

Review Article

## Compliance in glaucoma management: Challenges decoded - A review

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### ABSTRACT

The first line treatment for glaucoma, a chronic condition which is the second biggest cause of irreversible vision loss in the globe, is self-administered topical ocular hypotensive drops. Medication adherence is a major issue in the management of glaucoma patients. Numerous obstacles to patients' compliance have been discovered in the literature, ranging from elements related to the drug delivered, interactions between patients and their doctors, and elements related to patients' behaviours and lifestyles. Patients who do not take their medications as directed run the danger of not getting the expected results, which frequently results in irreversible vision loss. We have reviewed available literature regarding patient compliance in the disease management of glaucoma and formulated a few recommendations based on the latest research in the field to practically apply in practice to increase compliance in this chronic condition.

**Keywords:** Glaucoma, Compliance, Patient education, Patient adherence, Topical eye drops

### INTRODUCTION

Glaucoma is the leading cause of global irreversible blindness. In 2013, the number of people (aged 40–80 years) with glaucoma worldwide was estimated to be 64.3 million, increasing to 76.0 million in 2020 and 111.8 million in 2040.<sup>[1]</sup> It is the leading cause of curable, irreversible blindness in India.<sup>[2]</sup> The estimated numbers are suggesting the tip of the iceberg for the magnitude of the problem.

This illness disproportionately burdens poor countries. With a population of over 1 billion, India carries a heavy burden of blindness and vision impairment.<sup>[3]</sup> Furthermore, a sizable section of India's population lives in rural areas, where glaucoma is once more prevalent at a disproportionately high rate.<sup>[2]</sup> A community-based research in Southern India found glaucoma to be the second-most common cause of bilateral blindness with a 10% prevalence.<sup>[4]</sup> According to the Aravind Comprehensive Eye Survey, just 16% of the community members with glaucoma had ever seen an ophthalmologist. Because of this, they are not only losing their eyesight but also not receiving the treatment they need.<sup>[4]</sup>

The fact that a significant fraction of patients has been proven to have poor adherence to medication is a serious

issue affecting glaucoma management. Numerous studies have shown that over 75% of the time, over 50% of patients are not taking their prescription as prescribed.<sup>[5]</sup> Even though some professionals have hypothesised that physician education might improve doctors' acceptable manner of communication with patients.<sup>[6]</sup> It could be very challenging to devote more time to each patient contact when there is such a significant backlog of cataract blindness. Furthermore, there is a direct correlation between basic health literacy and both adherence and health literacy.<sup>[7]</sup>

Age and increased intraocular pressure (IOP) are the main risk factors for glaucoma, but none of them are sensitive or specific enough to employ them in mass screening. Early diagnosis and appropriate management form the mainstay of the strategies that can be adopted. In the management armamentarium, there are medical management, laser therapy and surgical options.

Poor adherence to topical glaucoma medication is a worldwide issue. Apart from less amount of health literacy various side effects of chronic therapy of topical anti-glaucoma medications also contribute to an increased attrition rate of compliance with time.<sup>[8]</sup> Poor compliance

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with medical therapy is costly to the patient and the healthcare system.<sup>[9]</sup>

Especially ophthalmologists in developing nations face several difficulties. Making sure patients have access to medical and ophthalmology treatment is the first hurdle. The next step is to motivate patients to use this treatment. The third issue is making sure that patients stick to this treatment.

In this review, we discuss the value of compliance in chronic therapy, go through the most recent research on compliance, and then give some humble recommendations about how to apply compliance in daily clinical practice translating results of the latest research results in the field.

## MATERIALS AND METHODS

Using the MEDLINE repository, we looked up the literature for a thorough search. The following search terms were used: 'Compliance in glaucoma,' 'adherence to glaucoma medication,' 'methods of measuring adherence,' and 'non-adherence,' 'electronic medication monitoring,' 'self-tonometry,' 'topical treatment for the glaucoma,' and 'questionnaires for glaucoma compliance.' Articles written other than in English were not included in the study. English manuscripts that had been published before June 2023 were included in the inclusion criteria. We focused on the studies that best described how well a medication regimen was adhered to, assessed efficacy and/or compared adherence, measurement techniques with new studies on glaucoma compliance. Following the retrieval of pertinent articles using these keywords, further papers were chosen after searching through the reference lists of the selected studies.

## LITERATURE REVIEW

### Definitions decoded

Compliance has been defined as the extent to which patients' behaviours correspond with physician's recommendations. It is passive on the patient's part. Hence, now majority of the glaucoma experts use the word adherence in its place.<sup>[10-14]</sup>

Persistency is the total time for which the patient correctly takes the appropriate medication. Some people define compliance as sticking to the drug regimen every day, whereas persistence refers to compliance over a longer period.<sup>[15]</sup> It is believed that persistence can serve as a proxy for both the patient's and the doctor's contentment with the agent's clinical effectiveness and tolerability. This strategy, though, is probably oversimplified. In truth, persistency is also influenced by several other variables, including price, side effects, frequency of dose, and many others.

Persistence with glaucoma medications is generally considered to be poor, with studies reporting that fewer than 25% of patients use their eye drops continuously for 12 months.<sup>[10]</sup>

Alliance is the ultimate form of compliance. It denotes a holistic approach for the inclusion of not just patient and treating physicians but also the patient's family members. This has proven to reduce dropout rates in outpatient management of patients. Patients are kept well informed about the effects of the treatment and their anticipated side effects so that they can also actively give inputs in the therapy and feel included.<sup>[16,17]</sup>

### Importance of compliance in clinical practice

Olthoff *et al.* suggested in their evidence-based review that compliance among glaucoma patients is poor and can range between 5% and 80%. Such a wide range is due to the dependence of compliance on many factors. A few of these factors are the patient's age, systemic and economic conditions, level of education, understanding of glaucomatous progression, motivation, and confidence in his doctor. The complexity of the therapeutic regimen also plays an important role in compliance.<sup>[18,19]</sup>

Budenz in his study described six patterns of drug regimen adherence in chronic conditions such as systemic hypertension and glaucoma. Approximately one-sixth come close to perfect adherence to a regimen; one-sixth take nearly all doses, but with some timing irregularity; one-sixth miss an occasional single day's dose and have some timing inconsistency; one-sixth take drug holidays 3–4 times per year, with occasional dose omissions; one-sixth have a drug holiday monthly or more often, with frequent omissions of doses; and one-sixth take few or no doses while giving the impression of good adherence.<sup>[20]</sup>

Earlier studies had demonstrated higher IOPs and more advanced visual field (VF) loss in non-compliant glaucoma patients; however, a recent review of the literature demands more evidence in support of the earlier hypothesis. (Sentence removed) It is difficult to determine the degree of progression of the disease from the amount of non-compliance to the treatment of glaucoma. No determinants are sensitive and precise enough to correctly pinpoint the possible effects of non-compliance on measurable treatment outcomes such as IOP and VF.<sup>[18,21]</sup>

### Factors determining compliance with glaucoma therapy

Comparatively speaking to other medical therapies, evaluating compliance with eye treatment is challenging. In the case of other systemic medications, compliance may be determined not only by treatment response but also by blood levels of the medicine.<sup>[22]</sup> The 'white coat syndrome' is linked to IOP evaluation as a sign of compliance, with a percentage of patients complying with their prescription regimen in the days before the office visit and dropping subsequently.<sup>[23,24]</sup> Patients are more cooperative soon before and just after an

office visit, according to research by Okeke *et al.*,<sup>[5]</sup> with 55% of patients taking 75% of the prescribed drops.

The Glaucoma Adherence and Persistency Study (GAPS) has given us two important insights. One, the most common factors responsible for non-compliance, and two, the most common factors according to treating physicians responsible for non-compliance.<sup>[25]</sup>

The most common factors responsible for non-compliance, according to GAPS, are the cost of the medications (55%), forgetfulness of the patients (32%), fear or denial (16%), lack of understanding about glaucoma (16%) and regimen complexity (15%).

The most common factors, according to treating physicians, responsible for non-compliance according to GAPS are lack of patient motivation to use drops (50%), lack of patient understanding about glaucoma (41%), inability to communicate why compliance is important (15%) and limited time spent with patients in the context of a brief office encounter (12%) in chronological order of frequency.

Lacey *et al.* also described similar causes for non-compliance. They identified a lack of early training in application methods, the forgetting of drops, the scheduling of drops, and issues with drop supply as chief causes. Sight preservation appeared to be a major motivator for compliance in their study, as these patients already had some amount of symptomatic vision loss.<sup>[26]</sup>

Abu Hussein *et al.* have done a multivariate analysis of factors affecting patient compliance with topical antiglaucoma medications in a developing country. They found that older patients may exhibit lesser compliance, most likely as a result of a lack of family support, failing eyesight, or issues with hand dexterity, coordination, cognition, or memory. Based on their multivariate analysis, they found no evidence that gender, dropper-related challenges, illness duration, prescription side effects, or systemic comorbidity were significantly associated with non-compliance. They discovered a strong correlation between a high degree of education, accurate disease information, and improved compliance. On doing multivariate analysis, they found lack of formal education had a much more statistically significant association with compliance than knowledge about the disease.<sup>[27]</sup> On the contrary, learning more about glaucoma through education, according to Norell in 1979, Rendell in 2000 and Okeke *et al.* in 2009, dramatically increased compliance.<sup>[5,28,29]</sup>

In patients with a positive family history of glaucoma, the Abu Hussein *et al.* study revealed a statistically significant compliance rate, which may once again indicate superior compliance with the illness information that is inherited from the family. In addition, they discovered that poor compliance was related to poor follow-up appointment

attendance rather than the severity of the disease, which is also backed up by other studies.<sup>[27,30]</sup> According to Gurwitz *et al.*, non-compliance is most significantly correlated with less than two consultations with an ophthalmologist over the course of a year.<sup>[31]</sup>

Physician factors such as improved counselling and communication with patient and family for emphasising the importance of compliance to medication help in increasing compliance. Patient education is an integral pillar for compliance to be adhered to where the patient must be made a part of the team to encourage more proactive participation to adhere to treatment.<sup>[32]</sup>

The cost of glaucoma medications and the complexity of the regime also influences compliance.<sup>[32]</sup> Robin *et al.* objectively measured drug compliance through electronic monitoring. They found that once daily dosing regimen had more adherence rate compared to two drug regimens.<sup>[33]</sup>

### How to measure compliance?

Measuring the compliance of our patients is of utmost importance, as detecting non-compliance will help us in taking action to avoid it. Patient adherence to medication regimens has been monitored since the time of Hippocrates, and, to this day, measurement of patient adherence is essential if management of poor adherence is to be addressed efficiently. The methods available for measuring adherence can be divided into direct and indirect methods, each method having advantages and disadvantages. A gold standard method to measure adherence in patients with glaucoma is required but has not been established yet.

Directly witnessed therapy, which has the best accuracy, and measurement of medication concentrations in blood are two direct techniques of monitoring adherence. Direct approaches need costly tests, might be time-consuming for the ophthalmologist, and are prone to patient distortion.<sup>[11]</sup>

Indirect methods of measuring adherence include collecting patient questionnaires or self-reports, asking the patient to keep a medication diary, asking the patient how easy it is to apply the prescribed medication, assessing clinical response, determining refill rates, using electronic medication monitors, and assessing the adherence of children or elderly patients with the assistance of a caregiver. Verbal questioning of the patient, questionnaires and patient diaries are basic and easy-to-use approaches, although they can be manipulated by the patient.<sup>[11]</sup>

Patients may suppress information concerning non-adherence if they do not want to be viewed as misbehaving by their physicians. One possible answer is to promote the patient's engagement in a partnership between him or her and the physician that is based on the patient's views, concerns, and choices. As a result, a good patient should be viewed

as someone who collaborates with the physician to address the unavoidable pharmaceutical concerns and practical impediments to adherence.<sup>[6,34]</sup> Ophthalmologists can do this using self-reported adherence measures such as glaucoma therapy adherence surveys, which assess if and what the patient knows about her or his medical regimen, as well as the patient's confidence in medication adherence.<sup>[6]</sup> Self-reported measures may be the most cost-effective and simple way for providers to evaluate the rate of non-compliance and contribute to a better understanding of the barriers to and motivations for adherence with glaucoma medication, as well as to explore potential methods to improve adherence.<sup>[26,35]</sup>

### **24 h IOP curve**

Because IOP changes during the 24-h period, single-day IOP assessments during office hours can only give limited information on treatment effectiveness. A diurnal tension curve, which includes numerous IOP readings at different periods throughout office hours, is the most popular approach for measuring glaucoma patients' IOP. Mansouri *et al.* proposed that night-time measurements in the habitual posture are critical for IOP profile accuracy because they more closely correlate with an individual's circadian cycle and natural body placement. This intervention demonstrates the influence of glaucoma medication adherence by outlining an IOP profile over a 24-h period, and it may be employed when inpatient and outpatient IOP values differ significantly. By exposing a typical fluctuation of IOP over the circadian cycle, this method may also help better understand the true IOP-lowering effect of treatment, improving adherence and treatment outcomes as well as opening up the possibility of individualised disease management.<sup>[36]</sup>

### **Questionnaires**

By asking patients if they know why they are taking their medicine, whether they have encountered any adverse effects from their eye drops, or what their motivations are for taking the prescription, questionnaires are a powerful tool that can reveal poor adherence to glaucoma treatments.<sup>[11]</sup> In an article based on a patient interview, Lacey *et al.* sought to discover the motivating elements for using glaucoma medication. The interview covered topics including therapy, memory and habit of using the eye drops, problems taking the medicine, reasons for using the eye drops, and suggestions from the patients for improving future adherence. The authors observed adherence hurdles that were directly related to participant experiences, such as a lack of patient teaching and a desire for better education delivery that focused on drop application techniques and the negative effects of ineffective adherence. To increase their confidence in adherence, patients also suggested getting regular feedback regarding drop effectiveness. The adherence questions also showed that

many patients had issues with drop application techniques, forgetting drops, or practical challenges like going without treatment for brief periods when their medication ran out, finding a convenient spot to apply the drops during the day, or not having enough time to administer them while at work.<sup>[26]</sup>

With longer GAPS between visits, this strategy is more prone to mistakes. Results are susceptible to patient distortion, which frequently results in an overestimation of patient adherence.<sup>[11]</sup> Several studies compared the reliability of self-reported measurements in glaucoma patients to more reliable ones, including electronic monitoring devices or pharmacy records, and found that they tended to overvalue the dosages given and the timing (adherence to glaucoma medication).<sup>[35]</sup> Sayner *et al.*, therefore, pushed the notion that ophthalmologists may need to take a cautious and comforting approach when speaking with patients to uncover difficulties with delivering drops on time, making them feel comfortable and subsequently aiding in the detection of poor adherence.<sup>[11,35]</sup>

### **Rate of refilling prescriptions**

In a medical system that employs electronic medical records and a closed pharmacy system, the rate of prescription refills, as an indirect technique of evaluating adherence, is an accurate measure of adherence as long as the refills are measured from time to time. Pharmacy records can give the doctor unbiased data on prescription refill rates, which can be used to determine how well a patient is following their glaucoma treatment plan. In addition, the patient's replies to direct inquiries or questionnaires can be used to corroborate the records.<sup>[11]</sup> However, just because a prescription is filled at the pharmacy does not ensure the patient will use the drug. To measure adherence in a cohort of glaucoma patients, researchers from the GAPS examined extensive pharmacy databases. The study brought to light various drawbacks of utilising pharmacy information to assess medication adherence for glaucoma. First, research demonstrated that patients may have wrongly assumed the second prescription should have replaced the first or that a refill of the first medication was delayed because the patient had a significant supply of it. In addition, it will be assumed that patients who obtain samples have low adherence. The lack of the samples provided by the ophthalmologist in the claims data suggests that it is impossible to quantify them and to identify the patients who could have side effects or other adherence challenges while taking the sample medicine.<sup>[37]</sup>

### **Electronic medication monitoring**

Electronic monitoring using a Medication Event Monitoring System, which can record and stamp the time of opening

bottles and administering drops, is the most precise indirect means of identifying how patients utilise glaucoma medication.<sup>[11]</sup> According to Kass *et al.*, who conducted their study, patients who were interviewed reported a compliance rate of 90%, doctors predicted a compliance rate of 79% and electronic eye drop monitoring revealed a compliance rate of 75%.<sup>[38]</sup>

It is common practice in other medical specialties to compile drug consumption data automatically (dosing history). It offers a complete description of medication adherence and makes it obvious when to initiate, execute, and stop taking a drug.

Electronic monitoring does have certain technological drawbacks, though, and patients' knowledge that they are being watched may cause them to act differently than they would if they were just being observed: this is known as 'the Hawthorne effect.' On the one hand, this suggests that monitoring eye drop consumption is more challenging than measuring pill usage, and on the other hand, changing the eye drop container is expensive and challenging to do.<sup>[39]</sup> They are also impracticable for monitoring adherence in clinical settings due to their high cost, which is a significant downside. These gadgets also fail to record whether the patient dispensed the drop into the conjunctival sac. Because of this, patients may open the bottle but not apply the drop properly or may squander numerous drops at once.<sup>[11]</sup>

According to reports based on pharmacy data, prostaglandins have better rates of adherence and persistence (the length of time spent continuing therapy with the first prescribed prescription) than other medications. The development of a way to assess adherence by electronic monitoring between once-daily hypotensive treatments and other glaucoma medications that require more frequent dosing would be of considerable interest because there has not been a direct comparison utilising electronic monitoring.<sup>[5]</sup> The Hawthorne effect, which occurs when patients are aware they are being monitored and modify their conduct as a result of being seen, is another drawback of electronic glaucoma medication monitoring.<sup>[40]</sup> Electronic monitoring has the drawback that it can only be used with particular prescriptions. For instance, the Travatan Dosing Aid (DA; Alcon, Fort Worth, TX) can only provide data on the usage of travoprost because no other glaucoma medication bottle fits inside of it. To release the drug, a handle on the device must be fully depressed after inserting a bottle of travoprost. The event's date and time are recorded on a built-in memory chip, and the data are later transferred to a computer.<sup>[41]</sup>

In 196 patients over a period of 3 months, the Travatan Dosing Aid Study evaluated patients' adherence and patterns of use of topical once-daily treatment with travoprost (for glaucoma). The study found that 45% of patients did not use their drops at least 75% of the time, indicating low

compliance even though they were aware that they were being watched and receiving free medication. In addition, patients overestimated their medicine use compared to what they took, and those who took <50% of the recommended dosages exhibited far higher dose intake shortly following the office visit and right before the follow-up appointment at 3 months.

It was determined that either improved communication skills, better technological monitoring, or both were required to identify the patients who were less adherent.<sup>[5]</sup> When Robin *et al.* used electronic monitoring to assess patient adherence to once-daily prostaglandin analogues as the sole form of ocular hypotensive therapy, they also compared the prostaglandin analogues to adjunctive medications. They concluded that more complex dosing regimens lead to poorer adherence, while once-daily medications in complex dosing regimens were found to have good adherence.<sup>[33]</sup>

The research we uncovered; however, supported the notion that electronic monitoring of glaucoma therapy offers the most precise information on medication adherence and an extremely thorough understanding of patterns of medication-taking behaviour.

### How to increase compliance with treatment?

Interventions to address non-adherence are an important objective of glaucoma research and need a comprehensive strategy that depends on the demands and lifestyle of the patients.<sup>[35]</sup> Glaucoma is a unique chronic disease in that treatment adherence and compliance are significantly low when compared to other chronic disorders that require lifetime therapeutic treatments.<sup>[28]</sup> There is currently a scarcity of studies exploring intervention options to improve glaucoma drug adherence. Patient education, greater communication between physicians and patients, simplifying and optimising medication regimens, and enhanced patient contact with the healthcare system are all methods that can be utilised to promote adherence to glaucoma therapy. Budenz presented a list of strategies for improving glaucoma drug adherence based on research on systemic hypertension treatment, which supports incorporating or empowering patients in their treatment and a proactive approach by the clinician. Reviews of hypertension adherence studies have revealed that three of the simplest ways to improve adherence to medication are to simplify treatment regimens, optimise medicines to minimise side effects, reduce costs and educate patients.<sup>[20]</sup>

### Patient Education

Patient education is the first step in increasing medication adherence (glaucoma drugs are only effective if patients utilise them).<sup>[42]</sup> Education should include both verbal and

written instructions, as well as colour-coded medication regimens, illustrations, and modified material for persons with impaired vision or literacy. The ophthalmologist must ensure that the patient understands the treatment regimen, and didactic lectures on appropriate drop application are necessary for this reason. These presentations should be repeated on a regular basis to ensure that the patient continues to employ the proper method. Patients should be informed on proper dose schedules, waste minimisation, and a clear explanation about how non-adherence to prescribed medicines can cause irreversible eyesight loss. Furthermore, reviewing medicine administration at each appointment helps maintain adherence by giving the physician information about the patient's awareness of his treatment schedule. Patients should also be encouraged to engage in their treatment by maintaining a daily record of drug dose. With the availability of cell phones and internet communication, there are several potential avenues worth exploring to improve compliance using continuous reminder systems, such as those available on the phone (alarms, applications, text messages, and phone calls) or e-mails, to reduce forgetfulness.<sup>[5,11]</sup>

Adherence of glaucoma patients is affected by situational and environmental variables since there are individual particular everyday events that make it difficult for individuals to remain compliant.<sup>[43]</sup> It is critical to include a regimen that is simple to apply and easy to integrate into patients' everyday lives. Despite having greater access to technological devices, treatment adherence has been proven to be poorer in younger age groups, frequently due to a busy lifestyle and employment responsibilities. Involving patients might thus take the form of urging them to incorporate their therapy into their regular activities. They can, for example, bring a bottle of drops to work or keep the drops near their bed, desk, or toothbrush. Furthermore, physicians may recommend enlisting the assistance of a helpful family member to aid with administering drops or reminding the patient to take drops.<sup>[11]</sup> Even though young patients can manage internet information without the assistance of a physician, it does not appear to increase their adherence. There is evidence that adherence to glaucoma therapy is poorer in the 1<sup>st</sup> year of diagnosis, and enhanced illness information may help patients stick with their medication.<sup>[44]</sup>

Carpenter *et al.* investigated whether patient-physician communication promotes glaucoma patients' medication self-efficacy and concluded that it can improve treatment adherence. As a result, doctors should take a patient-centred approach, taking the time to educate patients about their chronic condition and analyse their perspectives on treatment. According to the study, patients who ask more medication-related inquiries may have less confidence in their ability to stick to their glaucoma regimen and should

be given extra help to overcome adherence difficulties.<sup>[45]</sup> A study of 279 glaucoma patients who were video-recorded during their visit found that while educating patients about their condition occurred during approximately two-thirds of the visits, it was not significantly associated with whether patients took their doses on time after the visit. Instead, the only provider communication component that was substantially linked with adherence was instruction about eye drop administration. As a result, health providers must devote more effort to educating people about glaucoma.<sup>[16]</sup> Observational research assessed an intervention programme that included teaching and a reminder system. In individuals whose baseline drop-taking rate was <75%, adherence to glaucoma treatment rose from 54% to 73%. The improvement was rapid and lasted for 3 months. The study found that utilising a diverse strategy increased the likelihood that the treatments would influence medication usage. The study was unable to establish which components of the intervention were most useful or which techniques could be adopted in clinical practice. Furthermore, the researchers discovered that there was a larger improvement in adherence among white patients and those with the lowest baseline adherence. Furthermore, the increase in adherence did not correspond with the amount of IOP evaluated in the clinic. To that aim, the study's findings revealed that many non-adherent patients had good IOP during routine visits, so IOP measurement was deemed insufficient for evaluating adherence. Finally, it was stated that more study is needed to differentiate poor adherence in patients to minimise overmedication and to discover which parts of the adherence programme were most beneficial.<sup>[5]</sup>

### **Optimise treatment**

Simpler drug regimens should be considered in interventions aimed at increasing patients' medication-related self-efficacy. Many studies have emphasised the need for simplifying patients' medication regimens, which reveals that patients on more complex regimens were less likely to take their doses on time and were less likely to take the right number of recommended doses each day.<sup>[14,16]</sup> Furthermore, individuals using once-daily medications on a complicated dose schedule were shown to have high adherence.<sup>[14]</sup> It has been demonstrated that 3 and 4 times-a-day dosing, as well as inappropriate dosage spacing, increase non-compliance versus twice-a-day dosing; hence, the fewest number of drugs, infused with the least frequency, improve patient satisfaction and dosing convenience.<sup>[46]</sup>

Shirai *et al.* compared the adherence of Japanese patients to fixed and unfixed combination eye drops and discovered that patients on fixed combination treatment had stronger adherence to their regimens. The key explanation might be that patients prefer a fixed mix. One drop of an ophthalmic

solution is easier and faster to apply than two drops from separate bottles of medicine, with no waiting period between the two types of drops, and with equivalent or potentially greater efficacies in daily practice compared to unfixed-combination therapy. Furthermore, it is more favourable due to lower preservative exposure and hence a lower chance of developing ocular surface illnesses.<sup>[47]</sup>

When patients require several drugs and dosages, possible options include synchronising administration with daily activities such as meals or cleaning teeth, as well as employing a medication schedule.<sup>[42]</sup> Furthermore, when patients are informed of the potential side effects of a medicine, their compliance improves, and patient education should include a discussion of treatment options. According to research, patients taking preservative-free medicine have reduced rates of non-adherence (12.5%), and moving to preservative-free therapy may be especially beneficial for adherence with self-administered treatments.<sup>[48]</sup>

### Medication costs

Several studies have found that most glaucoma clinic visits do not include a discussion of prescription costs. Providers frequently do not inquire about their patients' glaucoma drug costs, and as a result, patients who are experiencing financial difficulties with their treatment regimen seldom discuss it with their doctors. As a result, ophthalmologists may consider discussing drug costs during office visits to enhance adherence from the start of glaucoma therapy.<sup>[49]</sup> A viable approach to alleviating the financial and physical hardship of medicine acquisition would be to supply free eye drops to patients, either by handing out free samples on occasion or by making the medication reimbursable.

Finally, on a 60-year time horizon, a cost-utility analysis assessed the societal costs of optimal versus poor adherence to glaucoma medications among people over 40 years of age with newly diagnosed glaucoma and demonstrated that adherence to glaucoma medications resulted in improved quality of life for a relatively low increase in lifetime healthcare costs.<sup>[50]</sup>

### Drug instillation aids

The proper instillation of eye drops is one part of adherence; yet, it is well known that many patients struggle with this chore. Inadequate targeting can lead to undertreatment and disease progression. On the contrary, repeated attempts might result in over-medication and over-treatment, resulting in greater drug expenditures and an increased risk of adverse effects.<sup>[51]</sup> Contact of the eye drop container tip with the eye or skin causes a variety of outcomes ranging from contamination to injuries.<sup>[52-55]</sup> Difficulties may include putting their drops inside their eyes, extending their neck,

limiting excessive drop leakage, avoiding contamination of the bottle tip, and producing sufficient power to release a drop from the bottle. Instillation aids are devices designed to help overcome one or more of these obstacles. Instillation aids may be especially beneficial to elderly people and those with musculoskeletal problems.<sup>[39]</sup>

### Self-measurement of IOP

One of the most significant diagnostic procedures for determining the success of glaucoma treatment is the IOP assessment. A single measurement of IOP during office visits, on the other hand, does not disclose the full amount of intraocular hypertension or the daily changes in IOP. Astakhov *et al.* evaluated the convenience of patients self-monitoring their IOP at home using Icare<sup>®</sup> HOME tonometers and found an increase in treatment adherence. The study found that autonomous patient engagement in the diagnostic process increases illness knowledge and understanding, as well as the necessity of following the doctor's advice.<sup>[56]</sup>

Chen *et al.* compared the reliability of readings taken by patients utilising iCare tonometers to Goldmann applanation tonometry measurements. The study found that patients preferred the approach of self-measuring their IOP at home since it saves time for both the patients and the glaucoma care professionals. Patients responded favourably to the iCare One self-tonometer since they could view the data promptly. Furthermore, patients expressed a desire for this strategy to be used in future glaucoma monitoring. As a result, home IOP monitoring offers essential information for glaucoma therapy and may enhance treatment adherence.<sup>[57]</sup>

## RECOMMENDATIONS

Few guidelines for clinicians regarding non-compliance for glaucoma therapy can be derived from the currently available literature. Future research should be guided by clinically relevant questions.

1. Patient and their families should be educated well regarding the seriousness and potential life-threatening effects of the disease glaucoma by treating physicians
2. Counsellors to give patients education and ensure compliance including explaining to them the sight-threatening result of the failure to maintain compliance
3. Personalised appointment and drug administration reminders can be sent to patients through e-mail or phone.<sup>[5,58]</sup> The creation and use of applications, for example, the EyePhone App, which sends notifications and reminders of ongoing medical care<sup>[59]</sup>
4. Future developments in precise drug delivery system and remote glaucoma therapy monitoring such as smart electronic eye drop bottle that measures the number of single- and multiple-drop deliveries. (A team from the

- University of California – San Diego is working on it)<sup>[60]</sup>
5. In the future, the use of a nose-pivoted drop delivery device which is found to improve eye drop delivery success, reduce bottle tip contact, and decrease the number of eye drops wasted, leaving it strongly preferred by patients over a traditional drop delivery system<sup>[61]</sup>
  6. A change in treatment guidelines preferring early and repeated use of selective laser trabeculoplasty (SLT) to topical medication medications as first-line therapy as SLT is proven to be effective at lowering IOP with high success rates, even after a single treatment, and has the added benefit of being independent of a patient's capacity to remain compliant with a treatment plan.<sup>[62]</sup> Clarifying the optimal application of the SLT therapy trial is to determine the utility of low-energy SLT conducted annually as primary treatment for mild-to-moderate open-angle glaucoma<sup>[63]</sup>
  7. Awareness campaigns for the target population (i.e., glaucoma patients) at local hospital, state and national level
  8. Support groups for patients of glaucoma.

## CONCLUSION

The glaucoma care for each patient needs to be tailored to the age, socio-economic status, working conditions, financial background, and literacy of the patient. It is not only important to prescribe the medications but also to spend time to know the factors that will determine compliance to ensure successful control of rising IOP and further progression of the disease.

A multimodal approach appears to be a method for overcoming issues, even though there are several reasons for non-adherence and there are still significant GAPS in the detection, identification, and treatment of non-adherence.<sup>[19,20]</sup>

In conclusion, the body of research on glaucoma drug adherence demonstrates that it is a difficult issue for ophthalmologists who treat patients with this chronic condition, and the several tried-and-true strategies have had various degrees of effectiveness.

## Declaration of patient consent

Patient's consent was not required as patients identity was not disclosed or compromised.

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## Conflict of interest

Dr Purvi Bhagat is on the Editorial Board of Journal.

## Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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