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1 **Title: Factors Influencing Glaucoma Medication Adherence: A Qualitative Study in the United**
2 **Kingdom Using the Theoretical Domains Framework**

3 **Introduction**

4 Glaucoma is a progressive optic neuropathy characterized by loss of retinal ganglion cells (RGCs),
5 leading to irreversible vision loss if untreated.¹ It is a leading cause of irreversible blindness
6 worldwide, with prevalence projected to reach 111.8 million people by 2040.^{2,3} Lowering intraocular
7 pressure (IOP) remains the only proven strategy to slow disease progression,⁴ most commonly
8 achieved through long-term use of topical ocular hypotensive medications. However, the effectiveness
9 of treatment is dependent on sustained patient adherence.⁵

10 Adherence to glaucoma medication requires patients to adopt and maintain complex health-related
11 behaviors over time.^{6,7} Despite its importance, adherence to long-term glaucoma therapy remains
12 suboptimal,⁸ with reported rates ranging from 30% to 70% depending on definitions and measurement
13 methods.⁹ Poor adherence is associated with faster disease progression, higher health care costs,
14 and reduced quality of life.^{5,10,11} This can compromise patients' ability to carry out everyday activities,
15 with implications for their independence and overall wellbeing. With an estimated 76 million people
16 aged 40-80 living with glaucoma in 2020,³ even conservative adherence estimates suggest a
17 substantial number of individuals are at risk of preventable vision loss.¹² As the global burden of
18 glaucoma increases, addressing medication adherence represents a critical and potentially modifiable
19 determinant of improving clinical, social, and economic outcomes.

20 Understanding the factors that influence medication-taking behavior is essential for developing
21 effective interventions. While many adherence interventions focus primarily on patient behavior, the
22 role of eye care professionals (ECPs) in identifying, supporting, and managing nonadherence is
23 equally important. ECPs are responsible for assessing adherence during clinical encounters and
24 recommending strategies to support patients; however, nonadherence is often difficult to detect
25 accurately.^{13,14}

26 The United Kingdom (UK) Clinical Eye Research study, which aimed to identify research priorities for
27 clinical eye care in the UK, recently ranked nonadherence to glaucoma medication among the top 10
28 priorities for glaucoma care.¹⁵ To develop effective, evidence-based strategies, it is essential to
29 understand the behavioral determinants that facilitate or hinder correct eyedrop use. Interventions

30 aimed at improving adherence are more likely to succeed when they target these underlying
31 determinants of behavior.¹⁶

32 Behavioral science frameworks offer structured approaches for examining the determinants of health-
33 related behaviors. The Theoretical Domains Framework (TDF) integrates constructs from multiple
34 behavior change theories into 14 domains encompassing personal, social, and environmental
35 influences on behavior.¹⁷ The TDF has been widely applied to medication adherence in other chronic
36 conditions^{18–20} and is linked to evidence-based behavior change techniques (BCTs) that support the
37 development of theory-informed interventions targeting the root causes of behavior.^{21,22} However, its
38 application within glaucoma care remains limited.²³

39 Previous work has largely examined barriers and enablers to glaucoma medication adherence from
40 the patient perspective alone. Few studies have applied a comprehensive behavioral framework to
41 explore adherence-related behaviors from both patient and ECP perspectives within a single study.
42 Addressing this gap is important for developing interventions that are feasible, acceptable, and
43 effective in real-world clinical practice.

44 The aim of this study was to explore the behavioral factors influencing glaucoma medication
45 adherence in the UK. Specifically, the study sought to identify key barriers and enablers to adherence
46 from the perspectives of both patients with glaucoma and ECPs involved in their care, and to
47 determine which TDF domains are most relevant to adherence-related behaviors in each group.

48 **Methods**

49 **Standards and Ethics**

50 This manuscript follows the Standards for Reporting Qualitative Research (SPQR) guidelines.²⁴ Ethical
51 approval was granted by the Research Ethics Committee of the Department of Optometry and Visual
52 Science at City St George's, University of London, UK (Ethics Approval Number: ETH2122-1657). All
53 participants provided written informed consent. The study adhered to the principles of the Declaration
54 of Helsinki.

55 **Study design**

56 A qualitative study using semi-structured interviews was conducted to explore factors influencing
57 glaucoma medication adherence. Interview guides were informed by the TDF, with questions mapped

58 across the 14 domains. Separate interview guides were developed for patients and ECPs, each
59 tailored to their specific adherence-related behaviors. Patient interviews focused on behaviors related
60 to the use of eyedrops, whereas ECP interviews centered on their approaches to managing
61 medication adherence in clinical practice.

62 Questions were designed to facilitate open discussion rather than systematically addressing each
63 TDF domain, allowing participants to express their views freely.²⁵ The guides were informed by
64 previous research²³ and recommendations from researchers within the team (AS, JGL) experienced
65 in qualitative research and behavior change studies. Both guides were piloted with one patient and
66 one ECP, and minor refinements were made based on feedback. Final interview guides are provided
67 in Appendix 1.

68 **Participants and recruitment**

69 Two participant groups were recruited: adults currently prescribed or previously prescribed one or more
70 IOP-lowering eyedrops, and UK-registered ECPs (ophthalmologists, optometrists, orthoptists, or nurse
71 practitioners) involved in glaucoma management in either primary or secondary care settings.

72 Patients were recruited via the charity Glaucoma UK (website, magazine and telephone helpline), and
73 social media (e.g., X formerly Twitter, LinkedIn). Purposive sampling aimed to ensure diversity in age,
74 ethnicity, geographical location, number of prescribed eyedrops, and duration of use. ECPs were
75 recruited through professional bodies (e.g., Royal College of Ophthalmologists, College of
76 Optometrists, British and Irish Orthoptic Society), social media, and the UK and Eire Glaucoma Society
77 (UKEGS) annual conference. Sampling aimed for diversity in profession, experience, ethnicity, and
78 location.

79 **Procedure**

80 One-to-one interviews were conducted online via Zoom (San Jose, CA, Zoom Video Communications
81 Inc) by the same researcher (DB) between September 2022 and February 2023. Video was enabled to
82 facilitate rapport. Interviews were audio-recorded, transcribed verbatim, and anonymized prior to
83 analysis.

84 **Sample size**

85 Sample sizes were guided by principles of data saturation in theory-informed interviews.²⁶ Following
86 the approach described by Francis et al.²⁶, we predefined an initial analysis sample of 10 interviews,
87 after which additional interviews were conducted until no new themes emerged in a pre-specified
88 number of consecutive interviews (n=3).

89 **Researcher characteristics and reflexivity**

90 The interviewer (DB) is an experienced ECP working in glaucoma care. While this background
91 supported rapport and contextual understanding, reflexivity was maintained throughout to minimize
92 potential biases in data interpretation. DB actively reflected on how her professional experience might
93 influence data collection and interpretation, always trying to ensure that participants' perspectives were
94 accurately represented.

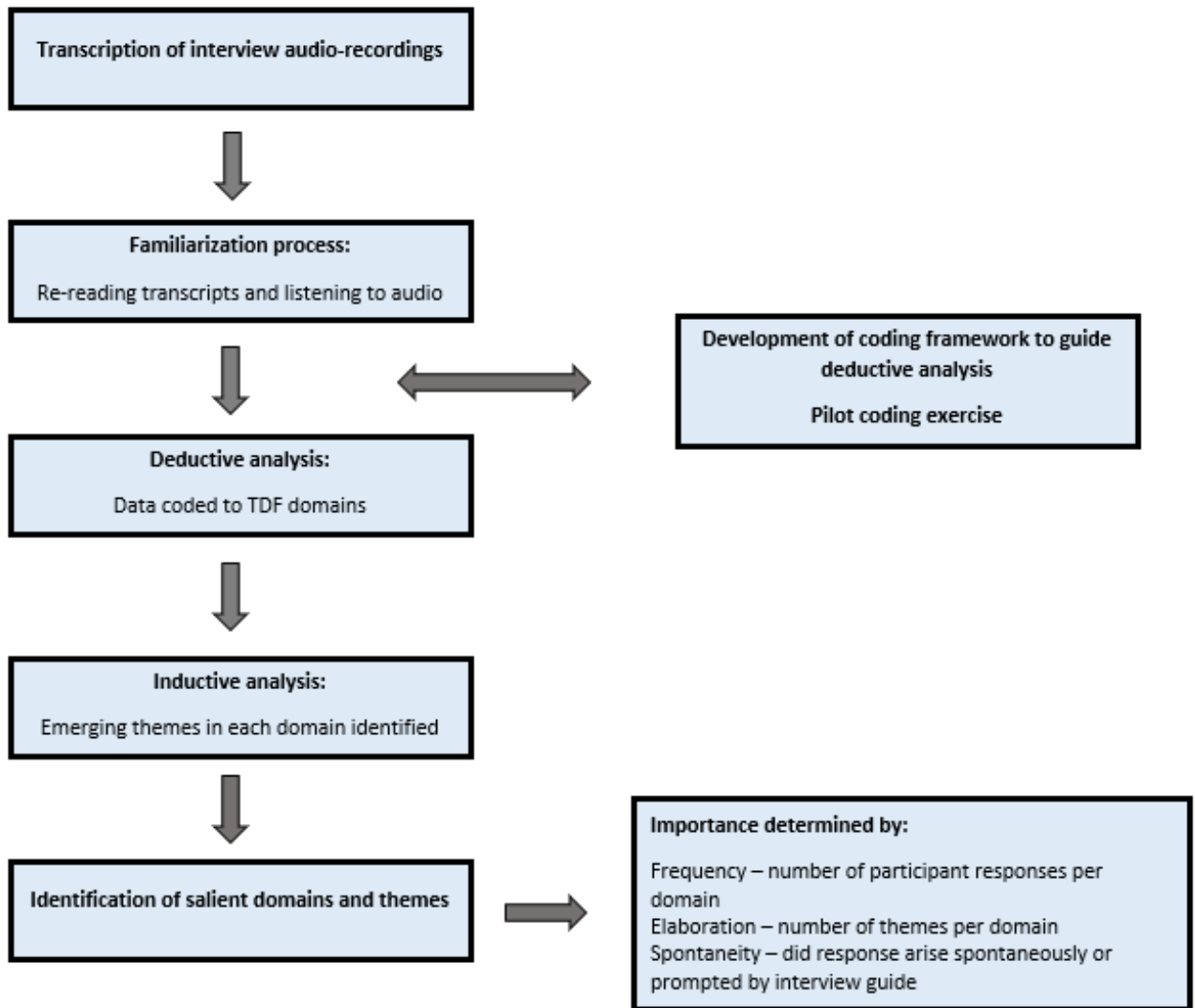
95 **Data analysis**

96 Data were organized using NVivo 12 software (QST International, Doncaster, Australia). Analysis was
97 conducted separately for patients and ECPs to preserve the distinct perspectives of each group, using
98 a combined content and framework approach (see Figure 1).²⁷

99 Transcripts were first coded deductively to the 14 TDF domains using a coding framework developed
100 collaboratively by the research team. Within each domain, patient responses were classified as
101 enablers when they were described as facilitating correct and consistent eyedrop use and as barriers
102 when they reflected factors that hindered or disrupted medication use, irrespective of adherence
103 group. ECP responses were classified as enablers when they were perceived to support adherence
104 management and as barriers when they represented challenges to identifying or supporting
105 adherence. Inductive thematic analysis was then undertaken within each domain to identify patterns
106 and generate themes representing key barriers and enablers to glaucoma medication adherence.

107 Coding was performed independently by two researchers, with discrepancies resolved through
108 discussion and iterative refinement of the coding framework. Salient domains were identified using
109 established criteria of frequency (number of participants contributing to a domain), elaboration
110 (number of themes generated within a domain), and spontaneity (extent to which responses were
111 raised without prompting).^{28,29}

112 The most important TDF domains were subsequently mapped to the Behavior Change Wheel (BCW)
113 using a systematic, structured approach guided by established TDF–BCW linking frameworks.³⁰ Two
114 researchers independently reviewed each domain to identify the underlying behavioral sources
115 (capability, opportunity, motivation) and the corresponding BCW intervention functions. Any
116 discrepancies were discussed and resolved through consensus. The mapped domains then guided
117 the identification of relevant BCTs using the Theory and Techniques Tool, which provides validated
118 links between mechanisms of action and BCTs, supporting transparent and theoretically grounded
119 selection of behaviour change techniques.³¹



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123 **Results**

124 **Participant characteristics**

125 13 patients and 13 ECPs participated. Patient interviews ranged from 28 to 75 minutes (mean 57
126 minutes), and ECP interviews ranged from 25 to 55 minutes (mean 40 minutes). Data saturation was
127 reached after 13 interviews in each group.

128 Based on self-reported medication use over the previous month, 10 patients described themselves as
129 adherent (missed eyedrops once or not at all in the past month), two as unintentionally nonadherent,
130 and one as intentionally nonadherent. Seven of the ECPs were qualified to prescribe glaucoma
131 medications. Participant characteristics are summarized in Table 1 (patients) and Table 2 (ECPs).

Table 1 Patient participant demographics

Patient demographics		N (%) N=13 total
Gender	Female	6 (46)
	Male	7 (54)
Age (years)	31-45	1 (8)
	46-60	4 (31)
	61-74	6 (46)
	75-90	2 (15)
Ethnicity	White British	11 (85)
	White Other	1 (8)
	Caribbean British	1 (8)
Location	England	11 (85)
	Wales	1 (8)
	Scotland	1 (8)
Highest level of education	School education (up to 16)	3 (23)
	School education (up to 18)	2 (15)
	Degree or higher	8 (62)
Occupational status	Full-time job	6 (46)
	Part-time job	2 (15)
	Retired	5 (38)
Type of glaucoma (according to patient)	POAG	9 (69)
	PACG	2 (15)
	2 ^o glaucoma	2 (15)
Number of topical glaucoma medications ¹	1	4 (33)
	2	4 (33)
	3	1 (8)
	4	3 (25)
Duration of glaucoma eyedrop usage (years)	<5	4 (31)
	5-10	3 (23)
	11-20	3 (23)
	30-35	2 (15)
	>50	1 (8)
Number of eyedrop instillations per day ¹	1	4 (33)
	2	2 (17)
	>2	6 (50)
Eyedrop administration ¹	Self-administer	10 (83)
	Dependence on others	2 (17)
¹ P009 currently not using eyedrops since had surgery in 2021 hence N=12		

134 **Table 2** ECP participant demographics

ECP demographics		N (%) N=13 total
Gender	Female	11 (85)
	Male	2 (15)
Age (years)	18-30	3 (23)
	31-45	6 (46)
	46-60	4 (31)
Ethnicity	White	6 (46)
	Asian	6 (46)
	Afro-Caribbean	1 (8)
Location in UK	London	7(54)
	Yorkshire	2(15)
	Liverpool	1(8)
	Kent	1(8)
	Birmingham	1(8)
	Cornwall	1(8)
Profession	Optometrist	3 (23)
	Ophthalmologist	4 (31)
	Orthoptist	4 (31)
	Nurse Practitioner	2 (15)
Time worked in glaucoma care (years)	<1	1 (8)
	5-10	6 (46)
	11-16	4 (31)
	21-26	2 (15)

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137 **Overview of salient TDF domains**

138 Barriers and enablers to glaucoma medication adherence were identified across 12 of the 14 TDF
139 domains for patients and 11 domains for ECPs. Using established criteria of frequency, elaboration,
140 and spontaneity, nine domains were identified as particularly salient for patients and seven for ECPs
141 (Table 3). A summary of the themes generated within these salient domains is presented below, with
142 particular attention to contrasts between participants who classified as adherent and nonadherent.
143 Illustrative quotations are provided in Tables 4 (patients) and 5 (ECPs).

144 **Patient perspectives**

145 Patient adherence behaviors were most frequently associated with the domains of *Environmental*
146 *Context and Resources; Skills; Goals; Memory, Attention and Decision Processes; Social Influences;*
147 *Behavioral Regulation; Knowledge; Beliefs about Capabilities; and Beliefs about Consequences.*

148 Commonly reported barriers included disruptions to routine, difficulties obtaining medication (including
149 pharmacy stock shortages and prescription delays), physical challenges with drop instillation,
150 particularly early in treatment, and forgetfulness. Forgetting to instill eyedrops was more frequently
151 reported by nonadherent patients, however adherent patients described it became more challenging to
152 remember to instill them at the correct time when they were particularly tired. Health system factors,
153 such as limited access to clinics or difficulties contacting services, were also described as barriers.

154 In contrast, enablers included practical skills related to ordering and organizing medication supplies
155 (e.g., forward planning, electronic prescription ordering, and home delivery services), the establishment
156 of routines, access to social support, confidence in administering eyedrops, and understanding the
157 purpose of treatment. While adherent patients generally demonstrated awareness of the role of
158 eyedrops in controlling IOP, gaps in practical knowledge particularly regarding timing and technique,
159 were reported by unintentionally nonadherent participants. Beliefs about preserving vision and
160 confidence in sustaining long-term treatment were prominent among adherent patients, whereas
161 skepticism about treatment necessity and doubts about ongoing use were reported by the intentionally
162 nonadherent participant.

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Table 3 Relevance of Theoretical Domains Framework (TDF) domains to medication adherence based on frequency, elaboration, and spontaneity for Patients and Eye Care Professionals (ECPs)
Frequency indicates the number of participant responses per domain, elaboration the number of themes per domain, and spontaneity the number of unprompted responses

TDF Domain	Patient group			TDF Domain	ECP group		
	Frequency (number of patients reporting barriers/enablers within domain, max N=13)	Elaboration (number of themes per domain)	Spontaneity (frequency of spontaneous response)		Frequency (number of patients reporting barriers/enablers within domain, max N=13)	Elaboration (number of themes per domain)	Spontaneity (frequency of spontaneous response)
Environmental Context and Resources	13	4	0	Environmental Context and Resources	13	5	2
Skills	12	2	0	Social/ Professional Role and Identity	12	1	1
Goals	13	1	0	Beliefs about capabilities	13	1	0
Memory, Attention and decision processes	13	1	0	Knowledge	12	1	0
Social Influences	11	1	2	Skills	12	1	0
Behavioral Regulation	13	1	0	Memory, Attention and decision processes	11	1	0
Knowledge	11	1	1	Behavioral Regulation	6	1	3
Beliefs about capabilities	10	1	0	Reinforcement	6	1	0
Beliefs about consequences	8	1	2	Social Influences	4	1	0
Emotion	5	1	0	Beliefs about consequences	4	1	0
Social/ Professional Role and Identity	3	1	0	Goals	2	1	1
Intentions	2	1	0	Optimism	0	0	0
Optimism	0	0	0	Intentions	0	0	0
Reinforcement	0	0	0	Emotion	0	0	0

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168 **Eye care professional perspectives**

169 For ECPs, adherence management was primarily associated with *Environmental Context and*
170 *Resources; Social/Professional Role and Identity; Beliefs about Capabilities; Knowledge; Skills;*
171 *Memory, Attention and Decision Processes; and Behavioral Regulation.*

172 Time constraints, limited staffing, and lack of educational resources were frequently identified as
173 barriers to addressing adherence in clinical practice. Medication availability and inconsistencies in
174 prescribing by other health care professionals (HCPs), such as general practitioners (GPs), were also
175 reported to complicate adherence management. In contrast, multidisciplinary team structures,
176 involvement of glaucoma nurses or Eye Clinic Liaison Officers (also known as ECLOs),³² and issuing
177 clinic letters directly to patients were identified as enablers.

178 ECPs viewed adherence management as a core professional responsibility, particularly among
179 prescribing clinicians. However, confidence in identifying nonadherence varied, with many expressing
180 uncertainty when relying on patient self-reporting. Uncertainty regarding how to define acceptable
181 adherence further hindered consistent management. Communication and patient education skills were
182 described as important enablers and were perceived to improve with experience. Tailoring treatment
183 decisions to individual patient circumstances, including simplifying regimens or considering alternatives
184 such as selective laser trabeculoplasty (SLT), was also described as supporting adherence
185 management.

Table 4 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: Knowledge		
An understanding of glaucoma and treatment rationale	Enabler	<i>'to keep your pressure down to reduce the damage at the back of your eye...ultimately, reducing that damage is going to slow down sight loss'</i> (P003)
TDF domain: Skills		
Skills needed to order ongoing supplies of eyedrops	Enabler	<i>'I signed up with Lloyds Direct...I just request [my eyedrops] by mail'</i> (P007)
Poor physical skills and/or lacks vision required to instill eyedrops	Barrier	<i>'my hands were very swollen and weak...I had trouble opening the bottle, especially when it was new'</i> (P012)
TDF domain: Beliefs about capabilities		
Believing can continue to use eyedrops long-term	Enabler	<i>'I'm completely confident that I can continue doing it'</i> [instilling eyedrops] (P013)
TDF domain: Beliefs about consequences		
Believing eyedrops are necessary to preserve sight	Enabler	<i>'when I decided I'm stopping medications, I didn't stop my eyedrops...to me that has been far more important than all the other tablets...I suppose it's the preserving of eyesight'</i> (P001)
TDF domain: Goals		
Not wanting to lose sight/go blind	Enabler	<i>'It would be pretty disastrous for the lifestyle we lead'</i> [losing eyesight] (P002)
TDF domain: Memory, Attention and decision processes		
Forgetting to instill eyedrops as prescribed	Barrier	<i>'I can be quite forgetful about putting my drops in...at least once a week I forget to put them in'</i> (P012)
TDF domain: Environmental Context and Resources		
Change in lifestyle	Barrier	<i>'It's even trickier when you go away'</i> [instilling eyedrops] (P008)
Difficulties obtaining medication	Barrier	<i>'but that one [Simbrinza eyedrops] repeatedly would be out of stock'</i> (P009)
Issues within the healthcare system	Barrier	<i>'Even when I got the secretary's phone number, left a message. No one called me back.'</i> [when patient had an issue with eyedrops] (P005)
Nature of eyedrop container	Enabler	<i>'I always carry the pilocarpine...It's a minim...it just fits...in your jeans'</i> (P010)
TDF domain: Social Influences		
Positive social influence from family/partner/charities/HCPs	Enabler	<i>'One thing that's motivated me to follow the regime more correctly, has been a session I had just by accident – Glaucoma UK did a small workshop one morning'</i> (P001)
TDF domain: Behavioral Regulation		
Developing a routine and/or reminder strategies	Enabler	<i>'I'm going to bed this is the perfect time. Put my head on the pillow, Brenda then just puts the eyedrops in, gives me a good-night kiss, job done'</i> (P007)
Codes such as P001 refer to anonymized patient participants		

Table 5 Summary of key themes and illustrative quotes from Eye Care Professionals assigned to TDF domains identified as relevant to adherence management behavior

Theme	Barrier/Enabler/ Mixed	Illustrative quote(s)
TDF domain: Knowledge		
Difficulties classifying an acceptable level of adherence	Barrier	<i>'it's difficult to have an exact cut-off'</i> (ECP009 Ophthalmologist)
TDF domain: Skills		
Practitioner communication, education and clinical skills	Enabler	<i>'I ask them an open-ended question about their drops...in a way that they're going to feel comfortable to say, I'm not really using them'</i> (ECP004 Optometrist)
TDF domain: Social/Professional Role and Identity		
Professional role in the management of adherence	Enabler	<i>'we have a duty to make sure we've educated the patient so...they understand why they're on treatment'</i> (ECP005 Orthoptist)
TDF domain: Beliefs about capabilities		
Perceived confidence/lack of confidence in own ability to identify nonadherence	Mixed	<i>'I would feel fairly confident...trying to identify people who are adherent'</i> (ECP008 Ophthalmologist) Enabler <i>'I've got no idea...as a clinician, you don't really know'</i> [if patient is adherent or not] (ECP004 Optometrist) Barrier
TDF domain: Memory, Attention and decision processes		
Tailoring decision-making process according to patient needs	Enabler	<i>'I'm looking at why they're not compliant, if they're suitable for a selective laser trabeculoplasty'</i> (ECP013 Optometrist)
TDF domain: Environmental Context and Resources		
Lack of time	Barrier	<i>'we've only got a finite amount of time...that can be a bit of a barrier'</i> (ECP005 Orthoptist)
Lack of resources (manpower/materials)	Barrier	<i>'there's less resources out there...we used to get District Nurses involved but that's really difficult... nowadays you haven't got those options'</i> [to help patients put their eyedrops in] (ECP001 Nurse practitioner)
Multidisciplinary team/organizational structure	Enabler	<i>'they have dedicated ophthalmic nurses within the glaucoma team...they work very well to communicate levels of questions to their patients...that's helpful'</i> (ECP008 Ophthalmologist)
Issuing clinic letters directly to patient after their appointment	Enabler	<i>[I] 'always give a letter...if they get home and are confused about the regime then they can look at the letter and it's all documented what drops they're to take'</i> (ECP001 Nurse practitioner)
Lack of availability of medications	Barrier	<i>'on more than a few occasions [patients] not being able to get the actual drops due to GPs not continuing prescribing'</i> (ECP011 Orthoptist)
TDF domain: Behavioral Regulation		
Action planning and/or habit formation	Enabler	<i>[I attended] 'a talk about educating patients and sight loss in glaucoma...following on from that I started using [visual illustrations] in my own practice'</i> (ECP005 Orthoptist)
Codes such as ECP001 refer to anonymized eye care professional participants		

192 **Discussion**

193 This study used the TDF framework to identify behavioral barriers and enablers influencing glaucoma
194 medication adherence. A key strength is its dual focus on patients and ECPs, addressing a notable
195 gap in the glaucoma adherence literature. While previous research has largely examined patient-
196 reported factors,^{33–35} this is, to our knowledge, the first study to systematically explore adherence-
197 related-behaviors from both perspectives using a shared theoretical framework. The findings expand
198 current understanding of adherence, highlighting its complexity, shaped by interacting personal,
199 professional, and system-level influences rather than any single determinant.^{23,36}

200 **Interpretation of Key Findings**

201 From the patient perspective, adherence was supported by understanding the purpose of treatment,
202 confidence in the ability to use eyedrops long-term, and strong motivation to preserve vision. These
203 enablers were most evident among participants who described consistent routines, adequate physical
204 ability to instill drops, perceived treatment as essential to protecting their eyesight, and had access to
205 social support. In contrast, barriers emerged when these internal drivers were disrupted by practical
206 challenges, including forgetfulness, lifestyle changes, physical difficulty with instillation (particularly
207 early in treatment), and problems accessing medication due to prescription delays or stock shortages.
208 Importantly, unintentionally nonadherent patients often demonstrated good conceptual understanding
209 of glaucoma but reported gaps in practical knowledge, such as timing or instillation technique,
210 suggesting that knowledge alone is insufficient to ensure sustained adherence.

211 ECPs regarded adherence management as a core professional responsibility, yet their ability to
212 support patients was constrained by environmental and systemic factors. Time constraints, limited
213 resources, and reliance on patient self-reporting made it difficult to accurately identify nonadherence
214 or provide tailored support. Uncertainty around how to define acceptable levels of adherence further
215 complicated decision-making. Despite these challenges, practitioners emphasized the value of
216 communication skills, patient education, and multidisciplinary working as key enablers of effective
217 adherence support.

218 A central finding was the misalignment between patient and practitioner perspectives. While many
219 patients expressed confidence in their understanding and self-management of their condition, ECPs
220 frequently questioned the reliability of self-reported adherence. This disconnect highlights the

221 limitations of subjective assessment alone and suggests a need for structured, nonjudgmental
222 conversations that normalize adherence difficulties and encourage open disclosure. Framing
223 adherence as a shared challenge rather than nonadherence as a patient failure may help bridge this
224 gap.

225 Medication availability emerged as a shared barrier across both groups. Patients reported
226 interruptions due to pharmacy stock shortages, while ECPs described difficulties arising from delays
227 or errors in repeat prescriptions, especially from other HCPs. These disruptions not only place an
228 additional burden on patients, who have to go to extra lengths to source ongoing supplies, but also
229 increase the workload for practitioners and hospital staff as they handle additional patient queries,³⁷
230 reinforcing the view that adherence is a system-level issue rather than solely an individual behavior.

231 **Value of the Theoretical Domains framework**

232 The TDF enabled systematic identification of salient, modifiable influences on adherence using
233 predefined criteria and facilitated interpretation beyond descriptive theme generation, highlighting how
234 multiple domains interact to shape behavior. Importantly, the framework also provides a structured
235 pathway for intervention development through its linkage with the BCW³⁸ and the Behavior Change
236 Technique Taxonomy (BCTT).³⁹ In this study, key TDF domains were mapped to relevant BCW
237 intervention functions (e.g., *Education, Training, Environmental Restructuring*) and policy categories
238 (e.g., *Legislation, Service Provision and Guidelines*) to inform the selection of appropriate intervention
239 strategies. The BCTT was then used to specify the likely 'active ingredients' of these strategies, using
240 standardized terminology, such as *Instructions on how to perform the behavior, prompts or cues, and*
241 *behavioral practice/rehearsal*. The recently developed 'Theory and Techniques Tool' further supported
242 this process by linking specific behavior change techniques to their underlying theoretical domains.⁴⁰
243 Together, the BCW and BCTT provide a transparent, theory-driven rationale for the intervention
244 components proposed in this study, increasing the likelihood that they are both effective and
245 reproducible.⁴¹ Similar theory-informed approaches have shown success in improving medication
246 adherence in other chronic conditions, such as Type 2 diabetes.⁴²

247 **Implications for Practice**

248 Improving glaucoma medication adherence requires a coordinated, multi-level approach.

249 **Patient-level Interventions**

250 Strategies should reinforce understanding of glaucoma and treatment necessity, develop practical
251 instillation skills, and support habit formation through routines aligned with daily life.

252 Patient education is essential, as understanding glaucoma and its treatment impacts adherence.^{43–45}
253 Studies suggest that when healthcare professionals explain the treatment rationale, provide guidance
254 on drop administration, and discuss glaucoma progression, patients report greater intention and
255 perceived capability to adhere to therapy, although direct evidence of improved adherence is not
256 established.²³ This aligns with the TDF domains *Knowledge* and *Beliefs about Consequences* and the
257 corresponding BCW intervention functions of *Education* and *Training*, which promote understanding
258 and skill development.

259 Establishing a routine also supports adherence and is consistent with findings from other qualitative
260 studies.^{33,46} Routines draw on the TDF domains of *Behavioral Regulation* and *Memory, Attention, and*
261 *decision processes*. Developing a routine that aligns with a patient's lifestyle, rather than requiring
262 substantial lifestyle changes, is likely to encourage automatic, habitual adherence behaviors.^{47,48}
263 Interventions incorporating BCTs, such as *Prompts or cues* and *self-monitoring*, could help facilitate
264 this.

265 Social and family support, linked to the TDF domain *Social Influences*, plays a key role in adherence.
266 This mirrors findings from other chronic conditions, such as diabetes, where support networks have
267 been shown to improve self-management.^{49,50} Integrating personalized education, behavioral
268 strategies, and tailored support systems to promote habit formation could further support adherence
269 and align with the BCW intervention function *Environmental Restructuring*.

270 **Practitioner-Level Interventions**

271 Clearer guidance from professional regulatory bodies on defining and detecting nonadherence may
272 help standardize adherence management practices. Training programs informed by BCTs, such as
273 *Instruction on How to perform the Behavior* and *Feedback on the Behavior*, could improve ECP
274 practice. Online, CPD-accredited modules on adherence strategies, effective patient communication,
275 and glaucoma management updates could offer accessible, flexible training solutions. BCW policy
276 categories, such as *Guidelines and Service Provision*, could help support these initiatives.

277 Tailored clinic letters providing relevant and accessible information, summarizing diagnosis, treatment,
278 and dosing schedules may reinforce patient understanding and recall, addressing *Environmental*
279 *Context and Resources* and aligning with BCW functions of *Education* and *Training*. Providing
280 patients with supportive information in an understandable, digestible and relatable manner follows
281 best practice and encourages patients to take greater responsibility for managing their condition.^{51,52}

282 For patients who continue to experience adherence difficulties despite support, alternative therapeutic
283 strategies such as SLT may offer a means of maintaining IOP control while reducing reliance on long-
284 term topical therapy.⁵³ Current guidance in the UK, United States and Europe recognizes SLT as an
285 initial or adjunctive option for ocular hypertension and primary open-angle glaucoma.^{54–56} Given the
286 medication access and adherence challenges identified in this study, SLT may represent an
287 appropriate treatment for certain patients, although its effect may not be sufficient or sustained in all
288 cases, and while uncommon, severe complications can arise.^{57,58}

289 **System-Level Interventions**

290 Addressing structural barriers, such as high patient volumes, limited clinic time, and resource
291 shortages could further enhance adherence. These barriers fall under the TDF domain of
292 *Environmental Context and Resources* and can be addressed through structural reforms. A
293 multidisciplinary approach incorporating contributions from allied health professionals, utilizing each
294 professional's expertise in areas such as patient education, clinical management, and administrative
295 support, aligns with the BCW function of *Environmental Restructuring*. Such strategies could help
296 create a more integrated care environment streamlining patient management within busy clinics.

297 Promoting electronic prescribing, linked to the TDF domain of *Environmental Context and Resources*,
298 has the potential to reduce prescription errors, simplify the prescription process, and improve
299 prescription quality.⁵⁹ A coordinated care model that includes pharmacists, primary care providers, and
300 glaucoma specialists could provide patients with a seamless, supportive environment. Pharmacy
301 policies focused on stock availability and optimizing resource distribution further support consistent
302 adherence and align with *Environmental Restructuring*.

303 **Strengths and Limitations**

304 The dual-perspective, theory-based design provides a comprehensive view of adherence that
305 integrates patient, professional, and system influences. Inclusion of ECPs from diverse professional
306 backgrounds enhances the relevance of our findings, reflecting the increasingly multidisciplinary
307 nature of glaucoma care in the UK, where shared-care models are often adopted to meet rising
308 demand.^{54,60,61}

309 However, several limitations should be acknowledged. Adherence classification relied on self-
310 reporting, which is known to overestimate true adherence.^{62,63} This limitation is particularly salient
311 given the high proportion of participants who self-identified as adherent, meaning that individuals
312 experiencing greater difficulty may be under-represented. As a result, the dataset may
313 disproportionately reflect enablers rather than barriers, limiting the depth of insight into more severe
314 adherence challenges. Recruitment through patient support networks and social media may have
315 introduced selection bias toward more engaged individuals. Additionally, Afro-Caribbean patients, who
316 experience higher glaucoma prevalence⁶⁴ and lower adherence,^{65,66} were underrepresented; the
317 sample was relatively highly educated compared with the general population;⁶⁷ and all ECPs were
318 based in England, which may limit transferability.

319 **Future Research Directions**

320 Future research should evaluate the acceptability and feasibility of theory-informed intervention
321 components identified in this study, with particular emphasis on co-design with diverse and
322 underrepresented patient groups. Multicomponent interventions addressing behavioral, professional,
323 and system-level influences should be piloted and tested for effectiveness in improving adherence
324 and clinical outcomes.

325 **Conclusions**

326 Glaucoma medication adherence is a complex, multi-level behavior influenced by patient capabilities,
327 practitioner practices, and health system structures. By integrating patient and ECP perspectives
328 using the TDF, this study provides a foundation for designing targeted, theory-informed interventions.
329 Addressing adherence through coordinated, people-centered strategies has the potential to improve
330 clinical outcomes, support practitioner decision-making, and reduce preventable vision loss in
331 glaucoma care.

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FIGURE LEGENDS

Figure 1 Flow chart representing step-by-step process of data analysis.
Abbreviation: TDF, Theoretical Domains Framework