Factsheet
Glaucoma

CPPE
CENTRE FOR PHARMACY POSTGRADUATE EDUCATION

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Definition

Access *What is glaucoma?* on the Glaucoma UK website, which provides an easy-to-read overview of glaucoma.

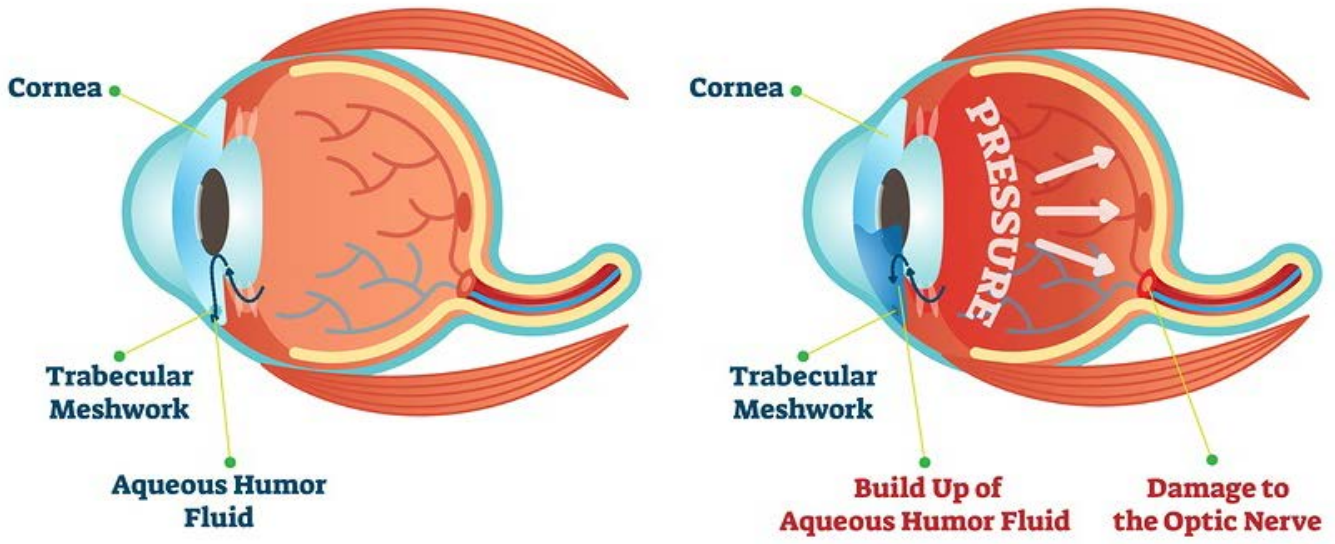
The National Institute for Health and Care Excellence (NICE) Clinical knowledge summary (CKS) of *Glaucoma* defines glaucoma as '*a group of eye diseases that cause progressive optic neuropathy, and in which intraocular pressure (IOP) is a key modifiable factor. Glaucoma is commonly associated with raised IOP and is characterized by:*

- *Visual field defects.*
- *Changes to the optic nerve head such as pathological cupping or, as a late sign, pallor of the optic disc.*

Ocular hypertension is where there is consistently or recurrently elevated IOP (greater than 21 mmHg) but with no signs of glaucoma.'[1]

The diagram below shows a normal eye (left) and an eye with glaucoma (right). The fluid inside the eye (aqueous humour) drains out through the pupil, around the iris and out of the eye through the trabecular meshwork (drainage channels).

When this process is disrupted, the pressure inside the eye can cause damage to the optic nerve, as described above. The optic disc is the area where the optic nerve enters the back of the eye. Pathological cupping and pallor of the optic disc are changes that can be seen when the back of the eye is examined in a person with glaucoma. It should be noted that some people develop normotensive glaucoma – glaucoma with an IOP below 21 mmHg.[2]



As per the NICE CKS of *Glaucoma*, there are several ways to classify glaucoma:

- '*Age of onset: congenital, infantile, juvenile, or adult.*
- *Cause: primary (no known cause) or secondary with a known underlying cause.*
- *Rate of onset: acute, subacute, or chronic.*
- *The anterior chamber angle between the iris and cornea: being either open or closed*'.[3]

Visit NICE CKS *Glaucoma: how is glaucoma classified?* to learn more about the different types of open and closed angle glaucoma. A more detailed description of the anatomy of the eye and open and closed angle glaucoma can be found under *Anatomy and physiology*.

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Prevalence and incidence

Ocular hypertension affects three to five percent of people in the UK over 40 years of age.[4]

Primary open angle glaucoma (POAG) is the most common type of glaucoma.[5] In the UK, it is estimated to affect about two percent of people older than 40 years. Prevalence increases with age and affects about eight percent of people over 80.

Primary angle closure glaucoma (PACG) affects around 130,000 people in the UK and about 0.4 percent of people over 40. Again, prevalence increases with age and PACG affects around 0.94 percent of those over 70. PACG is three times more common in women than in men.[4]

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Signs and symptoms

Open angle glaucoma and closed angle glaucoma present differently.

Open angle glaucoma

People with open angle glaucoma are normally asymptomatic initially and unaware of early peripheral vision loss. If uncontrolled, open angle glaucoma can cause more significant visual field loss and reduced central vision.

Closed angle glaucoma

Acute angle closure is an ocular emergency and symptoms develop suddenly. As per the NICE CKS of *Glaucoma*, typical signs and symptoms of acute angle closure include:

- '*Eye pain, often severe, and associated with headache, nausea, and vomiting caused by the pain.*
- *A red eye.*
- *Impaired visual acuity and lights are seen surrounded by halos – caused by a hazy oedematous cornea.*
- *Semi-dilated and fixed pupil. Classically, the pupil becomes fixed in a vertically oval shape.*
- *A tender, hard eye (palpate very gently). When measured by an optometrist or ophthalmologist, the intraocular pressure (IOP) is typically very high*'.[6]

Information about the symptoms of subacute angle glaucoma and chronic PACG can be found in the NICE CKS of *Glaucoma: how is primary angle closure glaucoma diagnosed?*

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Causes/risk factors

Open angle glaucoma

It is unclear why POAG develops; it is thought to be related to changes in the trabecular meshwork.[7]
Risk factors for POAG include:

- raised IOP
- increasing age
- family history and genetic factors
- black ethnicity
- corticosteroid use
- myopia (near-sightedness)
- *type 2 diabetes mellitus*
- *hypertension* and cardiovascular disease.[8]

Secondary causes of open angle glaucoma include:

- deposition of materials into the trabecular meshwork such as pigment, organelles, inflammatory cells and proteins
- the formation of new blood vessels, which block flow through the trabecular meshwork
- corticosteroids increasing the resistance to outflow of the aqueous humour through the trabecular meshwork.[7]

Closed angle glaucoma

PACG occurs in people who have an anatomical predisposition, meaning that their iris pushes onto the trabecular meshwork.[7]

Risk factors for PACG include:

- increasing age
- female gender
- Asian ethnicity
- hyperopia (farsightedness)
- family history and genetic factors.[8]

Secondary causes of angle closure glaucoma can occur as a result of various rare eye conditions.[7]

The NICE CKS pages contain more details about the causes and risk factors for glaucoma .

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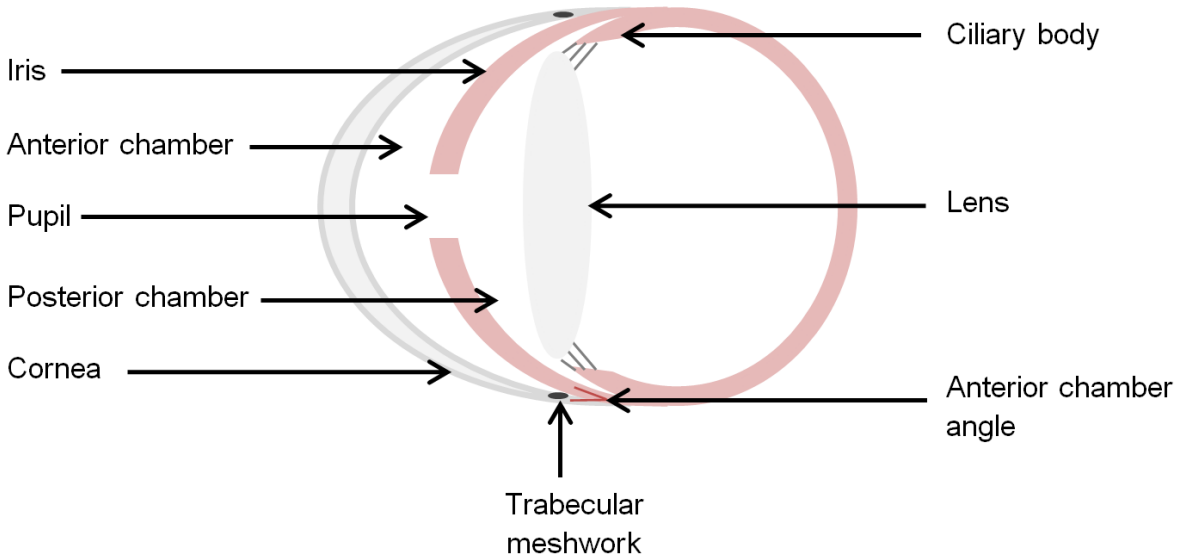
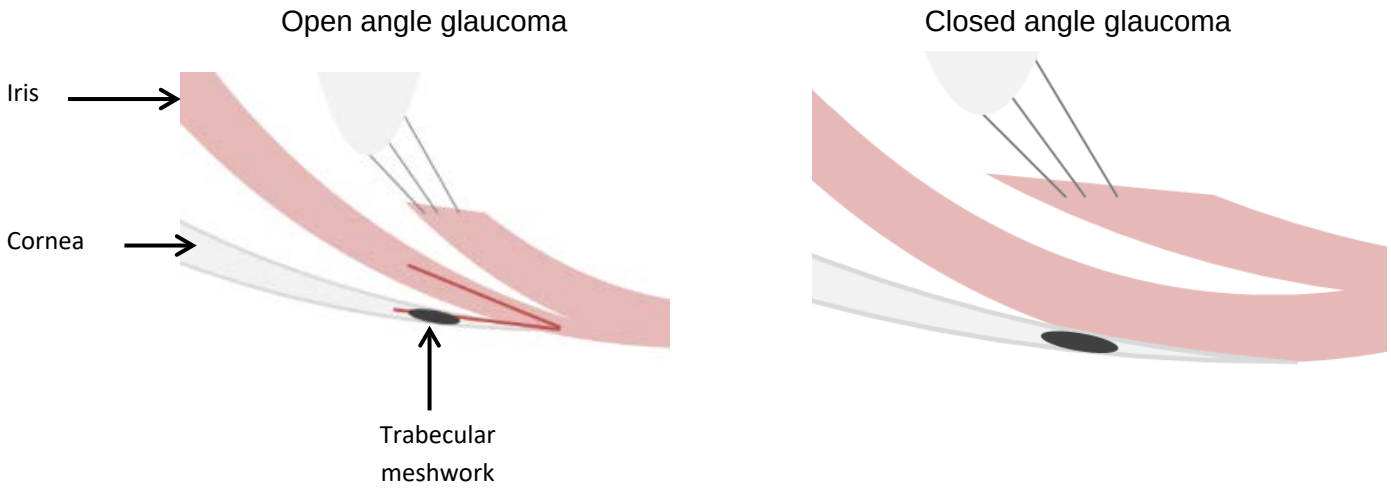
Pathophysiology (mechanism of disease)



In a healthy eye, aqueous humour (a clear fluid) is produced by the ciliary body behind the iris and secreted into the posterior chamber between the iris and lens. Secretion of aqueous humour is increased by stimulation of the beta-2 receptors and decreased by stimulation of the alpha-2 receptors of the sympathetic nervous system, which are located on the cells of the ciliary body. Carbonic anhydrase also plays a key role in the production of aqueous humour.

Aqueous humour passes out of the pupil and into the anterior chamber, between the cornea and iris. It then passes out of the eye primarily via the trabecular meshwork. A small percentage drains through the venous circulation of the iris, ciliary body and other structures in the eye. This is known as uveoscleral outflow.[2]

If the anterior chamber angle (between the iris and cornea) is normal, then the trabecular meshwork is exposed. If this angle is closed or partially closed, then the trabecular meshwork can become covered by the iris.



When the aqueous humour is unable to drain, either due to a closed anterior chamber angle obstructing the trabecular meshwork, or the anterior chamber angle being open but the trabecular meshwork being unable to drain due to another reason, glaucoma can develop.

IOP keeps the eye spherical and is maintained by a balance between aqueous humour production and outflow. Raised IOP is the main risk factor for developing glaucoma, as the raised pressure may damage the nerve fibres of the optic nerve. A pressure between 11 and 21 mmHg is considered normal; however, some people develop glaucoma at a pressure below 21 mmHg, and some people have pressures well above this level without showing signs of glaucoma.[2]

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Prognosis and complications

The risk of ocular hypertension developing into glaucoma depends on the severity of the IOP, corneal thickness and age, among other factors. If appropriately treated, the risk of glaucoma is reduced.

POAG usually progresses over several years; vision is lost peripherally at first, and then central vision may begin to be affected. Blindness develops in both eyes in around five to ten percent of people. All vision loss associated with glaucoma is irreversible.

PACG more commonly leads to blindness; however, if treatment is initiated early, outcomes are improved. If a fellow eye (eye that is not affected during the initial development of PACG) is left untreated, then there is a 40 to 80 percent chance of an acute episode of angle closure over the following five to ten years.[9]

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Diagnosis/detection

Signs of glaucoma and/or ocular hypertension may be picked up by the optometrist during an eye test. In ocular hypertension and POAG, the optometrist will usually refer the patient routinely to the ophthalmologist to make a formal diagnosis.[10, 11] Regular eye tests are available for certain groups of people; more information can be found on the *Free NHS eye tests and optical vouchers* page.

Acute angle closure leading to a rapid onset of symptoms is a medical emergency.[12, 13] It can be suspected in a person with an acute painful red eye and the symptoms listed above. If this is the case, then urgent specialist ophthalmology assessment and treatment are required.[14]

In the following Fight for Sight video, we meet Maureen and explore what it is like to receive a diagnosis of glaucoma:

Fight for Sight. Maureen's story living with glaucoma – Fight for Sight. 29 October 2015. **www.youtube.com/watch?v=dhGvAjKjxLU**

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Initial treatment

The intention of glaucoma treatment is to maintain a person's visual function and related quality of life. Currently, the only shown effective approach for maintaining visual function is reducing IOP.[15]

In January 2022, NICE published NG81: *Glaucoma: diagnosis and management*, which represents a significant change in the initial management of glaucoma. In Section 1.4, *Treatment*, it recommends that first-line treatment for any person diagnosed with ocular hypertension or early chronic open angle glaucoma is selective laser trabeculoplasty (SLT).[16]

The changes to the NICE guideline are based on a review of the evidence, which shows SLT to be as clinically effective and more cost efficient, while offering minimal side effects, when compared to pharmacological management.[17]

The exact mechanism of action for SLT is not fully understood; however, it is thought that the high-energy laser allows for increased aqueous outflow with a subsequent drop in intraocular pressure.[18]

Following successful treatment with SLT, patients still need to be monitored frequently by an ophthalmologist, as the treatment may need to be repeated.

If a person chose not to have SLT or if it is unsuitable, pharmacological management may be offered as a second-line treatment.[16]

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Pharmacological treatment

There are five main classes of medicines which are commonly used to treat glaucoma, all of which act to lower IOP:

- **Beta-blockers** are thought to reduce the amount of aqueous humour produced by the ciliary body and are effective in POAG. They are usually administered topically. Topical beta-blockers include betaxolol, levobunolol hydrochloride and timolol maleate.
- **Prostaglandin analogues and prostamides** increase uveoscleral outflow of aqueous humour and are used in ocular hypertension or open angle glaucoma. This group includes the topical prostaglandin analogues, latanoprost, tafluprost and travoprost, and the synthetic prostamide, bimatoprost.
- **Sympathomimetics** or selective alpha2-adrenoceptor agonists are thought to reduce aqueous humour production. This group includes brimonidine and apraclonidine. Brimonidone is also thought to increase outflow via the uveoscleral pathway.
- **Carbonic anhydrase inhibitors**, such as acetazolamide, brinzolamide and dorzolamide, inhibit carbonic anhydrase enzymes and reduce aqueous humour production. Acetazolamide is administered orally, and brinzolamide and dorzolamide are used topically.
- **Miotics**, such as pilocarpine, act by opening the inefficient drainage channels in the trabecular meshwork.[12, 15, 16]

For more information about the pharmacological treatment options for glaucoma, visit:

- British National Formulary (BNF) treatment summary: *Glaucoma and ocular hypertension*
- Section 1.4, *Treatment*, of NICE guideline [NG81]: *Glaucoma: diagnosis and management*
- Section 3.3, *Antiglaucoma drugs*, of the European Glaucoma Society (EGS)'s *Terminology and guidelines for glaucoma*

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Combination therapies and supporting people

If glaucoma is not controlled by monotherapy and a second eye drop is needed, a combination product should be offered before two separate eye drops. This helps people to use their eye drops as prescribed, reduces washout of the first eye drop by the second and reduces exposure to preservatives.[15]

The EGS's *Terminology and guidelines for glaucoma* covers combination therapies in Section 3.3.1.2, *Add second drug/combination therapy*.

The Moorfields Eye Hospital *Know Your Drops* campaign page includes a video explaining how to use eye drops and links to patient information.

The International Glaucoma Association (IGA) also offers the *Eye Drops and Dispensing Aids* booklet and a series of short films: *How to use eye drops*.

An IGA survey of over 1000 people with glaucoma showed that 45 percent had not been instructed how to use their eye drops, 91 percent were not assessed on their ability to use eye drops, and 50 percent were

not aware they should practise punctal occlusion (the process of gently pressing on the tear duct next to the nose after inserting the drop to reduce systemic absorption and, therefore, potential side effects).[19]

Pharmacy professionals can help patients get the most out of their eye drop treatment by providing information on how to use the eye drops and by emphasising the importance of punctal occlusion.
Eye irritation due to allergy, toxicity or inflammatory conditions can present as dry eye, burning/stinging, itching, irritation, tearing, foreign body sensation, red eye and blurred vision. This group of symptoms indicates ocular surface disease (OSD),[20] a term used to describe dry eye, eyelid disease, conjunctivitis and keratitis (inflammation of the cornea).[21]

Preservatives in eye drops have been linked to ocular surface changes, and referral to an ophthalmologist is recommended if an allergy to eye drops is suspected.[22, 23]

NICE recommends preservative-free eye drops for:

- ocular hypertension – if the person is at high risk of conversion to chronic open angle glaucoma (COAG) and has an allergy to preservatives or has clinically significant and symptomatic ocular surface disease
- COAG – if there is evidence that the person is allergic to preservatives or has clinically significant and symptomatic ocular surface disease.[16]

The EGS's *Terminology and guidelines for glaucoma* also offers recommendations on the use of preservative-free eye drops in Section 3.3.5, *Local toxicity of topical IOP – lowering treatment – the role of preservatives.*

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Patient support

Fight for Sight, the eye research charity, funds pioneering research to prevent sight loss and treat eye disease, and offers information about the eye, eye conditions and patient stories.

Sight Research UK is a leading eye research charity that funds research into the causes of and treatments of eye disease, sight loss and blindness, and offers information about eye conditions.

Sightline is a charity which provides practical and emotional support to blind and partially sighted people through a telephone helpline.

The NHS has a dedicated *Glaucoma* page.

Glaucoma UK is a charity for people with glaucoma. The charity provides information, literature and advice, and fund essential research to prevent unnecessary loss of sight through early detection, diagnosis and treatment. Glaucoma UK's **campaign** page links to previous and upcoming campaigns and resources.

The **Royal National Institute of Blind People** offers a *Glaucoma* information page and a helpline for those affected by sight loss.
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Further resources

PrescQIPP has launched a bulletin for eye preparations, which, along with the supporting resources, reviews the role of eye products in therapy, in particular products for glaucoma and dry eye. It offers guidance on prescribing, self-care and cost-effective treatments. Cost comparison charts across a range of areas are available as supporting resources.

The **College of Optometrists** offers clinical management guidelines for optometrists, which contain information on diagnosis and management, as well as lay summaries that may be useful for explaining glaucoma in a person-centred way:

- *Glaucoma (chronic open angle) (COAG)*
- *Primary angle closure/primary angle closure glaucoma (PAC/PACG)*
- *Steroid-related ocular hypertension and glaucoma*
- *Ocular hypertension (OHT)*

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External websites

CPPE is not responsible for the content of any non-CPPE websites mentioned on this page or for the accuracy of any information to be found there.

All web links were accessed on 24 May 2023.

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References

1. National Institute for Health and Care Excellence (NICE). Clinical knowledge summary (CKS): *Glaucoma: what is it?* March 2022. Revised February 2023.
2. National Institute for Health and Care Excellence (NICE). Clinical knowledge summary (CKS): *Glaucoma: what is the anatomy and physiology of the eye relevant to glaucoma?* March 2022. Revised February 2023.
3. National Institute for Health and Care Excellence (NICE). Clinical knowledge summary (CKS): *Glaucoma: how is glaucoma classified?* March 2022. Revised February 2023.
4. National Institute for Health and Care Excellence (NICE). Clinical knowledge summary (CKS): *Glaucoma: how common is it?* March 2022. Revised February 2023.
5. NHS. *Overview: glaucoma*. February 2021.
6. National Institute for Health and Care Excellence (NICE). Clinical knowledge summary (CKS): *Glaucoma: how is primary angle closure glaucoma diagnosed?* March 2022. Revised February 2023.
7. National Institute for Health and Care Excellence (NICE). Clinical knowledge summary (CKS): *Glaucoma: what are the causes of glaucoma?* March 2022. Revised February 2023.
8. National Institute for Health and Care Excellence (NICE). Clinical knowledge summary (CKS): *Glaucoma: what are the risk factors for developing primary glaucoma?* March 2022. Revised February 2023.

9. National Institute for Health and Care Excellence (NICE). Clinical knowledge summary (CKS). *Glaucoma: what is the prognosis?* March 2022. Revised February 2023.
10. College of Optometrists. *Glaucoma (chronic open angle) (COAG)*. Version 17. December 2022.
11. College of Optometrists. *Ocular hypertension (OHT)*. Version 9. December 2022.
12. National Institute for Health and Care Excellence (NICE). British National Formulary (BNF). *Glaucoma and ocular hypertension*. [No date].
13. College of Optometrists. *Primary angle closure/primary angle closure glaucoma (PAC/PACG)*. Version 16. June 2022.
14. National Institute for Health and Care Excellence (NICE). Clinical knowledge summary (CKS): *Glaucoma: scenario: acute angle closure and angle closure glaucoma*. March 2022. Revised February 2023.
15. European Glaucoma Society (EGS). *Terminology and guidelines for glaucoma*. 5th ed. EU: SvetPrint; 2017.
16. National Institute for Health and Care Excellence (NICE). NICE guideline [NG81]: *Glaucoma: diagnosis and management*. November 2017. Revised January 2022.
17. National Institute for Health and Care Excellence (NICE). NICE guideline [NG81]: Glaucoma: diagnosis and management – [A] Evidence reviews for selective laser trabeculoplasty in ocular hypertension or chronic open-angle glaucoma adult patients. January 2022.
18. Latina MA, Park C. Selective targeting of trabecular meshwork cells: in vitro studies of pulsed and CW laser interactions. *Exp Eye Res*. 1995;60(4): 359–371. DOI: 10.1016/s0014-4835(05)80093-4. PMID: 7789416.
19. Mann E. *Glaucoma: treatment of open angle glaucoma and ocular hypertension*. *The Pharmaceutical Journal.* May 2015.
20. Stewart WC, Stewart JA, Nelson LA. *Ocular surface disease in patients with ocular hypertension and glaucoma*. *Current Eye Research.* 2011;36(5): 391–398.
21. Leung EW, Medeiros FA, Weinreb RN. *Prevalence of ocular surface disease in glaucoma patients*. *Journal of Glaucoma.* 2008;17(5): 350–355. DOI: 10.1097/IJG.0b013e31815c5f4f
22. Steven DW, Alaghband P, Lim KS. *Preservatives in glaucoma medication*. *British Journal of Ophthalmology.* 2018;102(11): 1497-1503. DOI: 10.1136/bjophthalmol-2017-311544.
23. National Institute for Health and Care Excellence (NICE). Clinical knowledge summary (CKS). *Glaucoma: scenario: primary open angle glaucoma and intraocular hypertension*. March 2022. Revised February 2023.

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