

## EARLY DETECTION OF GLAUCOMA AND MODERN TREATMENT APPROACHES: DIAGNOSIS, RISK FACTORS, AND INTRAOCULAR PRESSURE CONTROL

**Esanova Nafisa Alsharovna**

*Assistant, Termez Branch of Tashkent Medical University*

E-mail: [nafisaesanova1989@gmail.com](mailto:nafisaesanova1989@gmail.com)

Tel.: 994577775

**Karamatulloev Mamatali Umidovich**

E-mail: [mamadalikaramatullayev@gmail.com](mailto:mamadalikaramatullayev@gmail.com)

Tel.: 912319304

**ABSTRACT:** Glaucoma comprises a group of progressive optic neuropathies characterized by retinal ganglion cell loss, optic nerve damage, and irreversible visual field loss. Because early disease is frequently asymptomatic, timely detection is essential for preserving visual function. This article aims to synthesize major risk factors, diagnostic criteria, and contemporary management strategies for glaucoma. Evidence was reviewed from the World Health Organization (WHO), the National Institute for Health and Care Excellence (NICE), the European Glaucoma Society (EGS), and peer-reviewed articles indexed in PubMed. The evidence indicates that intraocular pressure is the principal modifiable risk factor for glaucoma onset and progression, but diagnosis should not rely on tonometry alone. A comprehensive assessment should include gonioscopy, optic nerve head evaluation, optical coherence tomography, and standard automated perimetry. Treatment is directed toward achieving an individualized target intraocular pressure and slowing structural and functional progression. Topical medication, selective laser trabeculoplasty, and surgical options should be selected according to glaucoma type, disease severity, progression rate, life expectancy, treatment tolerance, and adherence. Risk-based follow-up and improved adherence are central to reducing preventable irreversible visual loss from glaucoma.

**Keywords:** glaucoma, intraocular pressure, optic neuropathy, optical coherence tomography, perimetry, gonioscopy, selective laser trabeculoplasty, visual field.

### INTRODUCTION

Glaucoma is one of the most important chronic diseases in ophthalmology and is regarded as an optic neuropathy associated with the progressive loss of retinal ganglion cells and their axons. Its clinical significance lies in the fact that established optic nerve damage and visual field defects are generally irreversible. According to

WHO information updated in 2026, glaucoma is among the leading causes of distance vision impairment or blindness worldwide; glaucoma-related visual impairment or blindness affects millions of people [1].

The clinical spectrum of glaucoma is broad, with primary open-angle glaucoma and primary angle-closure glaucoma among the most common forms. Other forms include normal-tension glaucoma, pseudoexfoliative glaucoma, pigmentary glaucoma, secondary glaucoma, and congenital glaucoma. Although the mechanisms of disease development vary, intraocular pressure (IOP) remains the principal modifiable risk factor confirmed in major randomized clinical trials [2, 3].

One of the major challenges in glaucoma is the scarcity of subjective symptoms in the early and sometimes intermediate stages of the disease. Gradual loss of the peripheral visual field may be noticed late by the patient. Therefore, it is incorrect to base the diagnosis solely on complaints or on a single IOP measurement. Modern diagnostics relies on the combined assessment of the optic nerve head, retinal nerve fiber layer, ganglion cell complex, and visual field [4, 5].

Global epidemiological analyses have estimated the overall prevalence of glaucoma among people aged 40–80 years at approximately 3.54%. A classic projection model suggested that the number of people aged 40–80 years living with glaucoma could reach 111.8 million by 2040 [6]. Population aging, the widespread prevalence of diabetes and cardiovascular risk factors, disparities in access to medical care, and undiagnosed cases increase the burden of this disease on healthcare systems.

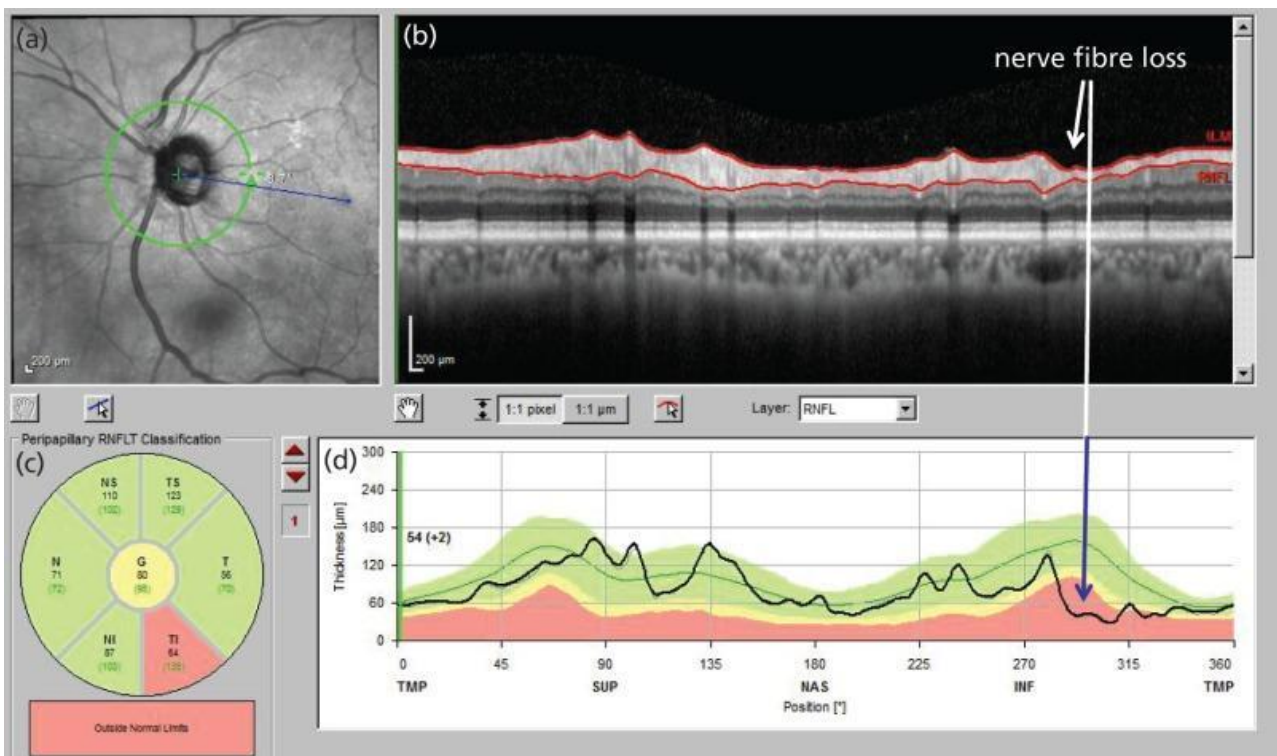
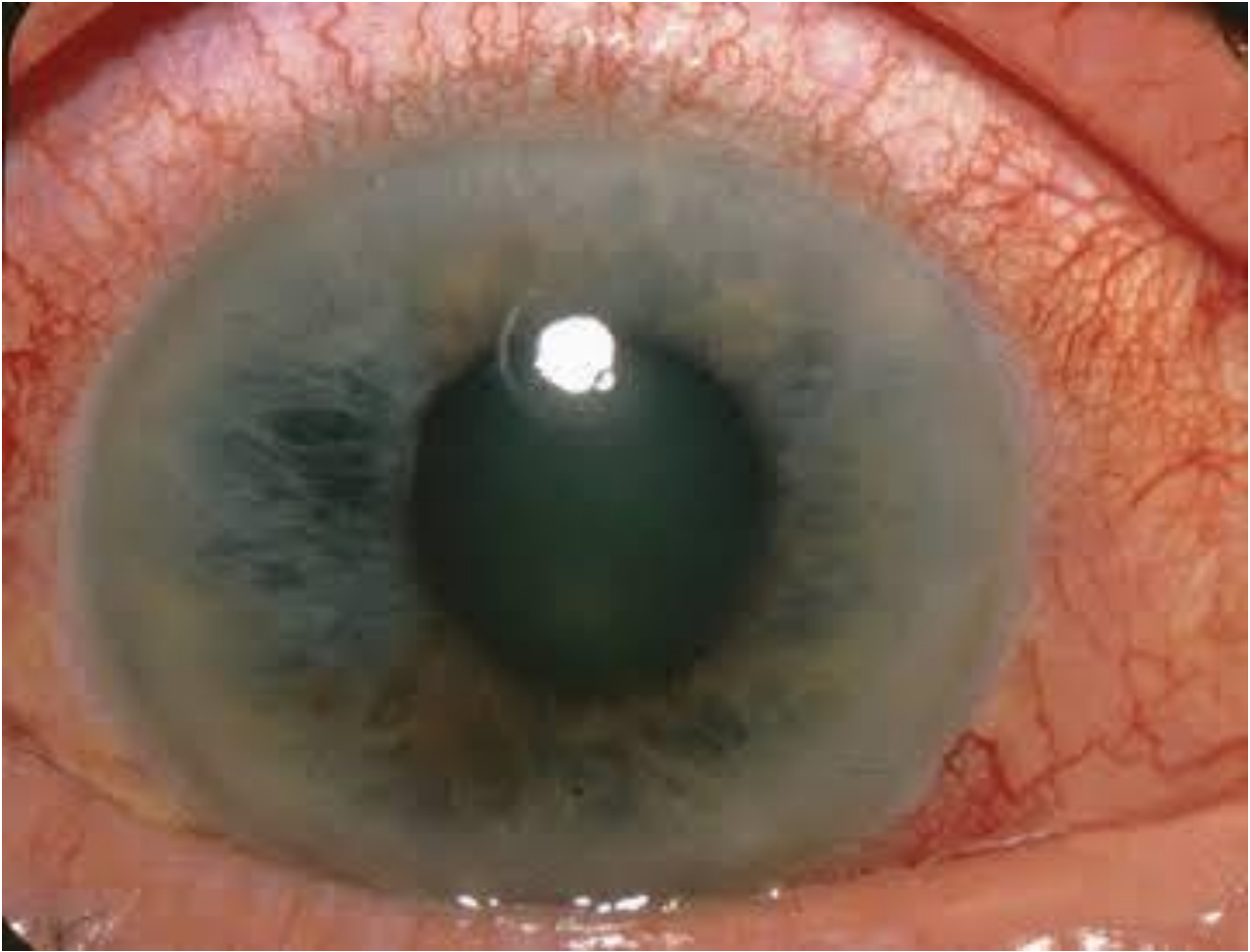
The aim of this article is to summarize, on the basis of evidence-based sources, the main risk factors involved in glaucoma pathogenesis, modern diagnostic algorithms, the concept of individualized target IOP, and medical, laser, and surgical treatment methods. The practical importance of assessing disease progression and improving patient adherence to treatment is also discussed.

## MATERIALS AND METHODS

This study was conducted as a structured narrative review. Priority was given to clinical guidelines, systematic reviews, meta-analyses, and major scientific articles devoted to the diagnosis and treatment of glaucoma. Official documents from the WHO, NICE, and the European Glaucoma Society, as well as publications indexed in PubMed, were reviewed as information sources.

The search used the keywords “glaucoma,” “primary open-angle glaucoma,” “angle-closure glaucoma,” “intraocular pressure,” “optical coherence tomography,” “visual field,” “selective laser trabeculoplasty,” “glaucoma surgery,” and “adherence,” as well as combinations of these terms. Clinically important data were extracted on disease definition, global burden, diagnostic examinations, the effect of IOP reduction

on progression, and treatment methods.



The findings were synthesized by topic: 1) epidemiology and risk factors; 2) minimum and extended diagnostic components; 3) assessment of progression; 4) IOP-lowering treatment; 5) laser and surgical methods; and 6) treatment adherence. No new patient cohort or experimental clinical data were generated in this article; all numerical data were taken from published sources.

## RESULTS

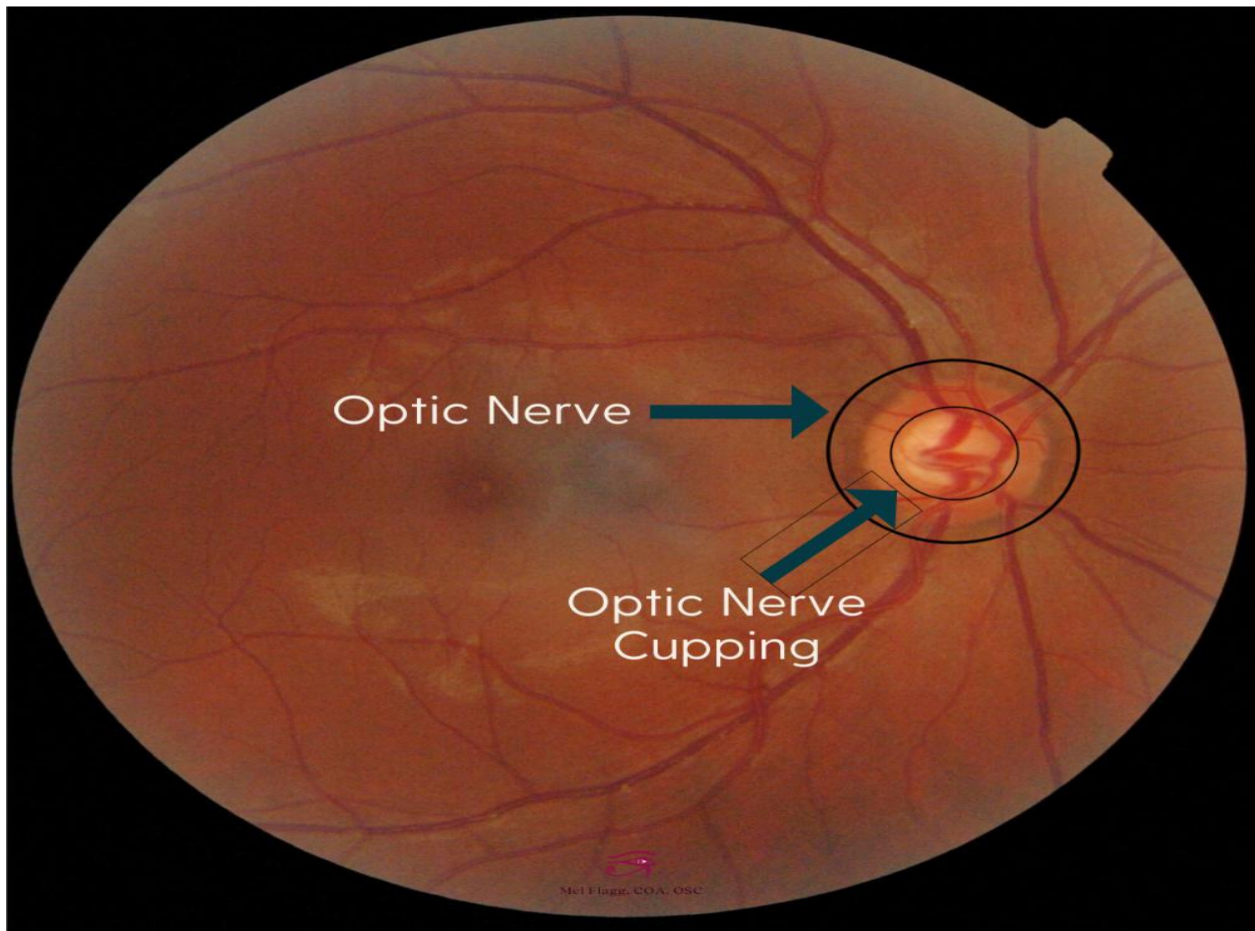
The analysis demonstrated the need for a comprehensive approach to glaucoma diagnosis. NICE recommendations for identifying chronic open-angle glaucoma and related conditions include standard automated perimetry, stereoscopic optic nerve head assessment, OCT or another imaging method where available, Goldmann-type applanation tonometry, and gonioscopic assessment of the anterior chamber angle [4]. Measurement of central corneal thickness is also important for interpreting IOP findings and assessing risk.

Intraocular pressure plays a central role in clinical decision-making, but glaucoma cannot be equated solely with elevated IOP. Normal-tension glaucoma demonstrates that glaucomatous optic neuropathy can develop even in patients whose IOP lies within the statistically “normal” range. Conversely, not every patient with ocular hypertension develops glaucoma. Structural and functional data must therefore be analyzed together.

OCT allows quantitative assessment of losses in the retinal nerve fiber layer and ganglion cell complex. Standard automated perimetry demonstrates functional damage. These two methods are not interchangeable: in early disease, structural changes may be detected before functional defects, whereas in advanced stages OCT may be limited in assessing progression because of the “floor effect.” Repeated examinations over time and trend analysis are therefore important components of

clinical

follow-up.



The primary goal of glaucoma treatment is to preserve an acceptable quality of life and visual function for the patient. This is often achieved by reducing IOP according to the individual risk profile. “Target IOP” is not a fixed universal number; it should be reassessed according to disease stage, baseline IOP, visual field damage, rate of progression, age, life expectancy, and other risk factors [2, 5].

Medical therapy includes prostaglandin analogues, beta-blockers, carbonic anhydrase inhibitors, alpha-2 agonists, and other IOP-lowering drug classes. When selecting a medication, efficacy should be considered together with cardiovascular and respiratory comorbidities, ocular surface status, adverse effects, the number of daily instillations, and the patient’s technical ability to administer drops. In chronic, often asymptomatic disease, poor adherence can substantially reduce treatment effectiveness [7].

Selective laser trabeculoplasty is an important option for lowering IOP in open-angle glaucoma and ocular hypertension and may also be selected as initial treatment in some patients. Surgical treatment is considered when target IOP is not achieved despite maximally tolerated conservative or laser therapy, when progression continues, or when very low IOP is required. Although trabeculectomy, drainage implants, and

minimally invasive glaucoma surgery serve the same clinical goal, they differ in IOP-lowering potency, risk profile, and indications.

A systematic review published in 2025 noted that data directly comparing the rate of visual field progression before and after IOP-lowering therapy at the individual level were limited. Nevertheless, in the available cohort, the rate of mean deviation decline slowed after treatment compared with the pretreatment period, and this change was associated with IOP reduction [8]. This finding reinforces the need to assess progression not only by a single IOP measurement but also by functional and structural changes over time.

**Table 1. Key examinations in glaucoma diagnosis and follow-up**

| Examination                    | Primary purpose                          | Strength                                               | Important limitation                                                          |
|--------------------------------|------------------------------------------|--------------------------------------------------------|-------------------------------------------------------------------------------|
| Goldmann applanation tonometry | Measure IOP                              | One of the clinical standard methods                   | IOP varies throughout the day; CCT and corneal biomechanics affect the result |
| Gonioscopy                     | Assess the anterior chamber angle        | Differentiates open-angle and angle-closure mechanisms | Operator-dependent                                                            |
| OCT                            | Assess RNFL/GCC and the optic nerve head | Quantifies early structural damage                     | Artifacts may occur in high myopia, media opacity, and advanced disease       |
| Standard automated perimetry   | Assess the visual field                  | Demonstrates functional damage and progression         | Affected by learning effect and patient cooperation                           |

| Examination                              | Primary purpose                            | Strength                       | Important limitation                     |
|------------------------------------------|--------------------------------------------|--------------------------------|------------------------------------------|
| Stereoscopic disc assessment/photography | Assess optic nerve cupping and hemorrhages | Allows documentation over time | Possibility of subjective interpretation |
| Pachymetry                               | Measure central corneal thickness          | Helps interpret IOP and risk   | Does not independently confirm glaucoma  |

## DISCUSSION

The reviewed sources show that a simplified “IOP measurement - diagnosis - treatment” approach is insufficient for glaucoma management. First, glaucoma is a progressive structural and functional disease of the optic nerve, and IOP is only one of its biological mechanisms, although it is the most clinically important and modifiable factor. Therefore, normal IOP does not exclude glaucoma, and elevated IOP does not automatically confirm it.

Second, early diagnosis depends on high-quality baseline documentation. Initial OCT and visual field results provide a reference point for subsequent examinations. It is incorrect to diagnose “progression” from a single result; measurement error, the learning effect in perimetry, OCT segmentation errors, and diurnal IOP variability must be considered. Clinical decisions should preferably be based on concordant structural and functional data obtained at multiple time points.

Third, the intensity of treatment should correspond to disease severity and the rate of progression. In mild, slowly progressing disease, excessively aggressive treatment may increase adverse effects and costs. Conversely, in rapidly progressing glaucoma or glaucoma threatening the central visual field, excessive reliance on “observation” may lead to irreversible visual loss. Thus, target IOP is a dynamic clinical parameter that should be redefined when new information becomes available.

Fourth, treatment does not end with prescribing medication. Incorrect drop instillation, forgetfulness, financial barriers, preservative-related ocular surface symptoms, and complex dosing regimens reduce adherence [7]. In clinical practice, checking instillation technique, simplifying the regimen, and explaining to the patient that glaucoma is progressive even when it is often asymptomatic should be integral components of treatment.

Fifth, laser and surgical methods should not be regarded as a “last resort,” but rather as part of the treatment arsenal tailored to individual risk and therapeutic goals. The patient’s clinical type, angle anatomy, previous operations, concomitant ocular disease, target IOP level, and quality of life influence treatment selection. From this perspective, although glaucoma management is algorithmic, it is not completely standardized and requires individualization.

A limitation of this review is that it is not a formal meta-analysis and does not present data from a new clinical cohort. Nevertheless, the combined analysis of current guidelines and major scientific publications clearly demonstrates the practical foundations of glaucoma diagnosis and management.

## CONCLUSION

1. Glaucoma is a progressive optic neuropathy that may lead to irreversible visual loss, and its effective management relies on early detection, individualized risk assessment, and long-term follow-up.

2. Diagnosis should not be based on intraocular pressure alone. Goldmann applanation tonometry, gonioscopy, central corneal thickness measurement, optic nerve head assessment, OCT, and standard automated perimetry are complementary examinations.

3. Lowering intraocular pressure is the principal evidence-based strategy for slowing glaucoma progression. Medications, selective laser trabeculoplasty, and surgical treatment are selected according to the patient’s clinical profile and target IOP.

4. Patient adherence, correct eye-drop technique, and compliance with scheduled follow-up examinations directly affect clinical outcomes. In glaucoma, the main practical goal is not to achieve a single “normal IOP” reading, but to preserve visual function throughout the patient’s lifetime.

## REFERENCES

1. World Health Organization. (2026, February 10). Blindness and vision impairment. WHO. <https://www.who.int/news-room/fact-sheets/detail/blindness-and-visual-impairment>
2. Jonas, J. B., Aung, T., Bourne, R. R. A., Bron, A. M., Ritch, R., & Panda-Jonas, S. (2017). Glaucoma. *The Lancet*, 390(10108), 2183–2193. [https://doi.org/10.1016/S0140-6736\(17\)31469-1](https://doi.org/10.1016/S0140-6736(17)31469-1)
3. Jayaram, H., Kolko, M., Friedman, D. S., & Gazzard, G. (2023). Glaucoma: now and beyond. *The Lancet*, 402(10414), 1788–1801. [https://doi.org/10.1016/S0140-6736\(23\)01289-8](https://doi.org/10.1016/S0140-6736(23)01289-8)

4. National Institute for Health and Care Excellence. (2022). Glaucoma: diagnosis and management (NICE Guideline NG81). Last reviewed March 26, 2025. <https://www.nice.org.uk/guidance/ng81>
5. European Glaucoma Society. (2021). Terminology and Guidelines for Glaucoma, 5th Edition. European Glaucoma Society.
6. Tham, Y. C., Li, X., Wong, T. Y., Quigley, H. A., Aung, T., & Cheng, C. Y. (2014). Global prevalence of glaucoma and projections of glaucoma burden through 2040: a systematic review and meta-analysis. *Ophthalmology*, 121(11), 2081–2090. <https://doi.org/10.1016/j.ophtha.2014.05.013>
7. Quaranta, L., Novella, A., Tettamanti, M., Pasina, L., Weinreb, R. N., & Nobili, A. (2023). Adherence and persistence to medical therapy in glaucoma: an overview. *Ophthalmology and Therapy*, 12(5), 2227–2240. <https://doi.org/10.1007/s40123-023-00730-z>
8. Naik, V., Ohri, S., Fernandez, E., Mwanza, J.-C., & Fleischman, D. (2025). Changes in individuals' glaucoma progression velocity after IOP-lowering therapy: A systematic review. *PLOS ONE*, 20(5), e0324806. <https://doi.org/10.1371/journal.pone.0324806>
9. Lauwers, A., Breda, J. B., & Stalmans, I. (2023). The natural history of untreated ocular hypertension and glaucoma. *Survey of Ophthalmology*, 68(3), 388–424. <https://doi.org/10.1016/j.survophthal.2022.12.001>
10. GBD 2019 Blindness and Vision Impairment Collaborators; Vision Loss Expert Group. (2021). Causes of blindness and vision impairment in 2020 and trends over 30 years. *The Lancet Global Health*, 9(2), e144–e160. [https://doi.org/10.1016/S2214-109X\(20\)30489-7](https://doi.org/10.1016/S2214-109X(20)30489-7)
11. Li, F., et al. (2022). Current situation and progress of drugs for reducing intraocular pressure. *Therapeutic Advances in Chronic Disease*, 13, 20406223221140392. <https://doi.org/10.1177/20406223221140392>
12. Weinreb, R. N., Aung, T., & Medeiros, F. A. (2014). The pathophysiology and treatment of glaucoma: a review. *JAMA*, 311(18), 1901–1911. <https://doi.org/10.1001/jama.2014.3192>