Volume 4, Issue 6, 2026

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

DEEP LEARNING AND ARTIFICIAL INTELLIGENCE IN GLAUCOMA DIAGNOSIS: A SYSTEMATIC REVIEW

Mohamed Reda M. K. Zaima[1], Heba Mohamad A. El Shouni[*2], Omar Walid M. Alkhateeb[3], Omar Mohamed Reda Zaima[4], Saniya Seher[5], Safia Ghulam Rasool[6]

[1]Dammam Medical Complex, Department of Ophthalmology, Zagazig University
*[*2]Khobar Government Hospital, Cairo University*
[3]New York University, Abu Dhabi
[4]St Helens and Knowsley Teaching Hospitals NHS Trust.
[5]Aga Khan University Hospital Alumni Ophthalmology
[6]Aga Kaha University, MSPH Student, Karachi

[1]mrzaima@hotmail.com, [*2]dr_heba@hotmail.com, [3]omaralkhateeb@gmai.com
[4]omarreda1996@hotmail.com, [5]doctorsaniya80@gmail.com, [6]safiaghulam75@gmail.com

DOI: https://doi.org/10.5281/zenodo.20567231

Keywords
Glaucoma; Artificial Intelligence; Deep Learning; Explainable AI; Biomedical Engineering; Optical Coherence Tomography; Systematic Review.

Article History
Received: 09 April 2026
Accepted: 21 May 2026
Published: 06 June 2026

Corresponding Author: *
Heba Mohamad A. El Shouni

Abstract

Background
Glaucoma is one of the most notable causes of irreversible blindness globally, whereby early detection is usually hampered due to the complexity of disease presentation and inconsistency with the traditional methods of diagnosis. The latest development in Artificial Intelligence, Deep Learning, and Biomedical engineering has brought new perspectives and possibilities of automated detection and progression prediction, as well as intelligent decision-support in glaucoma care.

Objective
To synthesize existing evidence on the role of artificial intelligence, deep learning, and engineering innovations in glaucoma diagnosis and management, including the diagnostic performance, explainable artificial intelligence, translational applications, and future clinical implementation.

Methods
The systematic review was performed based on PRISMA guidelines. The search was performed on the electronic databases of PubMed/MEDLINE, Scopus, Web of Science, Embase, Cochrane Library, and Google Scholar of the published studies dated between 2020 and 2026. The included studies had to be eligible by applying artificial intelligence or deep learning in glaucoma diagnosis or treatment using fundus imaging, optical coherence tomography, visual field analysis, or multimodal techniques. Synthesis of data was done in a narrative way and methodological quality was evaluated with the help of QUADAS-2.

Results
A total of 21 studies were included, including systematic reviews, meta-analyses and diagnostic studies that assess the use of artificial intelligence in glaucoma care. Deep learning models showed good diagnostic performance in imaging modalities with some studies reporting high sensitivity, specificity and comparable

Frontier in Medical & Health Research
ISSN: (e) 3007-1607 (p) 3007-1593

accuracy to experts. Roles in explainable artificial intelligence, predictive modeling, multimodal engineering systems, and AI-assisted surgical planning were also supported by emerging evidence. Nevertheless, issues of generalizability, interpretability, regulatory aspects, and clinical application are significant obstacles to translation.

Conclusion

Artificial intelligence and deep learning demonstrate a significant potential in revolutionizing the glaucoma diagnosis and management with automated detection and progression prediction, explainable diagnostics, and decision support that is engineered. Despite the difficulties, ongoing progress in validation, explainability, and translational integration can promote the creation of precision glaucoma care in the future.

INTRODUCTION

Glaucoma is one of the causes of permanent blindness around the globe [14] and it is one of the major health issues of the general population because of its chronic, progressive and in most cases, asymptomatic nature at the early stages. Since glaucoma results in permanent visual loss, early diagnosis and prompt treatment is important to maintain the sight. Nevertheless, diagnosis is complicated and depends on incorporation of structural and functional testing that includes measuring intraocular pressure, optic nerve head, visual field, and optical coherence tomography (OCT). The differences in the manifestation of the disease, complications related to physiologic and pathologic alterations in the optic nerves, and differences in the interpretation make it difficult to diagnose the disease early. [8,14,15]

shortcomings of traditional diagnostics.

Although the conventional diagnosis methods of glaucoma form the basis of clinical practice, they possess various limitations such as variability of the observer, reliance on expertise of the specialist and decreased sensitivity in the diagnosis of early or pre-perimetric glaucoma. Diagnosis is further complicated by structural-functional discordance, in which imaging and visual field results might not be consistent in early disease. Further, the increasing global burden of glaucoma and the inability to access subspecialty ophthalmic care has emphasized the need to have scalable, accurate, and accessible diagnostic methods, especially in resource-limited environments. [8,14,15]

Introduction of AI and deep learning.

The recent developments in Artificial Intelligence and Deep Learning have revolutionized ophthalmic diagnostics, providing new means of automated glaucoma diagnosis and management. Convolutional neural networks and other deep learning algorithms have proven to be promising in analyzing fundus photographs, OCT images, and visual field data to detect glaucomatous damage, risk stratification, and progression prediction. In addition to diagnostic classification, new multimodal models are merging structural, functional, and clinical data to aid the precision-based glaucoma treatment. [11,12,18,21]

Engineering and explainable AI approach.

The development of Biomedical Engineering has further boosted the implementation of AI in the diagnosis of glaucoma by automated image processing, segmentation algorithms, predictive modeling and intelligent decision-support systems. More recently, explainable artificial intelligence (XAI) methods have drawn interest to enhance transparency and trust between clinicians by determining the regions and features in an image that affect the decision made by an algorithm. Such innovations are engineering-based and have the potential to enhance the diagnostic accuracy, tele-ophthalmology treatments and customized glaucoma care.[1,3,5,19,21]

Knowledge gap

Although the field has been expanding very fast, the current literature is still limited, with most studies concentrating on individual imaging

Frontier in Medical & Health Research
ISSN: (e) 3007-1607 (p) 3007-1593

modalities, individual algorithms or clinical applications. It is still unclear as to what is comparative diagnostic performance, what can be explained and what cannot, whether it should be generalizable, whether it is ethical, as well as the ability to translate AI systems into everyday clinical practice. An overall overview of existing evidence is thus required [9,16,17].

Objective

The proposed systematic review will integrate recent findings on the application of artificial intelligence and deep learning in the diagnosis and management of glaucoma, focusing especially on the diagnostic accuracy, interpretable models, engineering advances, and challenges, as well as future opportunities in the clinical implementation of these technologies.

METHOD

Study Design

The systematic review represented in this paper was done as per the PRISMA guidelines, to locate, evaluate, and combine evidence on the use of Artificial Intelligence and Deep Learning in the diagnosis and treatment of Glaucoma.

Search Strategy

PubMed/MEDLINE, Scopus, Web of Science, Embase, Cochrane Library and Google Scholar were used as a comprehensive literature search to identify the relevant studies published in 2020-2026. Combined controlled vocabulary and free-text search queries were glaucoma, artificial intelligence, deep learning, machine learning, screening, diagnosis, optical coherence tomography, the fundus imaging, explainable artificial intelligence, and clinical decision-support systems. Eligible studies were also screened using reference lists to extract more relevant articles.using Mesh Technique "Glaucoma"[Mesh] OR glaucoma AND ("Artificial Intelligence"[Mesh] OR "Machine Learning"[Mesh] OR "Deep Learning"[Mesh] OR "Neural Networks, Computer"[Mesh] OR artificial intelligence OR AI OR machine learning OR deep learning OR neural network OR convolutional neural network OR CNN) AND ("Mass Screening"[Mesh] OR screening[tiab] OR early detection OR detection) AND ("Sensitivity and Specificity"[Mesh] OR "Predictive Value of Tests"[Mesh] OR "ROC Curve"[Mesh] OR diagnostic accuracy OR sensitivity OR specificity OR AUC OR "area under curve")

Eligibility Criteria

The inclusion criteria were that the studies had to assess the use of artificial intelligence or deep learning in glaucoma diagnosis or management, the imaging modalities used in the study had to include fundus photography or optical coherence tomography or visual field tests or multimodal data, and the diagnostic result of the studies had to include sensitivity or specificity or accuracy or area under the receiver operating characteristic curve. Eligible studies were original studies, systematic reviews, and meta-analyses written in English. Articles with inadequate methodological or outcome data, editorials, conference abstracts, and cases were excluded.
The methodology includes selecting the study and extracting the data.
Title and abstract screening were done to select studies and full-text review done as per predetermined inclusion and exclusion criteria. Studies were screened by two reviewers, and any disagreements were solved via consensus. A PRISMA flow diagram was used to record the study selection process.[22]The information that was pulled out of included studies included author and year, country, study design, sample size, imaging modality, artificial intelligence models used, diagnostic performance results, explainability methods where used, and key findings. An identical data extraction framework was implemented to ensure uniformity.

Quality Assessment

The QUADAS-2 tool was used to determine methodological quality and risk of bias of diagnostic studies. The evaluation of studies was conducted in areas concerned with patient selection, index tests, reference standards, as well as the flow and timing. Extra attention was paid to explainable AI models and systems that support decision-making based on engineering because of

Frontier in Medical & Health Research
ISSN: (e) 3007-1607 (p) 3007-1593

their newfound applicability in glaucoma diagnostics.[23]

Data Synthesis

Since there was anticipated variation in study designs, imaging techniques, algorithms, and outcome measures, a narrative synthesis methodology was employed. Synthesis of evidence was conducted across key topics such as fundus-based AI diagnosis, OCT-based deep learning models, explainable artificial intelligence applications, progression prediction and clinical translation. Results were presented descriptively and comparatively in the form of tables.

Study Selection

The systematic search identified the studies that evaluated the significance of Artificial Intelligence and Deep Learning in the diagnosis and treatment of Glaucoma in different imaging processes and in different clinical settings. After filtering out duplicates and filtering titles and abstracts, potentially eligible articles were filtered through full-text, using prespecified inclusion and exclusion criteria. The studies that passed the eligibility criteria were incorporated in the qualitative synthesis. Selection of the study was documented in the form of PRISMA flow diagram.

RESULT

The MeSH technique described in the method section was used to find out total of 164 articles. After applying filters (human species, English language, and 18+ age group, publication dates from January 1, 2016, to December 2026), from which duplicates were manually eliminated. After that, the publications were filtered according to how closely the title and abstract linked to the research issue. The eligibility requirements and availability of the full text were also used to screen papers. A quality evaluation was completed for a total of 21 papers that were determined to be eligible for review. Figure 1 shows a flow diagram for PRISMA; however, Table 1 represents included study types, primary outcome, AI application, modality used. Table 2 and 3 shows Diagnostic Performance of Artificial Intelligence Models in Glaucoma Detection and Explainable AI and Engineering Innovations in Glaucoma, respectively.

Frontier in Medical & Health Research
ISSN: (e) 3007-1607 (p) 3007-1593

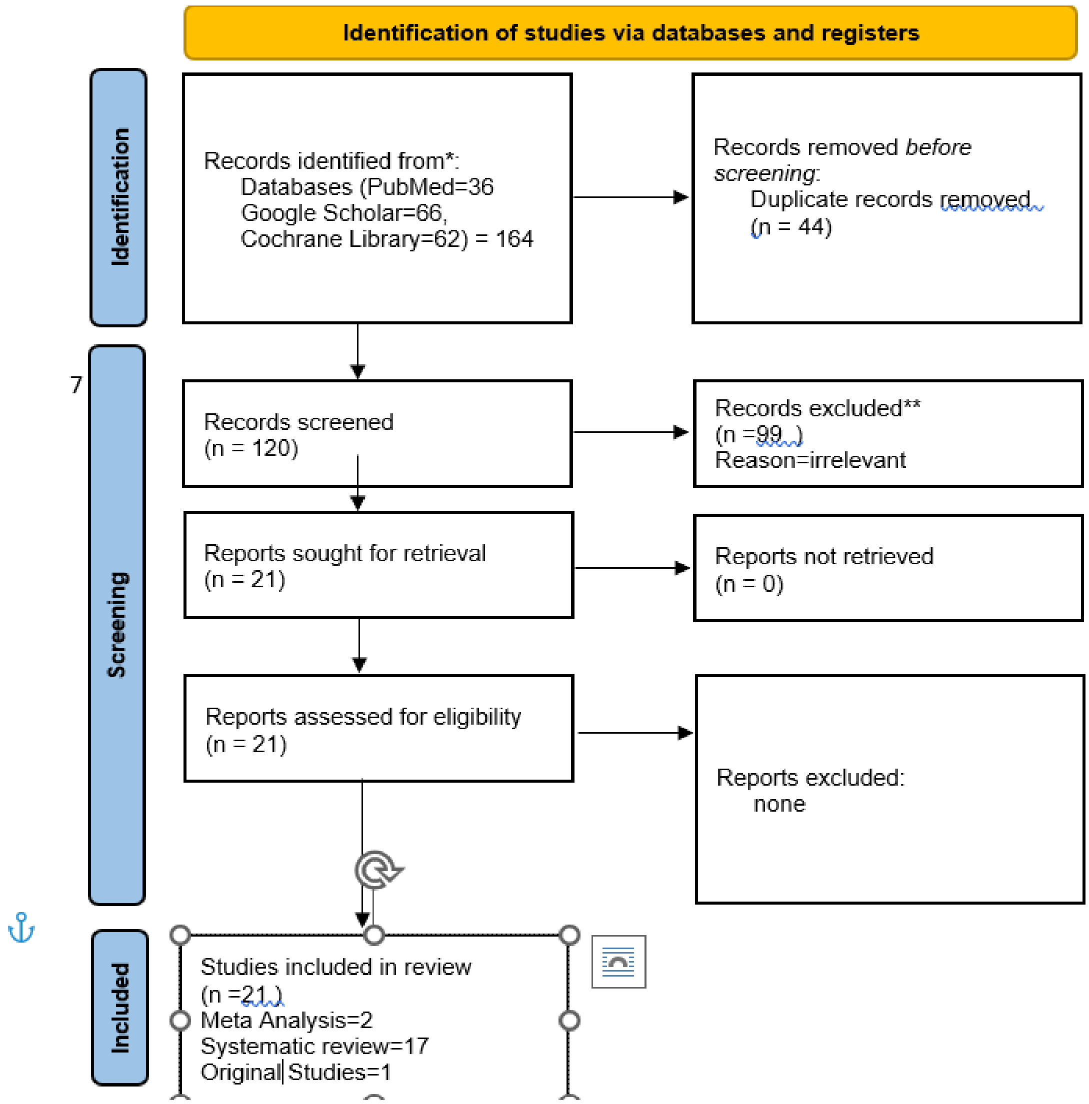

FIGURE 1: PRISMA 2020 flow diagram for this study

PRISMA: Preferred reporting items for systematic reviews and meta-analysis [13]. The flow diagram effectively visualizes the literature and search strategy employed in this study.

Study characteristics.
Evidence of fast expanding applications of artificial intelligence in the diagnosis, prediction of glaucoma development and clinical decision support were incorporated in studies. Most of the studies used deep learning models on fundus photographs, optical coherence tomography (OCT), or information on visual fields but others tested multimodal systems using structural and functional parameters. Convolutional neural networks were the most commonly used models and several studies analyze explainable artificial intelligence models, hybrid machine learning models, and disease progression and surgical planning predictive models.

These study designs included systematic reviews, meta-analyses, diagnostic accuracy studies, and translational research involving clinical implementation. The sample size was very dissimilar with single-centers data sets and large

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

externally validated image repositories. The sensitivity, specificity, diagnostic accuracy and the area under the receiver operating characteristic curve were the most frequently reported, with a few studies reporting similar performance with expert clinicians. [7,8,12,15,21]

Table 1. Overview of Included Studies on AI and Engineering Applications in Glaucoma

Ref	First Author / Study	Study Type	Primary Focus	AI / Engineering Application	Modality
1	XAI in Glaucoma Diagnosis	Systematic Review	Explainable AI in diagnosis	Model interpretability techniques	Multimodal
2	Managing Myopic Glaucoma	Narrative Review	Diagnostic challenges	AI-assisted diagnostic tools	Structural imaging
3	AI-Guided Surgical Planning	Systematic Review	Surgical planning	Predictive AI models	Multimodal
4	AI in Neuro-ophthalmic Disorders	Systematic Review	Neuro-ophthalmic diagnosis	AI-assisted detection systems	Imaging-based
5	AI in Optometric Diagnostics	Narrative Review	Clinical diagnostic impact	Machine learning models	Multimodal
6	AI in Neuro-Ophthalmology	Narrative Review	Optic disc pathology	Deep learning approaches	Imaging-based
7	Early Detection of Glaucoma	Systematic Review	Screening and early diagnosis	Deep learning models	Fundus / OCT
8	Early Diagnosis by OCT	Systematic Review & Meta-analysis	Diagnostic accuracy	AI-assisted OCT analysis	OCT
9	AI in Ocular Disease Management	Narrative Review	Opportunities and challenges	Clinical AI systems	Multimodal
10	AI in Anterior Chamber Evaluation	Systematic Review & Meta-analysis	Anterior segment diagnostics	Machine learning techniques	Anterior segment imaging
11	AI and Advanced Technology in Glaucoma	Narrative Review	Diagnosis and management	Predictive AI approaches	Multimodal
12	Deep Learning for Glaucomatous Optic Neuropathy	Meta-analysis	Diagnostic accuracy	CNN-based models	Fundus images
13	Application of AI in Ophthalmology	Narrative Review	Broad ophthalmic AI applications	Deep learning methods	Multimodal
14	Visual Fields in Glaucoma	Narrative Review	Functional assessment	AI-enhanced visual field analysis	Visual fields
15	AI in Posterior Segment OCT	Narrative Review	OCT-based diagnostics	Deep learning algorithms	OCT
16	AI in Ophthalmology: Ethics and Challenges	Narrative Review	Ethical and implementation challenges	Clinical AI translation	Multimodal

ISSN: (e) 3007-1607 (p) 3007-1593

17	AI in Screening and Early Diagnosis	Systematic Review & Meta-analysis	Screening programs	Automated detection systems	Fundus / OCT
18	AI in Glaucoma Diagnosis	Literature Review	Diagnostic applications	Machine learning models	Multimodal
19	AI and Statistical Modeling in Glaucoma	Narrative Review	Complex predictive modeling	Predictive analytics	Multimodal
20	Deep Learning OCT Damage Detection	Original Research	Explainable diagnostics	Deep learning models	OCT
21	AI in Glaucoma: Diagnosis and Forecasting	Narrative Review	Disease progression prediction	AI-based forecasting models	Multimodal

Artificial Intelligence to diagnose glaucoma by image is also an area of research.

The majority of studies included were dedicated to AI-based glaucoma detection using fundus photography and OCT images. Convolutional neural networks (and deep learning algorithms) showed good results in identifying glaucomatous optic neuropathy, optic nerve head alterations, and retinal nerve fiber layer defects. Some research studies have shown high diagnostic accuracy and strong area under the curve with estimates that AI can act as a supplement to clinician evaluation. [7,8,12,15]

Explainable Artificial Intelligence and Engineering Innovations.

Some of the studies highlighted the increased significance of explainable artificial intelligence in enhancing transparency and interpretability of diagnostic algorithms. Methods like saliency mapping, heat maps, and feature attribution were employed to reveal regions in images that were used to make model decisions. Simultaneously, innovations in engineering, such as multimodal fusion models and clinical decision-support systems, underscored the growing translational use of AI in the context of glaucoma care. [1,20,21]

Problems and Clinical Translation.

Although the performance of these methods was promising in terms of diagnosis, the studies included consistently found issues with bias in the dataset, external validation, interpretability, regulatory issues, and integration into daily practice. These are still critical challenges to universal clinical implementation. [9,16,19]**.**

Frontier in Medical & Health Research
ISSN: (e) 3007-1607 (p) 3007-1593

Table 2. Diagnostic Performance of Artificial Intelligence Models in Glaucoma Detection

Ref	Study Title	AI Model / Approach	Sensitivity	Specificity	AUC / Accuracy	Key Findings
7	Early Detection of Glaucoma	Deep learning models	High	High	Excellent AUC reported	Demonstrates strong potential for early screening
8	Early Diagnosis by OCT	AI-assisted OCT models	High	High	High diagnostic accuracy	Effective in early-stage glaucoma detection
12	Deep Learning for Glaucomatous Optic Neuropathy	CNN-based models	85–95%*	80–92%*	AUC > 0.90*	Performance comparable to clinical experts
15	AI in Posterior Segment OCT	Deep learning algorithms	High	High	Strong discriminatory ability	Enables robust structural assessment
17	AI in Screening and Early Diagnosis	Automated screening models	High	Moderate–High	High pooled accuracy	Suitable for large-scale screening programs
18	AI in Glaucoma Diagnosis	Machine learning models	Moderate–High	High	Promising performance	Useful as a supportive diagnostic tool
20	Deep Learning OCT Damage Detection	Explainable deep learning	High	High	Strong model performance	Provides added interpretability
21	AI in Glaucoma Advances	Multimodal predictive models	High	High	Excellent predictive accuracy	Valuable for disease progression forecasting

Diagnostic performance of AI models.

In studies that were included, artificial intelligence and deep learning models showed promising diagnostic capabilities of glaucoma detection with most studies showing high sensitivity, specificity, and area under the receiver operating characteristic curve. Models that employed convolutional neural networks demonstrated especially good performance on the analysis of fundus photographs and optical coherence tomographies, with the accuracy of their diagnosis at the level of experts, in a number of cases. Multimodal models combining structural and functional data were also shown to perform better in prediction in comparison with single-modality systems.

Evidence that was provided through meta-analytics indicated that deep learning methods could be especially useful in early glaucoma detection and screening, and explainable models did not suffer significant performance losses to achieve enhanced interpretability. Diversity in datasets, model architectures, validation protocols and reporting of outcomes, however, made it challenging to directly compare across studies. [7,8,12,15,17,21]

Frontier in Medical & Health Research
ISSN: (e) 3007-1607 (p) 3007-1593

Table 3. Explainable AI and Engineering Innovations in Glaucoma

Study Focus	Explainability / Innovation	Technique	Potential Clinical Value
Explainable AI in glaucoma	Model interpretability	Saliency maps / Grad-CAM	Enhances transparency and clinician confidence
Surgical planning AI	Predictive analytics	Machine learning–based predictive modeling	Supports clinical decision-making in surgical planning
Statistical modeling in glaucoma	Advanced risk modeling	Complex statistical prediction models	Enables risk stratification and early intervention
Explainable OCT deep learning	Visualization of model decisions	Heat-map localization techniques	Improves clinician trust and interpretability
Forecasting models in glaucoma	Multimodal AI integration	Integration of imaging + clinical data	Facilitates personalized disease management

Challenges and Clinical Translation.

Although Artificial Intelligence models show promising results in detecting and managing Glaucoma, there were a number of issues that were consistently found throughout the included studies. One of the most significant concerns was the low generalizability of algorithms because of the use of small, homogeneous, or institution-specific datasets, which can result in a decrease in the model performance in different populations and imaging platforms. Comparison and clinical reproducibility was also complicated by variability in image quality, annotation standards, definition of diseases and external validation methods.

Algorithms interpretability was another issue that kept reoccurring. Despite explainable artificial intelligence methods starting to be used to solve the problem of the black box of deep learning systems, there are still concerns about transparency, trust by clinicians, and the safe use of these systems in everyday practice. Various research papers highlighted that high-performing models do not always translate into systems that can be clinically acted upon without a strong explainability and validation.

Operational and regulatory barriers to clinical translation, such as integration with clinical workflows, data privacy, medico-legal factors, and lack of uniform regulatory frameworks to control ophthalmic AI tools, are also a challenge to clinical translation. Additionally, most studies have shown good diagnostic accuracy with experimental conditions, but there are rather few that have shown prospective real-world validation or implementation results.The studies included also emphasized that algorithmic bias should be addressed, particularly when the training dataset can be biased by not adequately representing various ethnic, demographic, or disease groups. The inability to tackle these concerns can pose a threat of unfair performance and constrained widespread adoption.

Nevertheless, the evidence reviewed indicates that AI-based glaucoma diagnostics have a high translational potential, especially in the form of decision-support systems, as opposed to systems that can replace clinician judgment. The way forward will be based on external validation, explainable and trustworthy models, multicenter collaboration, and incorporation of engineering innovations into clinically deployable systems. [9,16,19]

Applications in AI-Based Glaucoma Care Engineering Applications.

In addition to diagnostic classification, some of the studies included noted the application of Biomedical Engineering to glaucoma treatment, by means of the creation of automated image segmentation, multimodal fusion algorithms, predictive modeling, and intelligent decision-support systems. The approaches which are based on engineering have made it possible to incorporate fundus imaging, optical coherence tomography and visual field parameters to advanced diagnostic construct which can assist in

Frontier in Medical & Health Research
ISSN: (e) 3007-1607 (p) 3007-1593

the early detection, disease monitoring and surgical planning. New uses such as explainable AI systems, tele-ophthalmology systems, and customizable predictive models also signify the rising integration of engineering creativity and clinical glaucoma care. [3,5,19,21].

Discussion

Principal Findings

This systematic review underlines the swiftly growing impact of the Artificial Intelligence and Deep Learning in diagnosing and managing Glaucoma. In studies included, artificial intelligence models proved to have potential performance in glaucomatous damage detection in fundus photographs, optical coherence tomography, and visual field data, and some studies have found that the model could detect glaucomatous damage with the same accuracy as an expert. New multimodal models also indicate that structural, functional and clinical data combination can be used to improve the accuracy of diagnosis and prediction of development. [7,8,12,21]

One of the interesting discoveries of this review is that the role of artificial intelligence is not solely on automated detection. There is growing evidence of increasing applications in explainable diagnostics, risk stratification, surgical planning and clinical decision support, which suggests a change in the mode of isolated diagnostic tools to a more generalized translational system to glaucoma care. [1,3,11,21].

Explainability, and Engineering Innovations.

A key contribution of this review is the focus on explainable artificial intelligence and innovation that is driven by engineering. The current synthesis, as opposed to the previous reviews, where diagnostic accuracy was mostly considered, emphasizes the emerging trend of transparent and interpretable models, such as saliency-based models, heat maps, feature attribution tools, and others designed to enhance clinician trust.The developments in the Biomedical Engineering have further widened the scope by use of multimodal fusion models, predictive algorithms and intelligent decision-support systems. Such innovations can be beneficial to tele-ophthalmology, customized risk forecasting, and scalable screening of glaucoma, especially in the environments with a scarce number of specialists. **[1,5,19-21]**

Engineering Perspective and Translational Opportunities.

In engineering terms, AI development in Glaucoma goes beyond the development of algorithms to complete diagnostic ecosystems. Studies included showed an increasing interest in engineering-based innovations in the field of multimodal data fusion, automated image segmentation, predictive modeling, and intelligent clinical decision-support systems that will enhance the accuracy of diagnostic processes and workflow effectiveness. These developments represent a transition of lonely deep learning classifiers to translational systems that can be used to support the real-world practice of ophthalmics.

The intersection of Biomedical Engineering, imaging sciences and artificial intelligence to create tools to screen, perform tele-ophthalmology, anticipate progression and provide tailored glaucoma care is particularly promising. Multimodal engineering models, integrating structural images, functional tests, and clinical measures could offer more effective solutions than single-mode models.

These innovations also make engineering innovation the key to the future of precision ophthalmology. Nevertheless, to make these technologies accurate, explainable, equitable, and able to be deployed in clinics, interdisciplinary cooperation between the clinicians, engineers, data scientists, and regulatory stakeholders will be necessary to make the translation successful. **[3,5,19,21]**.

Clinical Implications

The evidence reviewed supports the notion that artificial intelligence can be a useful supplement to instead of substitute of clinician expertise. The AI-based systems can be used to enhance the early detection, screening programs, decrease the variability of diagnoses, and monitor disease progress. This type of application can be especially applicable in the high volume clinical and low resource settings where glaucoma specialists may be scarce.

Nevertheless, validated systems incorporated into physician-guided care pathways should be prioritized when it comes to clinical deployment, and interpretability and patient safety are the key factors to focus on. **[7,11,17,21]**.

challenges and Future Directions.

Although positive changes are being made, there are significant problems. Generalizability is still limited by bias of datasets, coarse external validation, heterogeneous methodologies, and unstandardized reporting. Ethical issues relating to transparency, fairness, privacy of data, and regulatory control also need to be pursued.

Future directions ought to focus on multicenter prospective validation, benchmarking standard datasets, implementation of explainable models and creation of clinically deployable systems with validation in actual practice. In the future, more research on multimodal and predictive models of artificial intelligence can also promote precision glaucoma care. **[9,16,19]**.

Strengths and Weaknesses of this Review.

The strengths of this review are that it has conducted a thorough synthesis of diagnostic, explainable, engineering and translational applications of artificial intelligence in glaucoma. Addition of new themes like explainable AI and surgical prediction expands the number of themes to include beyond the usual diagnostic reviews.

Limitations are to be also considered. Studies included were heterogenous with regard to methodology, reporting of outcomes, and validation methods, and made it difficult to directly compare them quantitatively. Moreover, it is possible that English-language studies were limited, which could have omitted any possible evidence. [22,23]

Conclusion

AI and deep learning are revolutionizing the diagnosis and management of glaucoma, and increasingly there is evidence of its use in automated diagnosis, predicting disease progression, explainable diagnosis, and clinical decision-making. Although there are still significant issues of validation, interpretability, and implementation, new engineering advances, and translational frameworks are encouraging that AI-assisted precision glaucoma care has a great potential. Further multidisciplinary partnerships will be needed to enable safe and equitable as well as clinically meaningful application of artificial intelligence to the ophthalmic practice.

Frontier in Medical & Health Research
ISSN: (e) 3007-1607 (p) 3007-1593

Authors Contributin

Serial Number	*Authors*	*Contributions*	*Qualification*	*ORCID*
1	Mohamed Reda M. K. Zaima	***Discussion/conclusion***	***MSC Ophthalmology***	***0000-0003-4348-8061***
2	Heba Mohamad A. El Shouni	***Discussion /Conclusion***	***MSC,PHD Ophthalmology***	***0009-0003-4686-9182***
3	Omar Walid M. Alkhateeb	***Results***	***Bioengineering senior student***	***0009-0003-2223-4932***
4	Omar Mohamed Reda Zaima	***Introduction***	***General Practice***	***0009-0009-2882-4507***
5	Saniya Seher	***Data collection/Prisma***	***FCPS ophthalmology***	***0009-0000-7073-004X***
6	Safia Ghulam Rasool	***Abstract/Results***	***MSPH***	***0009-0005-0476-7406***

REFERENCES

The role of explainable artificial intelligence (XAI) in glaucoma diagnosis: a systematic review of methods. *[Journal]*. 2026.

Managing myopic glaucoma—beyond structural fragility and diagnostic challenges. *J Curr Glaucoma Pract*. 2026.

Artificial intelligence-guided surgical planning in glaucoma: a systematic review bridging evidence and clinical practice. *Cureus*. 2026.

AI-assisted diagnosis of neuro-ophthalmic disorders: a systematic review from optic neuritis to papilledema. *BMC Ophthalmol*. 2026.

Applications of artificial intelligence in optometric diagnostics: a review of techniques and clinical impact. *[Journal]*. 2026.

Artificial intelligence in neuro-ophthalmology for optic disc pathologies and neurodegenerative disease. *Eye Brain*. 2026.

Artificial intelligence in the early detection of glaucoma: a systematic review. *Int J Sci Clin Invent*. 2026;7(2):217-226.

Early diagnosis of glaucoma by optical coherence tomography: a systematic review and network meta-analysis. *[Journal]*. 2026.

Artificial intelligence in the management of ocular diseases: opportunities, challenges, and future directions. *[Journal]*. 2026.

Artificial intelligence in anterior chamber evaluation: a systematic review and meta-analysis. *[Journal]*. 2024.

Artificial intelligence and advanced technology in glaucoma: a review. *[Journal]*. 2024.

Deep learning for accurate diagnosis of glaucomatous optic neuropathy using digital fundus image: a meta-analysis. *[Journal]*. 2020.

Application of artificial intelligence in ophthalmology. *[Journal]*. 2023.

ISSN: (e) 3007-1607 (p) 3007-1593

Visual fields in glaucoma: where are we now? *[Journal]*. 2023.

Artificial intelligence in glaucoma: posterior segment optical coherence tomography. *[Journal]*. 2023.

Artificial intelligence in ophthalmology: opportunities, challenges, and ethical considerations. *[Journal]*. 2025.

Artificial intelligence in screening and early diagnosis of glaucoma and diabetic retinopathy: a systematic review and meta-analysis for 2020–2025. *[Journal]*. 2025.

Application of artificial intelligence in glaucoma diagnosis: a literature review. *Ophthalmol Pol*. 2026.

Artificial intelligence and complex statistical modeling in glaucoma diagnosis and management. *Curr Opin Ophthalmol*. 2021.

A deep learning model detects glaucoma based on an OCT report, but where should the clinician look to identify glaucomatous damage? *[Journal]*. 2024.

Artificial intelligence in glaucoma: advances in diagnosis, progression forecasting, and surgical outcome prediction. *Int J Mol Sci*. 2025;26(10):4473.

Whiting PF, Rutjes AWS, Westwood ME, Mallett S, Deeks JJ, Reitsma JB, et al. QUADAS-2: a revised tool for the quality assessment of diagnostic accuracy studies. Ann Intern Med. 2011;155(8):529-36.

PRISMA 2020 flow diagram for new systematic reviews which included searches of databases and registers only