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A Review of Literature on the Economic Implications of Implementing Artificial Intelligence in Healthcare

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Abstract

Background: This review delves into the effects of artificial intelligence (AI) on healthcare, which is a crucial aspect considering the increasing costs of healthcare worldwide. While there is potential for AI to enhance healthcare delivery and efficiency, there are still uncertainties surrounding its effectiveness, value, and broader adoption. This comprehensive literature review aims to explore and synthesize existing knowledge on the economic impact of AI in healthcare. The primary objective of this review is to understand the potential cost savings and efficiency improvements associated with the deployment of AI in healthcare settings. By highlighting the economic implications of AI, this review seeks to offer insights into the value proposition of investing in AI technologies for stakeholders such as healthcare providers, payers, and policymakers. *Methods*: To conduct this review, we conducted a search of literature from 2020 to 2023 across three databases: PubMed, Scopus and Google Scholar. We specifically focused on studies that discuss the impacts of AI in healthcare and include cost evaluations, using combinations of keywords related to AI, economics, healthcare, and cost evaluation. The inclusion criteria were studies that conducted some form of economic evaluation related to AI in healthcare settings, while exclusion criteria were studies without a cost evaluation component. Data extraction and quality assessment using the CASP checklist were undertaken on the final set of included studies. *Results*: After screening studies, we identified 10 out of a total of 28 studies and reports that met our criteria of outlining any form of economic impact and evaluation of AI in healthcare settings. Based on our findings, implementing AI in healthcare could potentially lead to cost savings. Several studies suggest savings ranging from $200 billion to $360 billion in the United States alone. The use of AI in healthcare sectors such as ophthalmology, radiology and disease screening has shown positive economic impacts. *Conclu-*

sion: While AI has potential for cost savings and efficiency improvements, in healthcare settings, it's crucial to conduct detailed context specific cost evaluations to optimize the adoption and implementation strategies of AI.

Keywords

Artificial Intelligence, Healthcare, Economic Impact, Cost Evaluation, Literature Review

1. Introduction

The healthcare field has experienced a surge in the application of artificial intelligence (AI) due to its potential to enhance healthcare delivery and efficiency [1]. However, certain uncertainties regarding the effectiveness and value of AI in practice persist, underscoring the need for implementation guidelines [2]. To optimize the use of healthcare resources, stakeholders must conduct health technology assessments, which also extend to AI applications in healthcare settings. The current dearth of understanding concerning the impact of such applications presents challenges for clinicians, health facilities, and policymakers alike [3].

The inception of AI can be traced back to the 1950s when mathematician Alan Turing speculated about the possibility of machines possessing intelligence [4]. The incorporation of AI into various settings gained momentum in the 1980s [5]. Despite these advancements, the number of AI applications currently being implemented in hospitals for care remains limited.

AI and Healthcare

There have been research studies indicating that AI has the potential to match or even surpass human performance in healthcare tasks [6]. The implementation of AI based technologies has demonstrated the ability to enhance the quality of life making it more convenient, secure, and productive [7]. However, opinions vary regarding the applications of AI in healthcare [8]. It is suggested that areas like workflows, image analysis, robotic surgery, virtual assistants, and clinical decision support hold importance [8]. Other reports highlight how AI can improve machines, reduce dosage errors, enhance cybersecurity measures, and enable personalized medicine [9]. Although those are mere predictions of the various uses of AI in healthcare, there are several AI applications in healthcare that have matured. One of these applications was a way to leverage AI by assisting healthcare professionals in making diagnoses and treatment recommendations. By analyzing data such as histories and test results, AI can identify patterns and establish connections between findings for potential diagnoses or treatment options [6]. Moreover, AI can aid patients in gaining an understanding of their health conditions and make decisions about their care by providing personalized health information. Using health data and histories as references, AI can offer

tailored insights, education materials, and recommendations to each patient [10]. Additionally, AI plays a role in managing tasks within healthcare settings by instantly providing up to date medical findings from diverse sources [1]. Furthermore, another application of AI lies in its ability to analyze medical images and detect anomalies at an early stage by utilizing intelligence in conjunction with imaging devices, which can result in more timely and precise diagnoses [11]. Lastly, AI can also be utilized for patient monitoring allowing healthcare professionals to monitor patients' conditions in time and provide guidance or make adjustments based on the transmitted medical data [10].

Certain challenges must be addressed for the broader adoption of AI in healthcare. Implementing AI systems in healthcare demands investments in technology, infrastructure, and personnel [12]. Moreover, healthcare leaders may resist embracing AI due to concerns about job displacement, privacy, security issues, and liability concerns. The existing gaps in regulations surrounding the development and use of AI in healthcare could potentially impede the adoption of these technologies [13]. Nevertheless, artificial intelligence is believed to hold potential in improving patient outcomes, reducing costs, and driving changes. It has the potential to aid in disease management by identifying patients who would benefit from care and serving as an early warning system for potential complications or side effects, ultimately leading to long-term cost savings.

The economic impact of AI on healthcare is a significant consideration given the escalating healthcare costs worldwide [14] [15]. To ensure the effective utilization of healthcare resources, it is crucial to comprehend both the costs and benefits associated with implementing AI systems. This literature review aims to consolidate evidence on the outcomes of applying AI technologies in clinical settings and to synthesize evidence from economic evaluations and cost analyses of AI applications in healthcare in order to understand potential cost savings and efficiency gains associated with adopting such technologies. The findings will provide insights for stakeholders in healthcare such as providers, payers, and policymakers, regarding the value proposition of investing in these emerging technologies.

This paper follows a format consisting of introduction, methods, results, and discussion sections. The methods entail a review of published studies that analyze the costs and/or cost-effectiveness of AI systems compared to traditional care. The findings presented here provide a summary of the results from the reviewed studies, focusing on the economic impact. The discussion section explores the strengths, limitations, and recommendations for research based on the available evidence. The ultimate aim is to offer an understanding of the value associated with AI in healthcare and facilitate well-informed decision-making regarding the adoption and implementation of AI technologies.

2. Methods

2.1. Literature Search Strategy

We designed a comprehensive strategy for our literature search. The focus was

mainly on developments after the recent hype of AI. So, we ensured that recent and relevant studies on how artificial intelligence (AI) impacts healthcare economically were collected, thus, focusing on publications from 2020 to 2023. Our search encompassed three databases: PubMed, Scopus, and Google Scholar. These databases were selected due to their coverage of health and economic literature.

Our search strategy involved using a combination of keywords and MeSH terms (for PubMed) related to "Artificial Intelligence", "Economics", "Healthcare", and "Cost Evaluation". This approach generated combinations of search terms such as "Artificial Intelligence AND Economics AND Healthcare", as well as "AI AND Cost Evaluation AND Healthcare". We did not limit our search based on publication type or geographical location to ensure a broad perspective. However, we did restrict our search to English language studies, articles, and reports. The search results were imported into a reference management software. In this software, we removed any duplicate citations. Then we carefully reviewed the remaining citations to determine if they should be included in the review.

2.2. Inclusion and Exclusion Criteria

To decide which articles to include or exclude, we first screened the titles and abstracts of the identified articles. We concentrated on articles that discussed or mentioned the economic impact of AI in healthcare, including its cost-effectiveness or any cost-related implications. After this screening process, we retrieved the full texts of potentially relevant articles for a more detailed assessment.

During this detailed assessment stage, our inclusion criteria were studies that included a cost evaluation related to AI in healthcare. This could take forms such as cost-effectiveness analysis, cost-utility analysis, cost-benefit analysis, or cost-minimization analysis. Any studies that did not include a cost evaluation were excluded from consideration.

2.3. Data Extraction

Once we had determined which studies met our inclusion criteria, we used a data extraction form to extract information for our review. The form used for data extraction contained fields such as author(s), publication year, study location, study objective, AI technology investigated, healthcare area or disease studied, type of evaluation employed, key findings, and conclusions. The data from the included studies were extracted by two reviewers independently. Any discrepancies that arose were resolved through consensus or by seeking input from a third reviewer if needed. This approach aimed to ensure the accuracy and reliability of the extracted data.

2.4. Assessment of Quality

To assess the quality of the studies included in our review, we utilized the Criti-

cal Appraisal Skills Programme (CASP) Economic Evaluation Checklist [16]. This tool is specifically designed to evaluate the quality of economic evaluations. The checklist comprises 12 items that evaluate aspects such as the clarity of study objectives, adequacy of methodology used, validity of data sources utilized, appropriateness of analysis techniques employed, and relevance of findings obtained. Each study was classified as either "high", "medium", or "low" quality based on the scores obtained for these items. Two reviewers conducted the quality assessments, with any disagreements resolved through consensus or consultation with a third reviewer if necessary. By employing this process for quality assessment, we aimed to ensure reliability and credibility in our review.

3. Results

The literature review has identified studies and reports discussing the economic impact of artificial intelligence (AI) on healthcare. The initial screening yielded 28 studies and reports. After excluding those with no mention of any economic or cost implications of AI on healthcare, the search resulted in 16 studies. The full text screening yielded 10 studies that directly discussed, as a primary or secondary aim of the study, the economic impact of AI in healthcare, which varied in its evaluations from simple cost analysis to advanced cost modelling. The following are the findings of the literature review. **Figure 1** below illustrates the literature review steps and results.

3.1. AI Cost-Saving in Healthcare

A report by researchers from McKinsey and Harvard suggests that the implementation of AI in healthcare could save the United States up to $360 billion annually. The researchers predict that AI adoption could reduce healthcare spending by 5% to 10%, resulting in savings ranging from $200 billion to $360 billion [17]. These estimates are predicated on AI applications using existing technologies within five years without compromising quality or accessibility. Private payers could potentially save approximately 7% to 9% of their expenses, equating to $80 billion to $110 billion in annual savings over the next five years. Physician groups, on the other hand, could save between 3% and 8% of costs, equivalent to savings ranging from $20 billion to $60 billion within the next five years [17]. By leveraging AI-based systems, inefficiencies can be minimized, leading to a cost-effective healthcare ecosystem. Additionally, organizations can utilize AI technology to maximize their return on investment (ROI) [18].

Additionally, Nikhil Sahni and colleagues have estimated that wider implementation of AI in healthcare could result in savings of 5 to 10 percent in US healthcare spending, equivalent to $200 billion to $360 billion annually in 2019 dollars. These estimates are predicated on use cases utilizing technologies achievable within the next five years without compromising quality or accessibility. The article also includes case studies and explores strategies for overcoming challenges associated with implementing AI in healthcare. The authors conclude that the adoption of AI in this field could yield financial benefits such

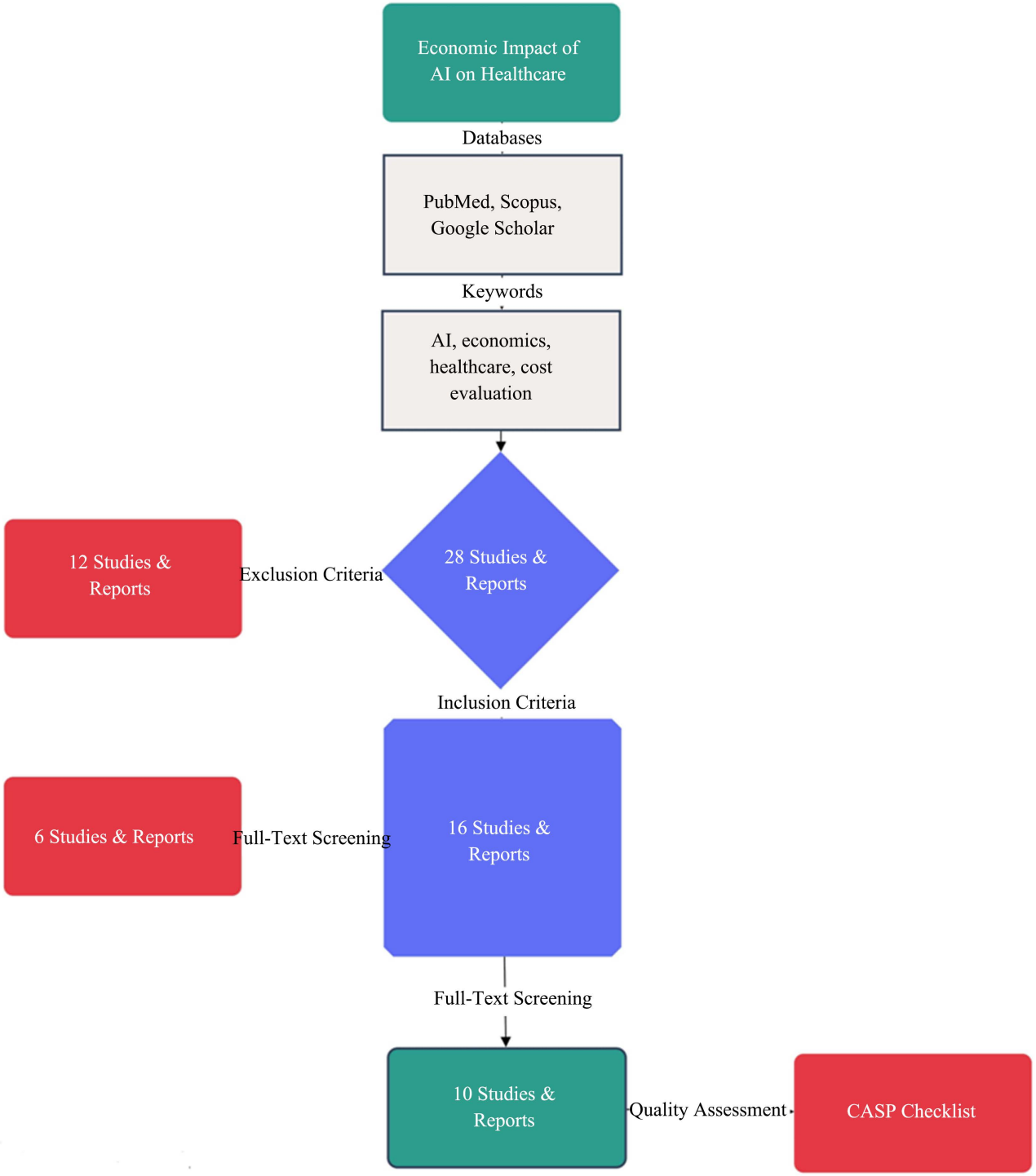

Figure 1. Literature search strategy flowchart.

as enhanced healthcare quality, increased accessibility, improved patient experience, and greater satisfaction among clinicians [19].

3.2. AI in Ophthalmology

A research study examining the integration of AI and telemedicine in ophthal-

mology found that merging these technologies can result in cost savings. After auditing 5456 eye visits, it was estimated that 15% of urgent transfers and 24% of outreach consultations were suitable for telemedicine, leading to a cost reduction of $1.1 million [20].

Moreover, Ruamviboonsuk and others propose that AI has the potential to enhance quality and reduce costs in ophthalmology significantly. The study emphasizes that most economic data on AI in ophthalmology focus on retinopathy (DR) screening. However, some studies delve into the costs associated with AI software being classified as a medical device, including both research and development investment and ongoing maintenance expenses [21].

3.3. AI in Radiology

AI in radiology is also seen as having potential for improving healthcare efficiency. According to a study by Leeuwenthe *et al.*, the integration of AI in radiology shows promise in enhancing healthcare delivery and reducing expenses. The researchers outline six objectives that can benefit from AI implementation, including streamlining workflow, reducing reading time, minimizing the use of contrast agents and radiation dose, enabling early disease detection, enhancing diagnostic accuracy, and facilitating personalized diagnostics. The study suggests that AI can help achieve these objectives by optimizing efficiency, speeding up the interpretation process, reducing reliance on contrast agents and radiation dose levels, detecting diseases, improving diagnostic accuracy rates, and tailoring diagnostics to individual patients. However, it is important to note that there is still limited knowledge regarding how AI impacts healthcare quality, efficiency, and costs [22].

3.4. Treatment vs. Diagnosis

In an analysis exploring the cost-effectiveness of AI applications in medicine, researchers found a disparity between studies demonstrating cost-effectiveness in treatment compared to those focusing on diagnosis. Nevertheless, they discovered that utilizing AI for screening colonoscopies can serve as a cost-saving strategy for preventing colorectal cancer. Furthermore, AI's cost-effectiveness has been extensively examined for its potential to enhance diagnosis, streamline screening processes, and optimize laboratory tests and surgical appointments. The cost-effectiveness of AI heavily relies on assumed treatment effects following diagnosis. It is particularly sensitive to the fees associated with AI usage. In summary, it is revealed that while the cost-effectiveness of AI in healthcare has been widely investigated, the results are diverse, and the potential for cost savings with AI varies depending on use cases and assumed treatment effects after diagnosis [23].

In terms of comparing diagnosis with treatment using an AI driven model, a study suggests that saving time in treatment procedures directly translates into cost savings. However, there are studies demonstrating the cost-effectiveness of

treatment compared to those focusing on efficiency. Although specific figures or results regarding cost savings are not provided by the study [24].

3.5. AI in Decision Support System

Rossi and others analyzed the "Cost-effectiveness of Artificial Intelligence as a Decision Support System Applied to the Detection and Grading of Melanoma, Dental Caries, and Diabetic Retinopathy" by utilizing data from three Markov models used in studies on cost-effectiveness. These models were adjusted to compare AI against standard care in detecting melanoma through skin photographs, dental caries through radiographs, and diabetic retinopathy through fundus imaging. The findings indicate that in dermatology, AI exhibited costs of $750 (with a 95% confidence interval ranging from $608 to $970) while yielding 86.5 quality-adjusted life years (QALYs) (with a 95% confidence interval between 84.9 - 87.9 QALYs). In comparison, standard care showed higher costs but fewer QALYs. The findings suggest that AI can effectively detect and assess melanoma, dental caries, and diabetic retinopathy at a lower cost compared to standard care [25].

3.6. AI in Intensive Care Units (ICUs)

Finally, a recent study investigated the cost-effectiveness of a machine learning prediction model called Pacmed Critical (PC) compared to care for patients in ICUs. The study used a 1-year 7-state Markov model that reflected the ICU care pathway and incorporated the PC decision tool. The findings demonstrated that PC was a cost-effective strategy and continued to be cost-effective when compared to standard care across various scenarios and sensitivity analyses. This study highlights the cost-effectiveness of PC for ICUs within a one-year timeframe, making it one of the pioneering analyses on the economic impact of machine learning devices [26].

Table 1 below outlines a classification of the ten studies and reports according to author(s) name, year of publication, study location, study objective, AI technology used, healthcare settings, type of economic evaluation, and key findings.

4. Discussion

This literature review aimed to explore existing evidence on how artificial intelligence (AI) affects healthcare costs. Our key findings indicate that AI has the potential to generate cost savings within the healthcare sector. For example, widespread implementation of AI could potentially reduce healthcare spending by 5% to 10%, saving up to US$360 billion annually in the United States alone. Furthermore, incorporating AI and telemedicine into ophthalmology was found to be a cost-effective approach, with potential annual savings amounting to $1.1 million. These findings seem consistent with results from numerous studies focusing on the economic impact of AI on healthcare, where some form of cost-saving was reported [24] [27] [28].

Table 1. Classification of literature review findings.

Author(s) Name	Publication Year	Study Location	Study Objective	AI Technology	Healthcare Area or Disease Studied	Type of Evaluation Employed	Key Findings
Pifer, R.	2023	United States	To estimate potential cost savings from implementing AI in healthcare	Not Specified	Healthcare system	Cost analysis	Implementation of AI could save: • The US healthcare system $200 - 360 billion annually. • Private payers between $80 - 110 billion annually. • Physician groups between $20 - 60 billion annually.
Spatharou *et al.*	2020	Europe	To explore how AI can support improvements in care outcomes, patient experience and access to healthcare services.	Various AI applications	Healthcare system	Cost analysis	AI can Minimize inefficiencies, create cost-effective healthcare ecosystem, and maximize return on investment.
Sahni *et al.*	2023	United States	To estimate potential impact of wider AI adoption on US healthcare spending	Various AI applications	Healthcare system	Cost analysis	Wider AI implementation could result in 5% - 10% savings in US healthcare spending annually.
Ramessur *et al.*	2021	Not specified	To examine cost impact of integrating AI and telemedicine in ophthalmology	AI and telemedicine	Ophthalmology	Literature Review	Integration led to 15% reduction in urgent transfers and 24% reduction in outreach consultations, saving $1.1 million
Ruamvibo-onsuk *et al.*	2021	Not specified	To discuss economic evaluations of AI in ophthalmology	AI software	Ophthalmology (retinopathy screening)	Literature review	AI could enhance quality and reduce cost
Leeuwenthe *et al.*	2022	Not specified	To discuss how AI improves efficiency and outcomes in radiology	Various AI applications relevant to radiology	Radiology	Literature review	AI shows promise in streamlining workflow, speeding interpretation, and improving accuracy and personalization.

Continued

Rossi *et al.*	2022	Not specified	To analyze cost-effectiveness of AI applications in medicine	Various AI applications	Healthcare system	Literature review	Results are diverse. Cost-effectiveness depends on use cases and assumed effects of diagnosis.
Khanna *et al.*	2022	Not specified	To evaluate AI technology in the context of healthcare costs, namely in the areas of diagnosis and treatment	Various AI applications	Diagnosis & treatment	Literature review	AI can save time for diagnosis & treatment which in turn results in cost-saving.
Rossi *et al.*	2022	Not specified	To analyze cost-effectiveness of AI as decision-support system for disease detection	AI models	dermatology, dentistry, and ophthalmology	Cost-effectiveness analysis using Markov models	AI can effectively detect and assess melanoma, dental caries, and diabetic retinopathy at a lower cost compared to standard care
De Vos *et al.*	2022	Not specified	To investigate cost-effectiveness of machine learning tool for ICU patients	Prediction model (Pacmed Critical)	Intensive care units	Literature Review	Pacmed Critical for ICE was a cost-effective strategy and continued to be cost-effective when compared to standard care

However, it is important to consider that the integration of AI in healthcare has faced obstacles like patients' and doctors' lack of trust, varied data, and conflicting incentives. Overall, while the potential for cost savings differs depending on the use case and underlying assumptions, there is evidence that embracing AI more widely could result in a more efficient healthcare system with reduced expenses.

This review's notable strength lies in its recency and coverage. By encompassing studies conducted after the recent AI hype and developments and from robust databases without limiting the search based on publication types or geographic locations, we were able to include a range of perspectives on the economic impact of AI in healthcare. This inclusive approach enabled us to capture an understanding of the financial benefits and operational efficiencies that can be achieved through implementing AI in healthcare. Moreover, our rigorous data extraction process and thorough quality assessment using the CASP Economic Evaluation Checklist ensured reliability and credibility, further bolstering the robustness of this review.

Furthermore, what sets this review apart is its focus on evaluating costs associated with AI in healthcare. The economic impact of AI on healthcare is a concern as global healthcare expenses continue to escalate. This review offers in-

sights for stakeholders considering investing in AI technologies in healthcare by focusing on the cost implications. Our findings shed light on the cost savings and efficiencies that can be achieved, aiding decision-making regarding the adoption and implementation of AI in healthcare.

However, it is important to acknowledge some limitations of this review. The variability in economic evaluation methods used across the included studies might have affected the comparability of our findings. While we encompassed different forms of evaluation, such as cost-effectiveness analysis, cost-utility analysis, cost-benefit analysis, or cost minimization analysis, it is worth noting that each method has its own strengths and weaknesses which may hinder direct comparison. Additionally, there was variation in the quality of studies included, which could have influenced the findings.

Another limitation is the lack of studies from middle-income countries. Our search primarily yielded studies from high-income countries, potentially limiting generalizability to settings. It is crucial to consider that implementing AI in healthcare might yield costs and benefits in middle-income countries due to variations in health systems and resources compared to high-income countries. Therefore, readers should interpret our findings with this context in mind.

5. Conclusion

In conclusion, this literature review offers an overview of the evidence regarding the economic impact of AI on healthcare. Our findings indicate that implementing AI has the potential to generate cost savings within the healthcare sector; however, we also underscore the challenges and limitations associated with its adoption. Strategically addressing these challenges and conducting research on the impact of AI in settings and countries will determine how much we can harness its potential to create a healthcare system that is both sustainable and value-oriented. These insights are crucial for stakeholders like healthcare providers, payers, and policymakers as they evaluate the benefits of investing in AI technologies. The significance of this research lies in its ability to inform decision-making and facilitate the use of healthcare resources amidst rising costs. Consequently, this review contributes to the ongoing discussion on the role of AI in healthcare and its potential economic effects.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

[1] Secinaro, S., Calandra, D., Secinaro, A., Muthurangu, V. and Biancone, P. (2021) The Role of Artificial Intelligence in Healthcare: A Structured Literature Review. *BMC Medical Informatics and Decision Making*, **21**, Article No. 125. https://doi.org/10.1186/s12911-021-01488-9

[2] Jiang, L., Wu, Z., Xu, X., Zhan, Y., Jin, X., Wang, L. and Qiu, Y. (2021) Opportuni-

ties and Challenges of Artificial Intelligence in the Medical Field: Current Application, Emerging Problems, and Problem-Solving Strategies. *The Journal of International Medical Research*, **49**, 1-11. https://doi.org/10.1177/03000605211000157

[3] Petersson, L., Larsson, I., Nygren, J.M., *et al.* (2022) Challenges to Implementing Artificial Intelligence in Healthcare: A Qualitative Interview Study with Healthcare Leaders in Sweden. *BMC Health Services Research*, **22**, Article No. 850. https://doi.org/10.1186/s12913-022-08215-8

[4] Turing, A.M. (1950) Computing Machinery and Intelligence. *Mind*, **LIX**, 433-460. https://doi.org/10.1093/mind/LIX.236.433

[5] Anyoha, R. (2017) The History of Artificial Intelligence. Science in the News. https://sitn.hms.harvard.edu/flash/2017/history-artificial-intelligence/

[6] Davenport, T. and Kalakota, R. (2019) The Potential for Artificial Intelligence in Healthcare. *Future Healthcare Journal*, **6**, 94-98. https://doi.org/10.7861/futurehosp.6-2-94

[7] Alia, O., Abdelbakib, W., Shrestha, A., Elbasib, E., Alryalat, M.A.A. and Dwivedi, Y.K. (2023) A Systematic Literature Review of Artificial Intelligence in the Healthcare Sector: Benefits, Challenges, Methodologies, and Functionalities. *Journal of Innovation & Knowledge*, **8**, Article ID: 100333. https://doi.org/10.1016/j.jik.2023.100333

[8] Bohr, A. and Memarzadeh, K. (2020) The Rise of Artificial Intelligence in Healthcare Applications. In: Bohr, A. and Memarzadeh, K., Eds., *Artificial Intelligence in Healthcare*, 25-60. https://doi.org/10.1016/B978-0-12-818438-7.00002-2

[9] Al Kuwaiti, A., Nazer, K., Al-Reedy, A., Al-Shehri, S., Al-Muhanna, A., Subbarayalu, A.V., Al Muhanna, D. and Al-Muhanna, F.A. (2023) A Review of the Role of Artificial Intelligence in Healthcare. *Journal of Personalized Medicine*, **13**, Article 951. https://doi.org/10.3390/jpm13060951

[10] Dave, M. and Patel, N. (2023) Artificial Intelligence in Healthcare and Education. *British Dental Journal*, **234**, 761-764. https://doi.org/10.1038/s41415-023-5845-2

[11] Dilmegani, C. (2021) Top 18 AI Use Cases in Healthcare Industry in 2023. AIMultiple. https://research.aimultiple.com/healthcare-ai-use-cases/

[12] Wahl, B., Cossy-Gantner, A., Germann, S. and Schwalbe, N.R. (2018) Artificial Intelligence (AI) and Global Health: How Can AI Contribute to Health in Resource-Poor Settings? *BMJ Global Health*, **3**, e000798. https://gh.bmj.com/content/bmjgh/3/4/e000798.full.pdf https://doi.org/10.1136/bmjgh-2018-000798

[13] McKee, M. and Wouters, O.J. (2023) The Challenges of Regulating Artificial Intelligence in Healthcare Comment on "Clinical Decision Support and New Regulatory Frameworks for Medical Devices: Are We Ready for It?—A Viewpoint Paper." *International Journal of Health Policy and Management*, **12**, 1-4. https://doi.org/10.34172/ijhpm.2022.7261

[14] Berwick, D.M., Nolan, T.W. and Whittington, J. (2008) The Triple Aim: Care, Health, and Cost. *Health Affairs*, **27**, 759-769. https://doi.org/10.1377/hlthaff.27.3.759

[15] Sunarti, S., Rahman, F.F., Naufal, M., Risky, M., Febriyanto, K. and Masnina, R. (2021) Artificial Intelligence in Healthcare: Opportunities and Risk for Future. *Gaceta Sanitaria*, **35**, S67-S70. https://www.sciencedirect.com/science/article/pii/S0213911120302788 https://doi.org/10.1016/j.gaceta.2020.12.019

[16] Critical Appraisal Skills Programme (2018) CASP Economic Evaluation Checklist. https://casp-uk.net/images/checklist/documents/CASP-Economic-Evaluation-Chec

klist/CASP-Economic-Evaluation-Checklist-2018.pdf

[17] Pifer, R. (2023) Artificial Intelligence Could Save Healthcare Industry $360B a Year. Healthcare Dive. https://www.healthcaredive.com/news/artificial-intelligence-healthcare-savings-harvard-mckinsey-report/641163/

[18] Spatharou, A., Hieronimus, S. and Jenkins, J. (2020) Transforming Healthcare with AI: The Impact on the Workforce and Organizations. McKinsey & Company. https://www.mckinsey.com/industries/healthcare/our-insights/transforming-healthcare-with-ai

[19] Sahni, N., Stein, G., Zemmel, R. and Cutler, D.M. (2023) The Potential Impact of Artificial Intelligence on Healthcare Spending. NBER Working Paper No. 30857. http://www.nber.org/papers/w30857 https://doi.org/10.3386/w30857

[20] Ramessur, R., Raja, L., Kilduff, C.L.S., Kang, S., Li, J.O., Thomas, P.B.M. and Sim, D.A. (2021) Impact and Challenges of Integrating Artificial Intelligence and Telemedicine into Clinical Ophthalmology. *Asia-Pacific Journal of Ophthalmology*, **10**, 317-327. https://doi.org/10.1097/APO.0000000000000406

[21] Ruamviboonsuk, P., Chantra, S., Seresirikachorn, K., Ruamviboonsuk, V. and Sangroongruangsri, S. (2021) Economic Evaluations of Artificial Intelligence in Ophthalmology. *Asia-Pacific Journal of Ophthalmology*, **10**, 307-316. https://doi.org/10.1097/APO.0000000000000403

[22] Van Leeuwen, K.G., de Rooij, M., Schalekamp, S., van Ginneken, B. and Rutten, M.J.C.M. (2022) How Does Artificial Intelligence in Radiology Improve Efficiency and Health Outcomes? *Pediatric Radiology*, **52**, 2087-2093. https://doi.org/10.1007/s00247-021-05114-8

[23] Gomez Rossi, J., Feldberg, B., Krois, J. and Schwendicke, F. (2022) Evaluation of the Clinical, Technical, and Financial Aspects of Cost-Effectiveness Analysis of Artificial Intelligence in Medicine: Scoping Review and Framework of Analysis. *JMIR Medical Informatics*, **10**, e33703. https://medinform.jmir.org/2022/8/e33703 https://doi.org/10.2196/33703

[24] Khanna, N.N., Maindarkar, M.A., Viswanathan, V., Fernandes, J.F.E., Paul, S., Bhagawati, M., Ahluwalia, P., Ruzsa, Z., Sharma, A., Kolluri, R., Singh, I.M., Laird, J.R., Fatemi, M., Alizad, A., Saba, L., Agarwal, V., Sharma, A., Teji, J.S., Al-Maini, M., Rathore, V. and Suri, J.S. (2022) Economics of Artificial Intelligence in Healthcare: Diagnosis vs. Treatment. *Healthcare*, **10**, Article 2493. https://doi.org/10.3390/healthcare10122493

[25] Gomez Rossi, J., Rojas-Perilla, N., Krois, J. and Schwendicke, F. (2022) Cost-Effectiveness of Artificial Intelligence as a Decision-Support System Applied to the Detection and Grading of Melanoma, Dental Caries, and Diabetic Retinopathy. *JAMA Network Open*, **5**, e220269. https://doi.org/10.1001/jamanetworkopen.2022.0269

[26] De Vos, J., Visser, L.A., de Beer, A.A., Fornasa, M., Thoral, P.J., Elbers, P.W.G. and Cinà, G. (2022) The Potential Cost-Effectiveness of a Machine Learning Tool That Can Prevent Untimely Intensive Care Unit Discharge. *Value in Health*, **25**, 359-367. https://doi.org/10.1016/j.jval.2021.06.018

[27] Ali, O., Abdelbakib, W., Shrestha, A., Elbasib, E., Alryalat, M.A.A. and Dwivedi, Y.K. (2023) A Systematic Literature Review of Artificial Intelligence in the Healthcare Sector: Benefits, Challenges, Methodologies, and Functionalities. *Journal of Innovation & Knowledge*, **8**, Article ID: 100333.

https://doi.org/10.1016/j.jik.2023.100333

[28] Voets, M.M., Veltman, J., Slump, C.H., Siesling, S. and Koffijberg, H. (2022) Systematic Review of Health Economic Evaluations Focused on Artificial Intelligence in Healthcare: The Tortoise and the Cheetah. *Value in Health*, **25**, 340-349. https://doi.org/10.1016/j.jval.2021.11.1362