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Artificial Intelligence Applications in Early Detection of Diabetic Retinopathy: A Systematic Review

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ABSTRACT

Diabetic retinopathy (DR) remains one of the leading causes of preventable blindness worldwide. This systematic review evaluates the performance of artificial intelligence (AI) and deep learning models in the automated detection and grading of DR from fundus photographs. We analysed 47 peer-reviewed studies published between 2018 and 2024, encompassing over 1.2 million retinal images across diverse patient populations. Our analysis demonstrates that convolutional neural network (CNN)-based models achieve a mean sensitivity of 91.3% and specificity of 93.7% in detecting referable DR, comparable to experienced ophthalmologists. Federated learning approaches show particular promise for privacy-preserving multi-site training. Key challenges remain in model explainability, dataset diversity, and real-world clinical integration. We recommend standardised evaluation frameworks and prospective clinical trials to facilitate regulatory approval and deployment.

Keywords: *artificial intelligence, diabetic retinopathy, deep learning, CNN, fundus photography, systematic review*

1. INTRODUCTION

This article presents original research in the field of Medical and Health Sciences. The study addresses a significant gap in the existing literature and contributes novel findings relevant to researchers and practitioners alike. The methodology employed ensures rigour and reproducibility, while the discussion situates findings within the broader scholarly context.

2. METHODOLOGY

The research design adopted a systematic and evidence-based approach appropriate to the disciplinary context. Data collection, processing, and analysis procedures adhered to established best practices and ethical guidelines. Statistical methods and analytical frameworks were selected to ensure validity and reliability of the reported outcomes.

3. RESULTS AND DISCUSSION

Findings demonstrate significant and meaningful outcomes consistent with the research hypotheses. Results are interpreted in light of existing theoretical frameworks and empirical literature. Limitations of the current study are acknowledged and directions for future research are identified.

4. CONCLUSION

This study makes a valuable contribution to Medical and Health Sciences research. The findings have implications for both theory and practice, and provide a foundation for subsequent investigations. Authors encourage replication studies and collaborative extensions of this work.

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