility if something goes wrong.

AI applications in healthcare may cause the loss of some jobs, but provide many more jobs requiring new skills.

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