Original Article

Factors influencing glaucoma medication adherence: A qualitative study of patients and ophthalmologists in India

Deborah Bott, Sirisha Senthil[1], Ahalya Subramanian, David F Edgar, John G Lawrenson, Peter Campbell

Purpose: Adherence to glaucoma medication helps prevent disease progression. Barriers to adherence exist, particularly in low- and middle-income countries. We explored factors influencing medication adherence from the perspectives of patients and ophthalmologists in India. **Design:** Cross-sectional, qualitative study. **Methods:** Semi-structured interviews with a purposive patient sample prescribed intraocular pressure (IOP)-lowering eyedrops and ophthalmologists involved in glaucoma care at a tertiary center. The theoretical domains framework (TDF) of behavior change guided deductive and inductive thematic analysis of interview transcripts to identify personal, sociocultural, and environmental influences on adherence. **Results:** Twenty-two participants (n = 11 patients, n = 11 ophthalmologists) were recruited. Seven TDF domains were key to patient adherence and practitioner management. Patient barriers mapped to TDF domains: *Environmental context and resources* (difficulties obtaining medication, lifestyle changes, hospital system issues), *Memory, attention and decision processes* (forgetfulness), and *Skills* (difficulty administering drops). Practitioner barriers related to *Environmental context and resources* (time constraints and medication availability). Patient enablers mapped to *Social influences* (family support), *Knowledge* (understanding glaucoma and treatments), *Beliefs about consequences* (perceived treatment necessity), and *Behavioral regulation* (establishing routines). Ophthalmologist enablers included *Environmental context and resources* (organizational infrastructure), *Knowledge* (knowing how to classify adherence, awareness of non-adherence), *Skills* (effective communication), *Memory, attention and decision processes* (tailoring patient care), *Social professional role/identity* (professional responsibility), and *Social influences* (practitioner influence). **Conclusions:** A complex interplay of factors influences adherence. Identifying modifiable behaviors provides a basis for developing culturally sensitive interventions to reduce barriers, enhance patient and family support, and equip practitioners with tools to manage non-adherence effectively.

Key words: Glaucoma medication adherence, India, patient and practitioner perspectives, theoretical domains framework

Access this article online

Website: https://journals.lww.com/ijo

DOI: 10.4103/IJO.IJO_556_25

Quick Response Code:

Glaucoma, the second leading cause of blindness worldwide,[1] causes irreversible vision loss if untreated.[2] In low- and middle-income countries (LMICs), patients often present later with more advanced disease, increasing their risk of blindness.[3] India, with its high population, contributes to the highest regional burden of global blindness.[4]

Glaucoma management focuses on lowering intraocular pressure (IOP), typically through daily, long-term eyedrop use.[5] Adherence, which involves patients modifying their health-related behaviors and following an agreed treatment plan,[6] is crucial for treatment success.

Unfortunately, non-adherence poses a global health challenge, with LMICs facing greater barriers.[7] In India, non-adherence rates range from 18% to 58%, depending on how adherence is defined and measured.[8] Sub-optimal adherence compromises treatment outcomes, accelerates disease progression, and increases societal and economic costs.[9,10]

Understanding the behavioral determinants of adherence (i.e., what facilitates or hinders medication-taking) is crucial for developing effective interventions to address non-adherence. Adherence involves complex behavioral patterns influenced by personal, sociocultural, and environmental factors. Interventions targeting these underlying drivers of behavior are more likely to be effective.[11] While strategies often focus solely on patient behavior, practitioners play a key role in identifying and managing non-adherence. However, many practitioners struggle to accurately detect non-adherence,[12] missing intervention opportunities.

The theoretical domains framework (TDF) synthesizes 33 theories of behavior and behavior change into 14 domains,

Department of Optometry and Visual Science, School of Health and Medical Sciences, City St George's, University of London, London, United Kingdom, [1]VST Centre for Glaucoma Care, L. V. Prasad Eye Institute, Hyderabad, Telangana, India

Correspondence to: Dr. Deborah Bott, Department of Optometry and Visual Science, School of Health and Medical Sciences, City St George's, University of London, Northampton Square, London EC1V 0HB, United Kingdom. E-mail: deborah.bott.2@citystgeorges.ac.uk

Received: 26-Feb-2025 Revision: 06-Aug-2025
Accepted: 25-Sep-2025 Published: 24-Nov-2025

Cite this article as: Bott D, Senthil S, Subramanian A, Edgar DF, Lawrenson JG, Campbell P. Factors influencing glaucoma medication adherence: A qualitative study of patients and ophthalmologists in India. Indian J Ophthalmol 2025;73:1792-800.

providing a structured approach to understanding and addressing determinants of behavior.[13] The TDF is linked to two key behavior change frameworks: the Behavior Change Wheel (BCW)[14] and Behavior Change Technique Taxonomy (BCTT).[15] The BCW maps key TDF domains to intervention functions (e.g. *Education*, *Training*, and *Environmental Restructuring*) and policy categories (e.g. *Legislation*, *Service Provision*, and *Guidelines*) to guide intervention development. The BCTT complements this by providing standardized language describing the components or "active ingredients" of interventions, e.g. *Instructions on how to perform the behavior*, *prompts or cues*, and *behavioral practice/rehearsal*. Together, these frameworks ensure adherence strategies are designed to address root causes of non-adherence (i.e., identify and overcome barriers to eyedrop use).

While the TDF has been applied to studies in India,[16] to our knowledge, none have explored glaucoma medication adherence. However, the TDF was used in a systematic review on glaucoma medication adherence.[12]

This study uses the TDF to:
1. Identify barriers and enablers to glaucoma medication adherence among patients and ophthalmologists in India
2. Identify the salient TDF domains most relevant to target behaviors from the perspectives of patients and ophthalmologists.

Methods

Standards, ethics, and informed consent

The study reporting follows the Consolidated Criteria for Reporting Qualitative Research (COREQ).[17] Prospective ethical approval was granted by the institutional ethical committee and adheres to the principles of the Declaration of Helsinki. All participants provided informed consent.

Study design

This qualitative study used semi-structured interviews, informed by the TDF, to investigate factors influencing glaucoma medication adherence. The choice of individual interviews in preference to a focus group was to allow participants to share personal views in depth, without the potential for peer influence. The interview guide was based on the 14 TDF domains[13] [see Table 1]. For patients, questions focused on behaviors related to eyedrop use, for ophthalmologists, they centered on approaches to managing adherence in clinical practice.

Not all TDF domains were explicitly addressed; instead, questions were structured to allow a natural flow, as rigid adherence to the TDF can limit participant expression in qualitative settings.[18] Both interview guides were informed by previous research[12] and recommendations from the team's experienced qualitative and behavior change researchers. Guides were piloted and refinements made based on patient and ophthalmologist feedback (see Appendix S1 for interview guides).

Participants and recruitment

Patients

Patients, ≥18 years, prescribed one or more IOP-lowering eyedrops for any glaucoma type were recruited from a glaucoma service at a tertiary eyecare institute in Southern India. Participants were from higher and lower socioeconomic strata (SES) and conversed in English, Telugu, or Hindi, with interpreters when needed. Purposive sampling was used to seek diversity in age, geographic location, number of prescribed eyedrops, and duration of eyedrop use.

Ophthalmologists

Ophthalmologists managing glaucoma at tertiary centers were recruited via email invitations. Purposive sampling aimed to capture diversity in age, gender, and experience.

Procedure

Patient interviews were conducted one-on-one in private, led by an English-speaking researcher with interpreters as needed. Ophthalmologist interviews were conducted in-person or online via Zoom (San Jose, CA, Zoom Video Communications Inc). Interviews occurred in February/March 2024, were audio-recorded, transcribed verbatim, and anonymized.

Sample size

Sample sizes were guided by data saturation in theory-informed interviews, with an initial analysis sample of 10.[19] Interviews continued until data saturation was reached, with no new themes or insights emerging from additional interviews.

Researcher characteristics and reflexivity

The primary researcher is an experienced United Kingdom (UK)-based practitioner specializing in glaucoma care; this background provided valuable insights into challenges associated with medication adherence. However, they consulted with local qualitative researchers to adopt culturally sensitive approaches and shadowed hospital staff to understand India's healthcare system, aiming to build rapport with participants, minimize the sense of being an "outsider" and enhance their communication methods.

Data analysis

Data analysis was conducted using NVivo 12 software (QST International, Doncaster, Australia), following a combined content and framework analysis approach,[20] outlined in Fig. 1 and detailed in Appendices S2 and S3. The key domains representing adherence barriers and enablers were identified using established criteria: frequency, elaboration, and spontaneity[21] [see Fig. 1].

Results

Participant characteristics

Eleven patients and 11 ophthalmologists participated. Data saturation was reached with these samples, with no new themes emerging at the 11th interview for either group. Interviews lasted between 16 and 44 minutes, averaging 19 minutes for patients and 28 minutes for ophthalmologists.

Nine patients were adherent, reporting no missed doses since treatment started. Two were non-adherent. One intentionally missed doses two to three times weekly, while the other reported both intentionally and unintentionally missing doses. Fifty-five percent of patients self-administered their eyedrops. Three interviews required an interpreter: (Telugu = 2, Hindi = 1). Participant characteristics are in Table 2.

Salient domains

Barriers and enablers to medication adherence were identified across 13 of the 14 TDF domains, excluding *Reinforcement* for

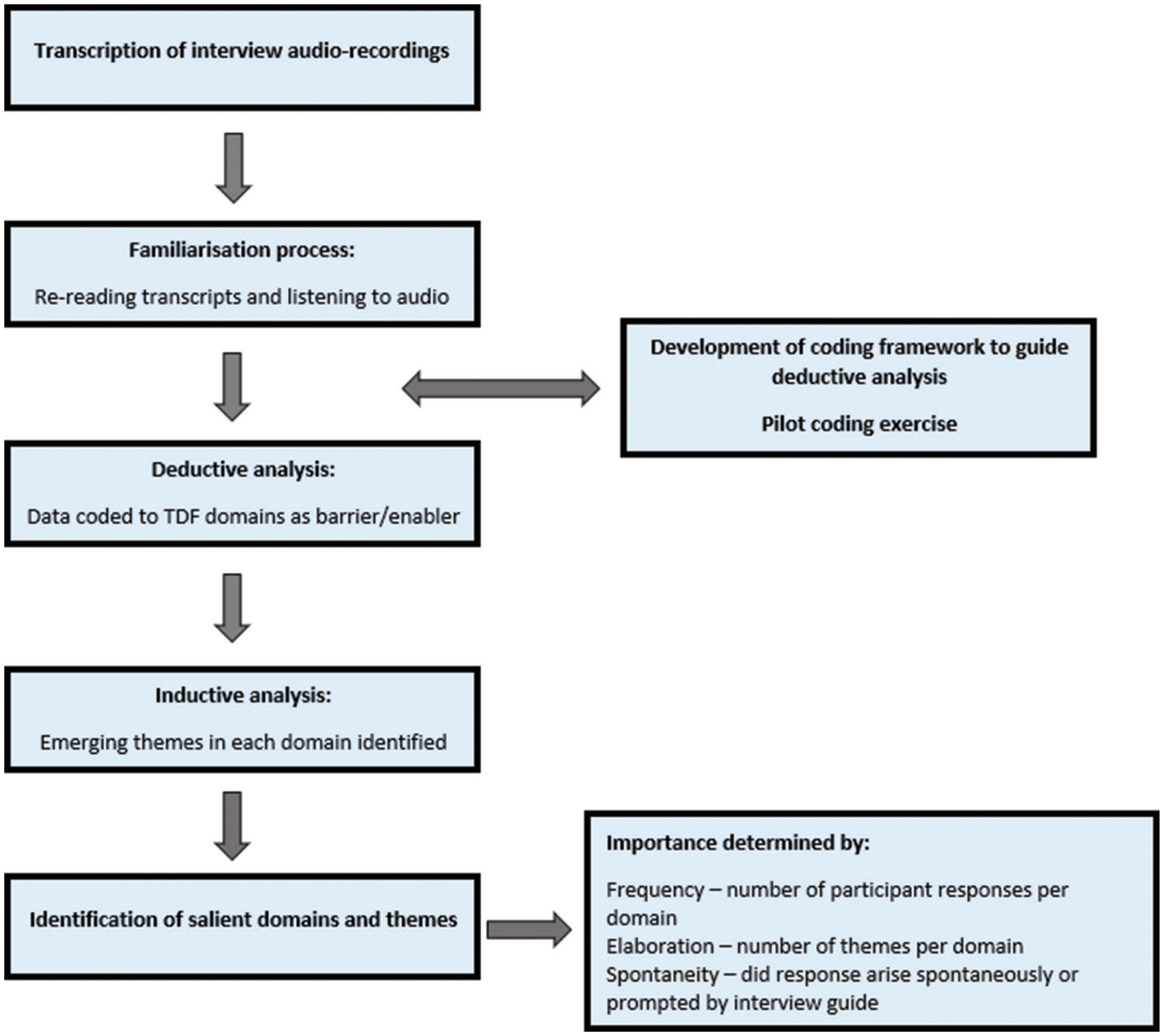

Figure 1: Flowchart representing the stepwise process of data analysis. TDF, Theoretical Domains Framework

patients and *Optimism* for ophthalmologists. The most salient domains influencing patient adherence and practitioner management were identified and ranked [Table 2]. Seven domains were particularly relevant for both groups. Key themes within these domains are described below and summarized in Tables 3a and b. Remaining themes and domains are in Appendix S4.

Patients

Environmental context and resources

Cost and difficulty obtaining medications were major barriers to adherence. Both adherent and non-adherent patients expressed concerns about eyedrops' cost, suggesting companies producing medications should not increase prices for LMICs. Additionally, some patients reported that medications were not always available at pharmacies and could only be found in a *"wholesale market"*.

Changes in lifestyles, e.g., visiting family or work commitments, often caused patients to delay scheduled eyedrop instillations. Regimens involving multiple instillations throughout the day were particularly challenging. Drops needing refrigeration posed issues, especially for the unintentionally non-adherent patient who lacked easy access to drops at instillation time.

Issues with the hospital system, e.g., rescheduling appointments, hindered adherence. One patient intentionally did not purchase eyedrops when her follow-up appointment was postponed, leading to a 15-day period of non-adherence.

Relying on family members to instill eyedrops facilitated adherence. All participants lived with a spouse or other family members who could assist.

Social Influences

Having trust in the doctor was an important enabler; all patients expressed strong faith in the advice received regarding eyedrop

Table 1: Relevance of Theoretical Domains Framework (TDF) domains to medication adherence based on frequency, elaboration, and spontaneity for patients (upper panel) and ophthalmologists (lower panel)

TDF Domain	Patient group		
	Frequency (number of patients reporting barriers/enablers within domain, max *n*=11)	Elaboration (number of themes per domain)	Spontaneity (frequency of spontaneous response)
Environmental context and resources	10	5	2
Social influences	10	1	5
Memory, attention and decision processes	11	1	0
Knowledge	10	1	0
Skills	10	1	0
Beliefs about consequences	9	1	1
Behavioral regulation	10	1	0
Social professional role/identity	8	1	0
Beliefs about capabilities	6	1	0
Goals	5	1	0
Emotion	4	1	0
Intentions	3	1	0
Optimism	1	1	0
Reinforcement	0	0	0

TDF Domain	Ophthalmologist group		
	Frequency (number of ophthalmologists reporting barriers/ enablers within domain, max *n*=11)	Elaboration (number of themes per domain)	Spontaneity (frequency of spontaneous response)
Environmental context and resources	11	3	2
Knowledge	10	2	0
Skills	10	1	0
Memory, attention and decision processes	10	1	0
Social professional role/identity	8	1	1
Beliefs about capabilities	9	1	0
Social influences	7	1	0
Beliefs about consequences	4	1	0
Reinforcement	4	1	0
Intentions	2	1	0
Goals	2	1	0
Behavioral regulation	2	1	0
Emotion	1	1	0
Optimism	0	0	0

use. Family support also played a crucial role in facilitating adherence. Patients frequently mentioned that family members accompanied them to hospital consultations and also believed in the doctor's recommendations.

Memory, attention and decision processes

Forgetting to take medication was an important barrier. While some adherent patients admitted they may forget to instill eyedrops at the recommended time, they did administer them within 2 hours of this time. Conversely, non-adherent patients who missed a dose would typically wait until the following day's dosing schedule to instill.

Knowledge

Patients who understood their medication purpose and its importance for preserving vision were more likely to adhere. One non-adherent patient was unaware of the purpose of their specific eyedrops.

Skills

Limited physical skills posed barriers to administering eyedrops. Several patients reported difficulties with eyedrops falling down their cheek or spilling from the eye, leading to frequent waste. Many patients felt family assistance was crucial because of their greater ability at instilling drops.

Beliefs about consequences

The belief that adhering to the eyedrop regimen would preserve vision was a key motivator for most patients. However, one intentionally non-adherent patient expressed skepticism about the necessity of eyedrops, believing *"nature"* would take its course and *"what will be will be"*.

Table 2: Participant demographics

Patient demographics		*n* (%) *n*=11 total
Gender	Female	3 (27)
	Male	8 (73)
Age (years)	31–45	2 (18)
	46–60	3 (27)
	61–74	6 (55)
Location in India (state)	West Bengal	1 (9)
	Telangana	5 (45)
	Andhra Pradesh	3 (27)
	Gujarat	1 (9)
	Maharashtra	1 (9)
Highest level of education	School education (up to 11)	1 (9)
	School education (11 to 18)	2 (18)
	Degree or higher	8 (73)
Occupational status	Full-time employment	4 (36)
	Retired	5 (45)
	Housewife	2 (18)
Type of glaucoma (according to patient)	POAG	1 (9)
	PACG	5 (45)
	2º glaucoma	2 (18)
	Does not know	3 (27)
Number of glaucoma medications	1	9 (82)
	2	2 (18)
Duration of glaucoma eyedrop usage (years)	<5	4 (36)
	5–10	5 (45)
	11–20	2 (18)
Number of eyedrop instillations per day	1	7 (64)
	2	3 (27)
	4	1 (9)
Ophthalmologist demographics		***n*** **(%)** ***n*****=11 total**
Gender	Female	3 (27)
	Male	8 (73)
Age (years)	33–45	7 (64)
	46–60	3 (27)
	>60	1 (9)
Location of hospital (state)	Telangana	9 (82)
	Andhra Pradesh	1 (9)
	Odisha	1 (9)
Time worked in glaucoma care (years)	4–9	5 (45)
	10–19	3 (27)
	20–29	2 (18)
	>30	1 (9)

Behavioral regulation

Establishing a consistent routine and using reminder strategies were key to adherence. Some patients set alarms to prompt themselves, while others relied on family members to act as reminders. One patient used the anticipated discomfort associated with administering her eyedrops as a reminder to instill them.

Ophthalmologists

Environmental context and resources

Ophthalmologists frequently noted that time constraints greatly hindered their ability to manage adherence effectively, particularly with large caseloads. High patient volumes limited the time available for in-depth discussions about adherence.

In contrast, good organizational infrastructure and sufficient resources facilitated adherence management. Ophthalmology fellows and optometrists in the clinic provided valuable support for managing adherence. One ophthalmologist suggested clinic counselors, who could provide one-to-one support for patients with their eyedrops, would be beneficial and help their *"job a lot"*. However, resource limitations meant this role was not currently filled. Practitioners especially appreciated teleconsultations' benefits, feeling they could manage many concerns about eyedrops remotely, reducing clinic demand. Additionally, instructional videos in local languages providing demonstrations of eyedrop instillation techniques were a welcome assistance in supporting adherence.

Ophthalmologists encountered challenges due to disruptions in the availability of eyedrops, particularly in rural areas where stock shortages were more common. To overcome this, practitioners often prescribed more widely available branded or generic medications.

Knowledge

Understanding what constitutes an acceptable level of patient adherence was identified as a facilitator to managing adherence. Most practitioners considered missing even one dose as non-adherent behavior, regardless of disease stability, and were especially clear that missing a scheduled dose on the morning of a hospital visit was unacceptable. Two ophthalmologists, however, interpreted adherence levels based on the patient's glaucoma status, demonstrating some flexibility in their approach.

Understanding issues of non-adherence and recognizing patient risk factors within the clinical setting were identified as enablers. Ophthalmologists were particularly mindful of patients' socio-demographic backgrounds and the extra challenges these factors could place on adherence.

Skills

Effective communication and educational skills from ophthalmologists improved adherence management. Practitioners recognized the importance of asking patients direct leading questions about their adherence. With experience, they found asking whether eyedrops had been used on the hospital consultation day helped identify non-adherence. To further support patient education, practitioners frequently demonstrated eyedrop instillation techniques to the patient and their attendant.

Memory, attention, and decision processes

Ophthalmologists found that tailoring their decision-making processes to align with individual patient circumstances enhanced their ability to manage non-adherence. By understanding each patient's specific challenges, practitioners were better able to recommend suitable alternatives, e.g., reducing the number of daily instillations, prescribing more affordable eyedrops, offering free samples to patients with financial difficulties or recommending surgery.

Social professional role/identity

Ophthalmologists recognized their professional responsibility to address and effectively manage non-adherence among patients as an enabler. They felt a strong duty to ensure patients understood their treatment and received the necessary adherence support.

Table 3a: Summary of key themes and illustrative quotes from patients assigned to TDF domains identified as relevant to adherence behavior

Theme	Barrier/ Enabler/mixed	Illustrative quote (s)
TDF domain: Environmental context and resources		
Difficulties obtaining medication	Barrier	"*[I] "will not find* [eyedrops in] *any medical stores"*(P018)
Nature of eyedrops	Barrier	*"I travel from* [City 1] *to* [City 2]. *It takes 2 1/2 hours by flight…How can I carry* [my Latanoprost eyedrops] *from* [City 1] to [City 2]? *They remain* [at home] *in my refrigerator*" (P017)
Changes in lifestyle	Barrier	"*Sometimes I'm working on the [computer] system and the time runs out"* (P021)
Issues within the hospital system	Barrier	"*getting an appointment is a very tedious job…They gave me appointment on 1st week of this February and after that they told me that Dr… is not available in 1st week as Dr. is travelling so [changed my appointment] to come on 23rd*" (P020)
Relying on others to instill eyedrops	Enabler	*"somebody is there in….family…. so some….other person will be doing it"* [instilling eyedrops] (P022)
TDF domain: Social influences		
Positive social influence from family or eye care practitioner	Enabler	"*I trust my doctor because without trust, nothing will work. I absolutely trust her*" (P020)
TDF domain: Memory, attention and decision processes		
Forgetting to instill eyedrops as prescribed	Barrier	"*So many days so many days* [I forget to use my eyedrops]" (P017)
TDF domain: Knowledge		
An understanding of glaucoma and treatment rationale	Enabler	"*Main thing is to control the ocular pressure….using eyedrop controls the ocular pressure….it may lead to blindness if the pressure keeps on increasing*" (P024)
TDF domain: Skills		
Poor physical skills	Barrier	"*if I put one drop more than 10 drops come out*" (P020)
TDF domain: Beliefs about Consequences		
Believing eyedrops are necessary to preserve sight	Enabler	"*I realise that drops is more important than my job*" (P024)
TDF domain: Behavioral regulation		
Developing a routine and/or reminder strategies	Enabler	*"You should keep…your drops out. So you see it….[next to] bed…. that reminds us….Because right beside the bed side table.we'll be keeping our mobiles….we won't forget to charge our phone"* (P016)

TDF, Theoretical Domains Framework, P codes (eg P016) refer to anonymised patient identifiers

Beliefs about capabilities

Beliefs about capabilities had a mixed influence on adherence management. Some practitioners expressed confidence in their ability to detect non-adherence, with others less certain. There was no obvious association between age or glaucoma experience and levels of confidence. Male practitioners were more likely to report lower confidence. The more confident practitioners credited this to establishing good relationships with and understanding their patients.

Social influences

Practitioners recognized the positive influence they had on managing adherence, noting their influence was greater than other staff, largely attributable to the continuity of care they provided by consistently seeing their own patients and building lasting relationships, unlike other staff who frequently changed.

Discussion

This study identified important factors influencing glaucoma medication adherence in India from patient and practitioner perspectives. It expands upon existing research highlighting the complexity of adherence behaviors shaped by individual, systemic, and environmental factors.[12] Using the TDF, we systematically identified modifiable key domains for developing targeted behavior change interventions at multiple levels: the patient, the practitioner, and the healthcare system. These domains can be mapped to evidence-based Behavior Change Techniques (BCTs),[22] which represent the "active" components of an intervention and guide its development. Linking intervention components to theoretical domains provides insights into "why" and "how" the intervention works, improving its chances of being effective and replicable.[23]

Implications for practice and future work

Both patients and ophthalmologists identified systemic challenges, e.g., medication procurement, as important adherence barriers. Challenges included high medication costs and inconsistent availability, issues previously noted in India.[24,25] Complex treatment regimens, with multiple daily instillations or medications requiring refrigeration, further

Table 3b: Summary of key themes and illustrative quotes from ophthalmologists assigned to TDF domains identified as relevant to adherence management behavior

Theme	Barrier/ Enabler/Mixed	Illustrative quote (s)
TDF domain: Environmental context and resources		
Lack of time	Barrier	*"As practitioners, the problem is that we have just too many patients and one of us has to do this…. it's not easy…we don't have so much time to be able to spend* [with patient] *even though you would like it to be that way"* (ECP014)
Organizational structure and/or available resources	Enabler	*"We have a telephone consult…we can say you can book a teleconference and call me. Many things I manage on the phone"* (ECP020)
Unavailability of medications	Barrier	*"what happens is many times we write a prescription and that is not available in their hometown"* (ECP020)
TDF domain: Knowledge		
An awareness of how to classify adherence/ non-adherence behavior	Enabler	*"If the patients are missing even a single drop on the day of the morning [of consultation] or even yesterday I will take it as non-compliant" (*ECP024)
An understanding of non-adherence issues and patient risk factors	Enabler	*"it is definitely a big problem in any medications. Non-compliance is like one of the major problems for you"* (ECP023)
TDF domain: Skills		
Practitioner communication, education, and interpersonal skills	Enabler	*"we speak to them* [patient]*, we find out…what their problem is….what we do is ask them a leading question"* (ECP014)
TDF domain: Memory, attention and decision processes		
Tailoring the decision-making process according to patient needs	Enabler	*"what I do in such a scenario is first…give them a medication which is of low cost...we give them an alternative which is within their living standards.and the second thing is to advise them surgery...over a shorter period of time it is more cost effective than being on long term glaucoma treatment"* (ECP019)
TDF domain: Social professional role/identity		
Professional role in the management of adherence	Enabler	*"I believe that since I am the one who is treating them… I should tell them"* (ECP019)
TDF domain: Beliefs about Capabilities		
Perceived confidence/lack of confidence in own ability to identify non-adherence	Mixed	Barrier *"I feel it is very difficult to really make out whether the patient is compliant to medications or not….it's a very subjective way of accessing"* (ECP018) Enabler *[From the] "two to three.questions I ask them, the way they answer I can make out…whether they are ….compliant or not"* (ECP017)
TDF domain: Social influences		
Positive influence from the practitioner	Enabler	*"If I speak to them personally, if I take the time out, and….try to make them understand definitely that will have a better impact than making an optometrist speak* [to the patient] *or giving them a leaflet...if the doctor really takes the time out to speak to the patient, I think that will have a greater impact"* (ECP023)

TDF, Theoretical Domains Framework, ECP codes (eg ECP014) refer to anonymised ophthalmologist identifiers

compounded these difficulties. Linking these barriers from the *Environmental context and resources* domain to the BCW suggests policy-driven solutions, including the following:

1. Subsidizing medication costs to improve affordability
2. Improving supply chains to ensure consistent availability in rural and underserved areas
3. Promoting cost-effective alternatives to medication, such as surgery or selective laser trabeculoplasty (SLT). Surgery is often considered a cost-effective first-line option in LMIC countries.[3] However, possible post-operative complications and accessibility to follow-up care must be considered, as these can increase indirect costs.[3] SLT is a safe, effective, repeatable treatment for open-angle glaucoma, reducing reliance on long-term medication.[26] Its integration into Indian glaucoma guidelines, similar to those advocated in other countries,[27] could benefit patients who face barriers to medication access. However, SLT may only be beneficial as an adjunctive treatment for patients with angle closure glaucoma,[28] the more prevalent form in India and Southeast Asian countries.[29] For primary angle closure, clear lens extraction is a proven, effective, safe, and cost-effective initial treatment, especially in LMICs.[30]

Within the healthcare system, delayed follow-up appointments, time constraints, and limited workforce resources were additional barriers. Structural reorganization, such as optimizing clinic workflows and improving scheduling systems, could address these issues. These improvements, part of *Environmental Restructuring* within the BCW, provide opportunities for more effective treatment adherence. For example, introducing stable/low-risk glaucoma clinics run by general ophthalmologists or optometrists could reduce the clinic burden. Similar models were acceptable to patients without compromising care in other countries.[31]

Family support and trust in healthcare providers, linked to the TDF domain *Social Influences*, emerged as important enablers, mirroring findings from other chronic conditions, e.g., diabetes, where family involvement supports patients' ability to manage their condition.[32] Interventions integrating family support into treatment plans or educating family members could enhance adherence, aligning with the intervention function *Environmental Restructuring*. Trust and rapport between practitioners and patients were also important. Ophthalmologists emphasized the importance of strong patient-provider relationships in promoting adherence. Good communication skills with non-judgmental interview techniques encourage healthy patient–practitioner relationships[33] and could be incorporated into training programs.

Patients' knowledge about glaucoma and the consequences of non-adherence was an important enabler. Patient education is essential, as understanding glaucoma and its treatment significantly impacts adherence.[34] However, in India, awareness and educational programs are often one-time events rather than ongoing initiatives.[35] This could be addressed through:

1. Establishing support roles where trained team members provide ongoing education, reinforce ophthalmologist recommendations, offer practical and emotional support, and ensure continuity of care in busy outpatient clinics. However, staff numbers and training resources should be sufficient to meet demand.
2. A patient advocacy group. Establishing a national patient organization, similar to Glaucoma UK (https://glaucoma.uk/), and utilizing resources from organizations such as The World Glaucoma Patient Association (https://glaucomafoundation.org/get-involved/world-glaucoma-patient-association/) and Sightsavers India (https://www.sightsaversindia.org/), can help disseminate accessible information in relatable and digestible formats through leaflets, videos, support groups, and telephone helplines.
3. Digital technology. Mobile phone applications offering educational resources, reminders, and adherence tracking could improve adherence. India's expanding IT infrastructure and increasing smartphone user base mean digital solutions could offer scalable, cost-effective solutions. Mobile health interventions have proved effective in improving medication adherence in various LMICs.[36]

These solutions align with the *Knowledge* and *Behavioral regulation TDF* domains, supported by the BCW intervention functions *Enablement* and *Education*.

Patients who lacked the physical ability to administer eyedrops or struggled with complex regimens faced adherence barriers. Ophthalmologists noted that demonstrating instillation techniques during consultations often helped. Training interventions that include *behavioral practice/rehearsal* could provide patients with the capability to overcome these challenges.

Practitioner confidence in managing adherence varied, highlighting a need for training to enhance their ability to identify and address non-adherence. Training programs informed by BCTs, such as *Instruction on How to perform the Behavior* and *Feedback on the Behavior*, could improve ophthalmologist practice. Online, Continuing Professional Development-accredited modules on adherence strategies, effective patient communication, and glaucoma management updates could offer accessible, flexible training solutions. BCW policy categories, such as *Guidelines* and *Service Provision*, could support these initiatives.

Strengths and limitations

This study addresses an evidence gap by exploring glaucoma medication adherence in India from patients' and practitioners' perspectives, an approach, to our knowledge, not previously undertaken. While existing research often highlights patient-reported barriers and enablers,[37] this dual perspective provides a more comprehensive understanding of adherence challenges.

Use of the TDF is another strength, providing a structured, theory-based methodology for identifying behavioral influences on adherence. This approach supports the development of tailored evidence-based behavior change strategies addressing modifiable barriers for both patients and practitioners. Similarly developed interventions were effective in improving medication adherence in type 2 diabetes.[38]

Our study has limitations. Most patients reported high adherence, potentially limiting our findings' generalisability, although self-reported adherence often overestimates actual adherence.[39] Recruitment from a tertiary center may not fully represent the broader Indian glaucoma population, restricting the applicability of our findings to other settings. The percentage of university-educated patients was higher than in the general Indian population,[40] which could bias findings. The underrepresentation of female participants may have led to missed factors specific to women.

Conclusions and Recommendations

It is important to target glaucoma medication adherence in India through a multilevel approach informed by a theoretical framework. Based on the identified key TDF domains and associated BCTs, we proposed several potential intervention components that could be implemented as part of a multicomponent strategy to enhance medication adherence. Future research should focus on piloting these components, assessing acceptability, feasibility, and evaluating their effectiveness in improving adherence. Implementing these strategies could significantly reduce glaucoma-related vision loss, enhancing patients' quality of life and easing the burden on India's healthcare system.

Acknowledgment

The authors acknowledge the contributions from Dr. Sahiti Puttagunta and Dr. Pratinya Kolipaka.

Financial support and sponsorship: Deborah Bott is funded by a College of Optometrists Postgraduate Research Scholarship. International travel was funded by a Turing Scheme International grant and City St George's, University of London, Global Engagement Fund.

The funding organizations had no role in the design or conduct of this research.

Conflicts of interest: There are no conflicts of interest.

References

1. Steinmetz JD, Bourne RRA, Briant PS, Flaxman SR, Taylor HRB, Jonas JB, *et al*. Causes of blindness and vision impairment in 2020 and trends over 30 years, and prevalence of avoidable blindness in relation to VISION 2020: The right to sight: An analysis for the global burden of disease study. Lancet Glob Health 2021;9:e144-60.
2. Jayaram H, Kolko M, Friedman DS, Gazzard G. Glaucoma: Now and beyond. Lancet 2023;402:1788-801.
3. Delgado MF, Abdelrahman AM, Terahi M, Miro Quesada Woll JJ, Gil-Carrasco F, Cook C, *et al*. Management of glaucoma in developing countries: Challenges and opportunities for improvement. Clin Outcomes Res 2019;11:591-604.
4. Jacob A, Thomas R, Koshi SP, Braganza A, Muliyil J. Prevalence of primary glaucoma in an urban south Indian population. Indian J Ophthalmol 1998;46:81-6.
5. Garway-Heath DF, Crabb DP, Bunce C, Lascaratos G, Amalfitano F, Anand N, *et al*. Latanoprost for open-angle glaucoma (UKGTS): A randomised, multicentre, placebo-controlled trial. Lancet 2015;385:1295-304.
6. Martos-Méndez MJ. Self-efficacy and adherence to treatment: The mediating effects of social support. J Behav Health Soc Issues 2015;7:19-29.
7. Sabaté E, World Health Organization, editors. Adherence to Long-Term Therapies: Evidence for Action. Geneva: World Health Organization; 2003.
8. Singh K, Singh A, Jain D, Verma V. Factors affecting adherence to glaucoma medication: Patient perspective from North India. Indian J Ophthalmol 2024;72:391.
9. Cutler RL, Fernandez-Llimos F, Frommer M, Benrimoj C, Garcia-Cardenas V. Economic impact of medication non-adherence by disease groups: A systematic review. BMJ Open 2018;8:e016982.
10. Iuga AO, McGuire MJ. Adherence and health care costs. Risk Manag Healthc Policy 2014;7:35-44.
11. Rahman M, Judah G, Murphy D, Garfield SF. Which domains of the theoretical domains framework should be targeted in interventions to increase adherence to antihypertensives? A systematic review. J Hypertens 2022;40:853-9.
12. Bott D, Subramanian A, Edgar D, Lawrenson JG, Campbell P. Barriers and enablers to medication adherence in glaucoma: A systematic review of modifiable factors using the theoretical domains framework. Ophthalmic Physiol Opt 2023;44:96-114.
13. Cane J, O'Connor D, Michie S. Validation of the theoretical domains framework for use in behaviour change and implementation research. Implement Sci 2012;7:37.
14. Michie S, van Stralen MM, West R. The behaviour change wheel: A new method for characterising and designing behaviour change interventions. Implement Sci 2011;6:42.
15. Michie S, Richardson M, Johnston M, Abraham C, Francis J, Hardeman W, *et al*. The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: Building an international consensus for the reporting of behavior change interventions. Ann Behav Med Publ Soc Behav Med 2013;46:81-95.
16. Joseph L, Greenfield S, Lavis A, Lekha TR, Panniyammakal J, Manaseki-Holland S. Exploring factors affecting health care providers' behaviors for maintaining continuity of care in Kerala, India; A qualitative analysis using the theoretical domains framework. Front Public Health 2022;10:891103.
17. Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): A 32-item checklist for interviews and focus groups. Int J Qual Health Care 2007;19:349-57.
18. Aloudah NM. A qualitative study on the perception of medication adherence by the social circles of patients with type 2 diabetes. Patient Prefer Adherence 2023;17:973.
19. Francis JJ, Johnston M, Robertson C, Glidewell L, Entwistle V, Eccles MP, *et al*. What is an adequate sample size? Operationalising data saturation for theory-based interview studies. Psychol Health 2010;25:1229-45.
20. Atkins L, Francis J, Islam R, O'Connor D, Patey A, Ivers N, *et al*. A guide to using the theoretical domains framework of behaviour change to investigate implementation problems. Implement Sci 2017;12:77.
21. Prothero L, Lawrenson JG, Cartwright M, Crosby-Nwaobi R, Burr JM, Gardner P, *et al*. Barriers and enablers to diabetic eye screening attendance: An interview study with young adults with type 1 diabetes. Diabet Med 2022;39:e14751.
22. Michie S, Johnston M, Francis J, Hardeman W, Eccles M. From theory to intervention: Mapping theoretically derived behavioural determinants to behaviour change techniques. Appl Psychol 2008;57:660-80.
23. Michie S, Abraham C. Interventions to change health behaviours: Evidence-based or evidence-inspired? Psychol Health 2004;19:29-49.
24. Killeen OJ, Pillai MR, Udayakumar B, Shroff S, Vimalanathan M, Cho J, *et al*. Understanding barriers to glaucoma treatment adherence among participants in south India. Ophthalmic Epidemiol 2020;27:200-8.
25. Yousuf S, Arsalan-un-nisa, Rasool A, Shafi T. A cross sectional study of compliance and adherence of topical antiglaucoma medications in rural population of Kashmir. JK Pract 2023;28:13-6.
26. Gazzard G, Konstantakopoulou E, Garway-Heath D, Adeleke M, Vickerstaff V, Ambler G, *et al*. Laser in glaucoma and ocular hypertension (LiGHT) trial: Six-year results of primary selective laser trabeculoplasty versus eye drops for the treatment of glaucoma and ocular hypertension. Ophthalmology 2023;130:139-51.
27. Gedde SJ, Vinod K, Wright MM, Muir KW, Lind JT, Chen PP, *et al*. Primary open-angle glaucoma preferred practice pattern®. Ophthalmology 2021;128:P71-150.
28. Raj S, Tigari B, Faisal TT, Gautam N, Kaushik S, Ichhpujani P, *et al*. Efficacy of selective laser trabeculoplasty in primary angle closure disease. Eye 2018;32:1710-6.
29. Zhang N, Wang J, Li Y, Jiang B. Prevalence of primary open angle glaucoma in the last 20 years: A meta-analysis and systematic review. Sci Rep 2021;11:13762.
30. Azuara-Blanco A, Burr J, Ramsay C, Cooper D, Foster PJ, Friedman DS, *et al*. Effectiveness of early lens extraction for the treatment of primary angle-closure glaucoma (EAGLE): A randomised controlled trial. Lancet 2016;388:1389-97.
31. Simons AS, Vercauteren J, Barbosa-Breda J, Stalmans I. Shared care and virtual clinics for glaucoma in a hospital setting. J Clin Med 2021;10:4785.
32. Angadi N, Davalgi S. Social support and medication adherence among people with type 2 diabetes mellitus in central Karnataka, India. Natl J Community Med 2023;14:834-41.
33. Hahn SR, Friedman DS, Quigley HA, Kotak S, Kim E, Onofrey M, *et al*. Effect of patient-centered communication training on discussion and detection of nonadherence in glaucoma. Ophthalmology 2010;117:1339-47.e6.
34. Newman-Casey PA, Shtein RM, Coleman AL, Herndon L, Lee PP. Why patients with glaucoma lose vision: The patient perspective. J Glaucoma 2016;25:e668-75.
35. Rewri P, Ali W, Yadav V, Vats DP. Role of mass communication and health care in promoting glaucoma awareness: An observational study. Delhi J Ophthalmol 2018;28:36.
36. Arshed M, Mahmud A, Minhat HS, Lim PY, Zakar R. Effectiveness of a multifaceted mobile health intervention (multi-aid-package) in medication adherence and treatment outcomes among patients with hypertension in a low- to middle-income country: Randomized controlled trial. JMIR MHealth UHealth 2024;12:e50248.
37. McClelland JF, Bodle L, Little JA. Investigation of medication adherence and reasons for poor adherence in patients on long-term glaucoma treatment regimes. Patient Prefer Adherence 2019;13:431-9.
38. Teo V, Weinman J, Yap KZ. Systematic review examining the behavior change techniques in medication adherence intervention studies among people with type 2 diabetes. Ann Behav Med Publ Soc Behav Med 2024;58:229-41.
39. Cate H, Bhattacharya D, Clark A, Holland R, Broadway DC. A comparison of measures used to describe adherence to glaucoma medication in a randomised controlled trial. Clin Trials 2015;12:608-17.
40. Waghmare A. Education levels in India. Data India 2024. Available from: https://www.dataforindia.com/education-levels-in-india/. [Last accessed on 2024 Nov 29].

Appendices

S1: Interview topic guide

Patient Interviews

Introduction

"My name is , a researcher at…….. The main purpose of this interview is to understand your experiences using eyedrops in glaucoma."

"I will also be interviewing doctors to understand their experiences of eyedrop compliance in practice and how they manage it. I plan to use the information gained from these interviews to help me develop some form of technology-based solution to help patients use their eyedrops correctly. "

"Have you read the participant information sheet that you have been provided with?"

"I will just re-cap some information. The interview should last about 45 minutes. Everything you say will be kept strictly confidential. You are free to stop participating at any time with no consequences. You do not need to answer any questions that you do not wish to. I will be audio recording the interview so that I don't have to take too many notes and can listen to what you are saying. After the interview any identifiable information, such as your name, will be removed."

"Please feel free to be open and honest about your experiences using eyedrops. There are no right or wrong answers, we are keen to learn from your experiences both positive and negative."

"Are you happy to take part in this interview? Before we start do you have any questions?"

Complete consent form.

"I'm going to start recording now."

Demographic Information

"I'd like to ask some questions about yourself first. This information will be used to describe the people who took part in our study, all your responses will be combined so you will not be identified."

Please can you confirm:

- your gender, where you live in the country e.g. which state
- what age range you fall into (18-30, 31-45, 46-60, 61-74, 76-90, 91+)
- what is your highest level of education (e.g. school/college -up to 18 yrs. old, graduate, postgraduate)
- your employment status
- if you live alone/with family members (if yes ask which members)
- what type of glaucoma do you have (if known)
- how long approximately have you been using eyedrops for glaucoma
- is this the first type of eyedrop you have used/have you been changed to a different type? If yes do you know how many times they been changed?
- what drops are you currently taking – how many times a day do they go in? Don't worry if you don't remember the names of the drops
- do you instil your eyedrops yourself/family member/carer?
- do you pay for your medications or healthcare?
- how often do you have check-ups for your glaucoma?
- you have no visual difficulties/have visual difficulties but not formally registered as sight impaired/registered as sight impaired/registered severely sight impaired

Questions aligned with domains of Theoretical Domains Framework (TDF)

1. Do you know why you take your eyedrops? **(Knowledge domain)**
   Prompts – explore understanding of glaucoma and rationale for using eyedrops and possibility of losing vision

2. On a daily basis do you have any problems putting your eyedrops in? **(Skills domain)**
   Prompts – if yes explore why, maybe have problems with opening bottle due to arthritis in hands/unable to see to put your drops in/drops keep running down cheek

3. If answer yes to above question– even though you have some difficulties putting your drops in, how confident are you that you can continue using your drops as prescribed (i.e. once/twice a day) on a long-term basis? **(Beliefs about capabilities)**
   If answer no to above question – as you don't experience any difficulties putting your drops in on a daily basis, how confident are you that you can continue to use your drops as prescribed (i.e. once/twice a day) on a long-term basis? **(Beliefs about capabilities)**

4. Is it important to you to use your eyedrops as instructed? **(Goals domain**)
   Prompt – explore why

5. What do you think the benefits of using your eyedrops correctly are?
   What do you think the disadvantages of not using your eyedrops correctly are?
   (Beliefs about consequences)

6. Who do you think is responsible for making sure your eyedrops are used correctly every day? **(Social/professional role and identity domain)**
   Prompt – your doctor, you, your family/carer

7. Is there anything/anyone that would make you more likely to use/not use your eyedrops as you should? **(Reinforcement domain)**
   Prompt – praise from your doctor/family or receiving negative feedback from your doctor

8. If you use your eyedrops correctly, how likely do you think it is that this will help you maintain your vision/stop your glaucoma from getting worse? **(Optimism domain)**

9. If you think about how you use your eyedrops each day, is there anything that makes it easier for you, anything that makes it harder? **(Environmental context and resources domain)**

   Prompts- being away on holiday, being dependant on a carer/family member to instil drops/ not being able to obtain/ afford medications

10. Is there anything that you do/or could do to overcome these problems? **(Behavioural regulation domain)**

Prompt – habits/techniques or practical strategies employed

11. Does anyone else influence your decision to take your eyedrops? **(Social influences domain)**
    Prompt – family members/carers/support groups/healthcare professionals (HCPs)

12. Do you ever forget or deliberately not use your eyedrops? If yes how often have you not used your eyedrops? Is there any reason that would lead to this decision? **(Memory, attention and decision processes domain)**
    Prompt – forgetting, away on holiday, side effects using drops so purposefully don't use
    "Thank you for your time today, I really appreciate you sharing your views and experiences. Is there anything else you would like to add that I haven't covered?"

Ophthalmologist Interviews

Introduction

"My name is , a researcher at ……The main purpose of this interview is to hear about your experiences managing glaucoma medication adherence in practice."

"I will also be interviewing patients to learn about their experiences with glaucoma medication. We will use the information from both practitioner and patient interviews to guide the development of a potential intervention to help with glaucoma medication adherence."

"Have you read the participant information sheet that you have been provided with?"

"I will just re-cap some information. The interview should last about 45 minutes. Everything you say will be kept strictly confidential. You are free to stop participating at any time with no consequences. You do not need to answer any questions that you do not wish to. I will be audio recording the interview so that I don't have to take too many notes and can listen to what you are saying. After the interview any identifiable information, such as your name, will be removed."

"Please feel free to be open and honest about how you feel. There are no right or wrong answers, we are keen to hear your views and learn from your experiences both positive and negative."

"Are you happy to take part in this interview? Before we start do you have any questions?"

Complete consent form.

"I'm going to start recording now."

Demographic Information

"I'd like to ask some questions about yourself first. This information will be used to describe the people who took part in our study, all your responses will be combined so you will not be identified."

Please can you confirm:

- your gender, where/which state do you work in
- what age range you fall into (18-30, 31-45, 46-60, 61-74, 76-90, 91+)
- your job title and role within glaucoma care
- how long have you been qualified as an ophthalmologist? How long have you been involved in glaucoma care?
- on average how many glaucoma sessional clinics a week are you involved in?

Questions aligned with domains of Theoretical Domains Framework (TDF)

1. In practice how do you usually assess whether a patient is taking their eyedrops as prescribed? **(Skills domain)**
   Prompt – subjectively ask patient/family member about adherence, what questions would you ask, use a questionnaire, what questionnaire would you use?
   Do you provide education regarding glaucoma/treatment/ adherence/advice on how to instil eyedrops? How do you do this?

2. How do you classify a patient as nonadherent? Do you think nonadherence is a problem in your clinic? **(Knowledge domain)**
   Prompt – is missing once/twice a week/month etc nonadherent

3. Whose role do you think it is to ensure patients comply with their treatment? Why do you think this? **(Social/ professional role and identity)**

4. How important do you feel it is to actively manage patient adherence to treatment? What influences your approach? What are the main outcomes you aim for when supporting a patient's adherence? **(Beliefs about consequences)**

5. How confident do you feel in your ability to identify if a patient is adherent or nonadherent to their medication? Why do you feel that? **(Beliefs about capabilities)**

6. If a patient is having difficulty using their eyedrops correctly, how do you determine the most appropriate adjustments to their treatment or select an alternative approach? **(Memory, Attention and decision processes domain)**
   Prompt – if developing side effects how do you manage, do you consider SLT or surgical intervention as an alternative, if patient struggling with dosing regimen due to hectic lifestyle how do you amend treatment to suit patient?

7. In clinic, are there any resources, tools, or colleagues that make it easier for you to manage non-adherence? Conversely, are there any factors that make it more challenging to support patients who struggle to adhere to their treatment? **(Environmental context and resources domain)**
   Prompt - dedicated glaucoma nurses, dedicated adherence clinics, educational resources, not enough time, too many patients to see, not enough staff to support smooth running of clinic

8. How do you keep up to date/remain consistently aware of glaucoma medication adherence and its management? **(Behavioural regulation domain)**
   Prompt – use of guidelines/recommendations, CPD, courses, conferences

9. When it comes to managing patient adherence what are your main goals or priorities in clinic? How do these goals guide your actions or interactions with patients? **(Goals)**

"Thank you for your time today, I really appreciate you sharing your views and experiences. Is there anything else you would like to add that I haven't covered?"

S2: Description of content and framework analysis for data analysis

The analysis followed a stepwise process:

(1). **Familiarisation process**: After transcribing the interviews, an in-depth familiarisation process was undertaken, which involved reading and re-reading the transcripts and listening to the audio recordings to gain a comprehensive understanding of the data.

(2). **Deductive analysis:** Participant responses were coded into one of the TDF domains, categorising each response as either a barrier or enabler to eyedrop adherence. To guide this process a coding framework was collaboratively developed by the researchers (DB/AS/DE/JGL/PC) after the first two pilot interviews and refined throughout data collection. For example, if a participant mentioned they didn't take their medication due to not understanding its importance, this would be coded as a barrier under the *Knowledge* domain. The coding framework for both participant groups is available in Appendix S3. The primary researcher (DB) deductively coded all transcripts, and a second researcher (PC) independently coded the same data to enhance coding reliability. Any disagreements were resolved through discussion and consensus between DB and PC, or with input from a third reviewer (AS) when necessary.

(3). **Inductive analysis**: Key themes were generated for each participant group based on the data within each domain. These themes, referred to as "belief statements" in TDF literature, were categorised as barriers, enablers, or mixed influences on adherence (i.e., themes that acted as barriers for some participants and enablers for others). The primary researcher (DB) generated and classified the key themes. Two reviewers (PC and AS) independently reviewed the generated themes to ensure they accurately represented the data. Any discrepancies were resolved through discussion until consensus was reached.

(4). **Identifying salient domains**: The most prominent domains representing barriers and enablers to glaucoma medication adherence were identified using established criteria: (a) frequency of coding (number of participant responses within a TDF domain) (b) elaboration (number of themes per domain) (c) spontaneity (whether responses arose spontaneously or were prompted by the interview guide).

S3: Coding framework

Coding framework for patient group

Determinants (enablers/barriers) influencing patient glaucoma medication adherence as categorised by TDF domains together with illustrative quotes

TDF Domain and definition	Component constructs	Examples may include	Illustrative quotes
Knowledge – an awareness of the existence of something	Knowledge about condition/scientific rationale Knowledge of task environment Procedural knowledge	Discussions around patient's knowledge of: • Glaucoma progression through poor adherence • Rationale for using eyedrops • Consequences of adherence/non-adherence • Treatment application and regimen • Side effects of eyedrops Knowledge can be either extent of (enabler) or lack of (barrier)	*"it [eyedrops] controls the pressure so that the eyesight will not be affected"* (P016)
Skills – an ability or proficiency acquired through practice	Skills Skills development Competence Ability Practice Skill assessment Interpersonal skills	Discussions around patient physical and/visual skills needed to correctly administer eyedrops (enabler/barrier)	*"if I put one drop more than 10 drops used to come out as tears"* (P020)
Social/Professional Role and Identity – a coherent set of behaviours and displayed personal qualities of an individual in a social or work setting	Professional role and identity Social identity Identity Professional boundaries Professional confidence Group identity Leadership Organisational commitment	Discussions around how patients relate to people without glaucoma when they have to use their eyedrops (e.g. in a social/group setting) and take personal responsibility for adhering to treatment (enabler/barrier)	*"This is my responsibility [to keep using drops] because because I am an adult man…..I should take my responsibility"* (P015)
Beliefs about capabilities - acceptance of the truth, reality, or validity about an ability, talent, or facility that a person can put to constructive use	Self-confidence Perceived competence Self-efficacy Perceived behavioural control Beliefs Self-esteem Empowerment	Discussions about how confident patients feel about their ability to instil eyedrops correctly and/or manage their glaucoma (enabler/barrier) Also consider coding references about how confident a patient feels about admitting not having used their eyedrops to others to **Social influences**	*"independently putting the drop* [in myself] *will be difficult"* (P016)
Optimism - The confidence that things will happen for the best or that desired goals will be attained	Optimism Pessimism Unrealistic optimism Identity	Discussions about how likely patients think adhering to treatment will prevent sight loss/control glaucoma. Includes optimism (enabler), unrealistic optimism or pessimism (barrier)	*"Technology if* [I] *use it in a proper way it can be helpful particularly to remember* [to instil eyedrops] *in the future"* (P016)
Beliefs about consequences - acceptance of the truth, reality, or validity about outcomes of a behaviour in a given situation	Beliefs Outcome expectations Characteristics of outcome expectancies Anticipated regret Consequents	Discussions about patients accepting they have glaucoma (enabler/barrier) Discussions regarding patient perceptions about the nature of glaucoma and/or outcomes of treatment (enabler/barrier). Includes beliefs regarding benefits and concerns about unwanted side-effects/future side effects, how glaucoma or eyedrops may affect patients' life or cause symptoms	*"I realise that drops is more important than my job so I started putting it [drops] regularly after one month, one month or so"* [in 1st month of using drops patient regularly missed as workday was so hectic but after 1 month he realised how important it was to use correctly] (P024)
Reinforcement - increasing the probability of a response by arranging a dependent relationship, or contingency, between the response and a given stimulus	Inventives Punishment Consequents Reinforcement Contingences Sanctions	Discussions surrounding patient's response to: • receiving praise/encouragement for instilling eyedrops as prescribed (enabler) • receiving negative feedback for not instilling eyedrops correctly (barrier/enabler) • receiving feedback (either positive or negative) about nature of glaucoma and/or treatment e.g. from family members/carer/practitioner (enabler/barrier) Consider coding discussions about support rather than reinforcement from to **Social Influences**	

TDF Domain and definition	Component constructs	Examples may include	Illustrative quotes
Intentions – a conscious decision to perform a behaviour or a resolve to act in a certain way	Stability of intentions Stages of change model Transtheoretical model and stages of change	References from patients referring to their intentions to: • instil/not instil their eyedrops as prescribed (enabler/barrier) • continue/discontinue instilling their eyedrops (enabler/barrier)	*"if nobody is there [to put drops in] obviously I will learn and I will do it for myself"* (P020)
Goals - mental representations of outcomes or end states that an individual wants to achieve	Goals (distal / proximal) Goal priority Goal / target setting Goals (autonomous / controlled) Action planning Implementation intention	Discussions about patient motivation to adhere to treatment (enabler) Discussions regarding patient desire to retain as much sight as possible (enabler)	*[importance of using eyedrops] "I want to do much more. I mean, I think little research and then maybe I have to write some book and lot of my PhD material. So I wish I have some good sight for some more years"* (P021)
Memory, Attention and Decision Processes -the ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives	Memory Attention Attention control Decision making Cognitive overload/ tiredness	Discussions around whether patients forget to instil their eyedrops (either occasionally or more frequently) (barrier) Discussions around patients' ability to decide whether they instil their eyedrops or whether they decide to take occasional breaks from using eyedrops (enabler/barrier)	*"never forgot since the beginning. Whatever time it will be I will have it"* (P018) *"So many days so many days [forgotten to use drops]….two to three days in a week"* (P017)
Environmental Context and Resources - any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence, and adaptive behaviour	Enviromental stressors Resources / material resources Organisational culture / climate Salient events / critical incidents Person x environment interaction Barriers and facilitators	Discussions around issues with health care system influencing patient adherence e.g. busy eye clinics, time constraints in clinic, difficulties obtaining follow up appointments, limited staff Discussions around circumstantial factors influencing patient adherence e.g. complexity of eyedrop regimen, work patterns, away on holiday, existence of side effects, financial issues, being dependent on a carer/family member to instil eyedrops and/or collect medications (barrier) Discussions around obtaining medication e.g. availability of eyedrops, access to chemist, financial implications of purchasing medication (enabler/barrier) Discussions around organisational structure to support patient if they have a problem using their eyedrops (e.g. provision of helpline) (enabler) Discussions around resources that encourage/ discourage patient adherence e.g. YouTube videos (enabler/barrier)	*"It's only one drop then it is not a problem"* (P018) *"The price is actually expensive. I don't know how the prices are in other countries, but at least for Indian people, right, the price is expensive"* (P022)
Social Influences - those interpersonal processes that can cause individuals to change their thoughts, feelings, or behaviours	Social pressure Social norms Group conformity Social comparisons Group norms	Discussions referring to influences, either positive or negative, patients/family/carers/other HCPs/support groups have in aiding patient adherence (enabler/barrier)	*it's doctor advise…..don't stop your putting your eyedrop….continue until your death…..because we obey the doctor's advice always"* (P015)

TDF Domain and definition	Component constructs	Examples may include	Illustrative quotes
	Social support Power Intergroup conflict Alienation Group identity Modelling	Discussions around the influence clinician-patient relationships have on patient adherence behaviour (enabler/barrier) Discussions around trust/respect or lack of trust/ respect patients have in doctors and/medical institution (enabler/barrier) Discussions around previous experiences with family members/friends influencing adherence behaviour (enabler)	" *"I trust my doctor because without trust, nothing will work. I absolutely trust her" [when Doctor says I need to use the drops]* (P020)
Emotion – a complex reaction pattern, involving experiential, behavioural, and physiological elements, by which the individual attempts to deal with a personally significant matter or event	Fear Anxiety Affect Stress Depression Positive/negative effect Burn-out	Discussions about how patients feel (could be positive or negative): • having to instil eyedrops • losing sight as a result of non-adherence • when eyedrops are unavailable (Enabler/barrier) Discussions about patient feelings/emotions/ reaction when having to admit they have not used their eyedrops (barrier)	*"He's worried about that"* [losing his sight if he does not use his eyedrops] (P023)
Behavioural Regulation - anything aimed at managing or changing objectively observed or measured actions	Self-monitoring Breaking habit Action planning	Discussions about strategies/techniques patient uses to help with adherence (enabler)	*"Yeah, yeah. Alarm is also there. Yeah, I use from my mobile*" (P014)

Coding framework for Ophthalmologists

Determinants (enablers/barriers) influencing ophthalmologists management of glaucoma medication adherence as categorised by TDF domains together with illustrative quotes

TDF Domain and definition	Component constructs	Examples may include	Illustrative quotes
Knowledge – an awareness of existence of something	Knowledge about condition/scientific rationale Knowledge of task environment Procedural knowledge	References from ophthalmologist demonstrating their knowledge/lack of knowledge of medication adherence and consequences of non-adherence (enabler/barrier) Understanding of patient factors e.g. socioeconomic background, ethnicity, general health status and factors which influence adherence behaviour (enabler) Discussions around knowing how to classify/ define patient as adherent/non-adherent (enabler)	*"Personally, I don't have a clear-cut answer"* [in terms of classifying patient as adherent/nonadherent] (E016)
Skills – an ability or proficiency acquired through practice	Skills Skills development Competence Ability Practice Skill assessment Interpersonal skills	Discussions demonstrating ophthalmologist skills in educating patients on nature of glaucoma and/or treatment and/or treatment application techniques (enabler/barrier) Discussions around skills needed to inquire about/assess adherence (e.g. listening, questioning, relationship building) (enabler)	*"what we do is we ask them a leading question and find out as to why the. If they are non-compliant, we need to understand why the non-compliance is and if it is just problem with understanding we try and explain it"* (E014)
Social/Professional Role and Identity – a coherent set of behaviours and displayed personal qualities of an individual in a social or work setting	Professional role and identity Social identity Identity Professional boundaries	Discussions around ophthalmologist role or professional responsibility to ensure patient adheres to treatment (enabler)	*"I believe that only since I am the one who is treating them I tell them"* [about the importance of adherence] (E019)

TDF Domain and definition	Component constructs	Examples may include	Illustrative quotes
	Professional confidence Group identity Leadership Organisational commitment	Ophthalmologists referring to integrating their role with other HCPs/patients to encourage adherence (enabler) Consider coding references about support provided by ophthalmologists to **Social Influences**	
Beliefs about capabilities - acceptance of the truth, reality, or validity about an ability, talent, or facility that a person can put to constructive use	Self-confidence Perceived competence Self-efficacy Perceived behavioural control Beliefs Self-esteem Empowerment Professional Confidence	Discussions about how confident an ophthalmologist feels identifying or managing non-adherence (enabler/barrier) Ophthalmologist referring to how difficult it is to influence medication adherence behaviours (barrier)	*"I think I'm reasonably confident enough to identify the patient"* [who is non-adherent](E023)
Optimism - The confidence that things will happen for the best or that desired goals will be attained	Optimism Pessimism Unrealistic optimism Identity	References to being optimistic/pessimistic about how to manage medication adherence	
Beliefs about consequences - acceptance of the truth, reality, or validity about outcomes of a behaviour in a given situation	Beliefs Outcome expectations Characteristics of outcome expectancies Anticipated regret Consequents	Ophthalmologist beliefs about the positive outcomes of patients adhering to treatment (e.g. saves sight, reduces unnecessary changes to medications, less follow ups, reduces burden on health system) (enabler)	*"what I feel that if I don't give that 2 minutes extra time today, I have to spend half an hour, one-hour extra time on some other day convincing to have surgery and having also explaining the complications of the surgery...so it's better to spend 2 minutes extra today rather than having to spend one hour and some other extra times later on"* (E016)
Reinforcement - increasing the probability of a response by arranging a dependent relationship, or contingency, between the response and a given stimulus	Incentives Punishment Consequents Reinforcement Contingencies Sanctions	Discussions about ophthalmologists reiterating importance of adherence (enabler) Discussions about ophthalmologists repeating education surrounding nature of glaucoma, rationale for treatment and instillation technique to promote patient adherence (enabler/barrier) Consider coding discussions about support rather than reinforcement from to **Social Influences**	*"I keep counselling them as much as possible"* [in terms of being adherent] (E023)
Intentions – a conscious decision to perform a behaviour or a resolve to act in a certain way	Stability of intentions Stages of change model Transtheoretical model and stages of change	Discussions around ophthalmologist intentions to aid patients' adhering to treatment	*"you know, working towards the goal of getting full 100% compliance we have to try to help them* [non adherent patients] *so like, we recommend"* [solutions to help] (E023)
Goals - mental representations of outcomes or end states that an individual wants to achieve	Goals (distal / proximal) Goal priority Goal / target setting Goals (autonomous / controlled) Action planning Implementation intention	Discussions about how important it is to ophthalmologists to ensure patients adhere to treatment (enabler/barrier) Discussions about how important it is for ophthalmologists to address adherence issues (enabler)	*"It is very important* [to try and ensure patient is adherent to treatment] *and that is the sole thing in getting the glaucoma* [controlled]…*I feel that is very important"* (E018)

TDF Domain and definition	Component constructs	Examples may include	Illustrative quotes
Memory, Attention and Decision Processes -the ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives	Memory Attention Attention control Decision making Cognitive overload/ tiredness	Discussions about ophthalmologists tailoring treatment or management decisions to suit individual patient needs or clinical findings (enabler) Discussions about using clinical information to decide if patient adherent/non-adherent (enabler)	*"what I do in such a scenario is give, first the first possible alternative is giving them a medication which is of low cost...we give them an alternative which is within their living standards..and the second thing is to advise them surgery...over a shorter period of time is more cost effective than being on long term glaucoma treatment"* (E019)
Environmental Context and Resources - any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence, and adaptive behaviour	Environmental stressors Resources / material resources Organisational culture / climate Salient events / critical incidents Person x environment interaction Barriers and facilitators	Discussions about challenges working in busy clinics, time constraints, issues with appointment systems, type of clinic or limited staff (barrier) Discussions around organisational structure to support ophthalmologist management of non-adherence (e.g. provision of emergency service/ teleconsultations) (enabler) Discussions around issuing prescriptions e.g. manufacturing issues, non-availability (barrier) Discussions around availability of physical resources e.g. leaflets, patient websites (enabler/ barrier)	*"that personal talk so I think that's the big challenge also because we have the time time problem. Yeah. So so many patients in a day, we really don't have time to we really have problem in finding time"* [to fully educate patient] (E016) *"teleconsultations, we do have that as well. So each of us on a day like tomorrow, I have telecom calls like on the day that I do the clinic, I also have a teleconsultations where... my own patient, can get in touch. They can book an online teleconsultations.... also be a video consult like I can see the person...and usually medication related and things like that"* (E014)
Social Influences - those interpersonal processes that can cause individuals to change their thoughts, feelings, or behaviours	Social pressure Social norms Group conformity Social comparisons Group norms Social support Power Intergroup conflict Alienation Group identity Modelling	Ophthalmologists referring to their influence, either positive or negative, on how they aid adherence (enabler/barrier) Discussions around the influence clinician-patient relationships have on patient adherence behaviour and admitting non-adherence (enabler/ barrier) Discussions around overall team approach	*"if we see each other a couple of times then obviously the relationship builds up" (E016)* *"And the optometrist keep changing and the doctor is the same person who's seeing them...then we realise that what they tell the optometrist versus what they tell the doctor different……*[because*] I guess the doctor knows that person"* (E014)
Emotion – a complex reaction pattern, involving experiential, behavioural, and physiological elements, by which the individual attempts to deal with a personally significant matter or event	Fear Anxiety Affect Stress Depression Positive/negative effect Burn-out	Discussions about stress experienced when managing adherence issues e.g. due to time constraints (barrier)	*"it's heartbreaking to see a patient after years of care coming and showing that they can't put the drugs"* [in correctly] (E021)

TDF Domain and definition	Component constructs	Examples may include	Illustrative quotes
Behavioural Regulation - anything aimed at managing or changing objectively observed or measured actions	Self-monitoring Breaking habit Action planning	Discussions around ophthalmologists developing strategies so they are consistently aware/up to date with glaucoma medication adherence and its management (e.g. the use of guidelines/ recommendations) (enabler)	*"we have something called as a medical audit that we do. So we do the audits…….So when there are issues related to the, everything starting from history to evaluation to management to referral, everything is looked at and if there are any problems that is noted and will be presented and that will be, you know, discussed with the person"* [doing monthly departmental audits helps to some extent with keeping up to date with adherence issues] (E014)

S4 Supplementary Table

Themes identified in non-salient TDF domains and illustrative quotes from patients

Theme	Barrier/Enabler/ Mixed	Illustrative quote(s)
TDF domain: Social professional role and identity		
Patient autonomy (patient regards taking eyedrops as their responsibility regardless of setting)	Enabler	*"I am the sufferer. I am responsible for this I use the drops"* (P014)
TDF domain: Beliefs about capabilities		
Belief in own capability to use eyedrops long-term	Barrier	*"If someone else will put* [the drops in], *it'll be better rather than we administering on ourselves"* [not confident with own ability to instil drops] (P020)
TDF domain: Goals		
Not wanting to lose sight/go blind	Enabler	*"I have glaucoma, I have to see the world for a long time. That's why"* [I take the drops] (P017)
TDF domain: Emotion		
Fear of nonadherence and/or consequences of nonadherence	Enabler	*"Fortunately, it is only one medication now. That's why I'm a little relieved and a little comfortable"* (P021)
TDF domain: Intentions		
Intention will continue to instil eyedrops	Enabler	*"if nobody is there [to put drops in] obviously I will learn and I will do it for myself"* (P020)
TDF domain: Optimism		
Optimistic using technology can help with adherence	Barrier	*"Technology if* [I] *use it in a proper way it can be helpful particularly to remember* [to instil eyedrops] *in the future"* (P016)

Themes identified in non-salient TDF domains and illustrative quotes from Ophthalmologists

Theme	Barrier/Enabler/ Mixed	Illustrative quote(s)
TDF domain: Beliefs about consequences		
Belief in the positive outcomes of patient adherence	Enabler	*"when you try and explain things to them, do it the right way…. if you spend that extra 5 minutes it's going to help them for the rest of their life"* (ECP014)
TDF domain: Reinforcement		
Reinforcing adherence	Enabler	*"I keep telling them that even on the day of the examination you have to put the drops...I keep counselling them as much as possible"* (ECP023)
TDF domain: Intentions		
Ophthalmologist intentions to aid adherence	Enabler	*"you know, working towards the goal of getting full 100% compliance we have to try to help them [non adherent patients]So like, we recommend"* [solutions to help] (ECP023)
TDF domain: Goals		
Prioritising patient adherence	Enabler	*"It is very important* [to ensure patient is adherent] *and that is the sole thing in getting the glaucoma"* [controlled] (ECP018)
TDF domain: Behavioural Regulation		
Facilitating adherence management through action planning and habit formation	Enabler	*"they're supposed to tick mark, which means that they have explained it to the patient. So we even audit that have they really explained the medications to the to the patients?"* (ECP014)
TDF domain: Emotion		
Negative emotions associated with managing nonadherence	Barrier	*"it's heartbreaking to see a patient after years of care coming and showing that they can't put the drugs"* [in correctly] (E021)