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Glaucoma Patient Expression of Medication Problems and Nonadherence

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Abstract

Purpose—The purpose of this study was to examine if patient demographic factors influenced self-reporting of medication side effects, difficulty with drop instillation and nonadherence to glaucoma therapy.

Methods—English-speaking adult glaucoma patients (n=279) from six ophthalmology clinics were enrolled. Patients' medical visits were videotaped and patients were interviewed immediately afterwards by research assistants. The videotapes were transcribed verbatim and coded to identify patients who expressed problems with medication side effects, eye drop administration, and non-adherence during the glaucoma office visits. Generalized estimating equations were performed to identify whether patient characteristics were associated with expression of problems with glaucoma medication and medication non-adherence during the office visit.

Results—Patients with lower health literacy were significantly less likely to express problems with side effects (OR (95%CI) = 0.47 (0.25, 0.88)) and eye drop administration (OR (95%CI) = 0.26 (0.11, 0.63)) during the visit. Patients who reported eye drop administration and side effect problems during the interview were significantly more likely to express these problems to their ophthalmologists, (OR (95%CI) = 3.13 (1.82, 5.37)); (OR (95%CI) = 1.86 (1.12, 3.08)) respectively. Patients who expressed a problem with eye drop administration and with side effects were significantly more likely to express medication non-adherence to their ophthalmologist (OR (95%CI) = 2.89 (1.44, 5.80)); (OR (95%CI) = 2.03 (1.16, 3.54)). Patients who reported greater

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than 80% medication adherence during the interview were significantly less likely to express non-adherence to their ophthalmologist (OR (95%CI) = 0.22 (0.12, 0.40)).

Conclusions—Eye care providers should be aware that glaucoma patients with lower health literacy are less likely to express problems with side effects and eye drop administration. Providers should work with patients to assess medication-related problems in order to mitigate potential barriers to medication adherence since patients who expressed medication problems were also more likely to express non-adherence.

Keywords

patient expression; glaucoma; medications; adherence; health literacy

Glaucoma is an incurable chronic eye disease that affects over 2 million people in the United States.[1] As the U.S. population continues to age, glaucoma is projected to affect over 3 million people by 2020.[1] To prevent or delay the progression of glaucoma, intraocular pressure-lowering medication eye drops are typically prescribed for life-long use. These medications are effective in slowing the progression of glaucoma; however, their effectiveness depends on patient adherence to the prescribed medication regimen. Research has found medication adherence to be a significant problem in the glaucoma patient population.[2–4] Barriers to glaucoma medication adherence include: medication side effects, difficulty with eye drop administration, low health literacy skills, depressive symptoms and complex medication regimens.[5–9] In order for physicians to address these barriers to adherence, patients must express their specific problems and concerns during their medical encounters.

There is limited literature on the relationship between patient characteristics and expression of medication side effects to an eye care provider. In a prior study, patients who were using adjunctive therapy for glaucoma were surveyed to examine patient-reported problems and found that 60% of them expressed at least one problem with their medication.[10] Difficulty with eye drop administration was the most commonly cited problem.[10] Younger patients were more likely to report problems with side effects and females were more likely to report problems with eye drop administration.[10]

There have been additional studies investigating a similar relationship in other chronic disease states. Sleath et al. found that younger and non-Hispanic white patients were more likely to express a complaint about their antidepressant medications than older and Hispanic patients.[11] The most commonly expressed complaints were medication side effects and lack of medication efficacy.[11] In another study, investigators examined the extent of patient-expressed complaints with their chronic disease medication regimens.[12] The most commonly expressed complaints included: medication side effects, medication not working, medication expense, having to take the medication, and having to use generic rather than brand named medication.[12] This study found that patients were significantly more likely to express complaints about their medication regimen to younger physicians, and physicians were more likely to change the patient's medication regimen if a problem was expressed.[12]

Similarly, there are few studies that examine the relationship between patient characteristics and an expression of medication non-adherence to an eye care provider. It is not clear what glaucoma patient characteristics are associated with an expression of non-adherence to an eye care provider. Sleath et al. found patients who expressed one or more complaints about their medication regimen to their physician were twice as likely to express an adherence problem as compared with patients who did not.[13] Additionally, patients reporting difficulty with eye drop administration were more likely to report lower rates of adherence.[13] Another study found that 14% of patients receiving adjunctive therapy for glaucoma reported problems with medication adherence.[10] That study also found patients who reported medication problems were more likely to be non-adherent to their medications in the prior week.[10]

It is important for providers to understand which patient characteristics are associated with patient expression of medication problems and non-adherence so that they can collaborate with the patient to find a medication regimen, or alternative treatment plan (e.g., surgery) that mitigates the patient's problems or concerns. In turn, this may help glaucoma patients become more adherent to their glaucoma medication.

To our knowledge, no one has assessed what specific glaucoma patient characteristics are associated with patient expression of medication problems or medication non-adherence during clinic visits. The purpose of the paper was to evaluate what patient characteristics lead patients to express: (1) medication problems, including difficulty with side effects and eye drop administration, and (2) problems with non-adherence to glaucoma medications.

METHODS

From 2009 to 2012, we recruited English-speaking adult glaucoma patients and ophthalmologists from six ophthalmology clinics located in four states. Four clinics were affiliated with academic ophthalmology departments and two were private offices. Provider consent was obtained. To see if provider race, age or gender would influence outcome variables, providers completed a short demographic questionnaire. Clinic staff referred eligible patients to a clinic-based research assistant. Patient consent was obtained after the study was explained. The patient's medical visit was videotape-recorded and then transcribed verbatim with identifiers removed. Research assistants interviewed patients immediately after their medical visits and collected information on demographic characteristics and medication related problems. The medical visit transcripts were coded to identify statements where patients self-reported medication side effects, difficulty with drop instillation and nonadherence to glaucoma therapy.

The institutional review boards at the University of North Carolina at Chapel Hill, Duke University, Emory University, and the University of Utah approved this study. This study adhered to the tenets of the declaration of Helsinki.

Measurement

Patient Characteristics—Patient age was measured as a continuous variable. Patient gender was measured as a dichotomous variable. Self-reported patient race was measured as

a categorical variable (White, African American, Asian, Native American, and Hispanic) and then recoded into African American and non-African American since the majority of the patient sample (95.3%) was either African-American or White. The number of glaucoma medications was measured as a discrete variable, and then recoded as a dichotomous variable (one glaucoma medication versus two or more) since the majority of the patient sample (95.7%) was taking one or two glaucoma medications. The number of prescription medications other than glaucoma medications was measured as a discrete variable since the variable ranged from 0–22 prescription medications. Whether the patient had health insurance coverage and prescription drug insurance were measured dichotomously (yes/no). Self-reported problems with eye drop administration were measured as a categorical variable (none, a little, and a lot) and then recoded as a dichotomous variable (none versus a little/a lot). Self-reported problems with side effects of glaucoma medications were measured as a categorical variable (none, a little/a lot) and then recoded as a dichotomous variable (none versus a little or a lot).

Health literacy was evaluated using the Rapid Estimate of Adult Literacy in Medicine (REALM). REALM is a validated, fast-screening instrument designed to identify patients who have difficulty reading common medical and lay terms that are routinely used in patient education materials.[14] Patient scores correspond to reading levels (score of 0–18 = third grade and below, 19–44 = fourth to sixth grade, 45–60 = seventh to eighth grade, 61–66 = ninth grade and above). REALM scores were dichotomized to “eighth grade or below” and “ninth grade and above” since patients reading below ninth grade have trouble reading most patient education materials.[14]

The Patient Health Questionnaire (PHQ-9) is a validated, multipurpose instrument designed to screen and assess the severity of depression.[15,16] The PHQ-9 was measured as a continuous variable with values ranging from 0–27, with higher values indicating more severe depression. The PHQ-9 score is divided into the following categories with increasing severity: 0–4, 5–9, 10–14, 15–19, and 20 or greater.[17] PHQ-9 scores of 5, 10, 15, and 20 represent mild, moderate, moderately severe, and severe depression.[17]

Patient medication adherence was measured using a Visual Analog Scale (VAS), which asks the patient to draw a line through a 10 cm scale to indicate how much of the time they use all of their glaucoma medications exactly as directed during the past week. The scale ranges from 0 cm (none of the time) to 10 cm (all of the time). The VAS has strong validity and reliability and has been validated against prescription drug refill records.[9,18–21] The VAS score was recoded into a dichotomous variable (less than 8.0 cm which is equivalent to less than 80% adherent versus 8.0 cm or greater which is 80% adherent or greater), which is supported by the glaucoma literature.[22,23]

Each videotape recording of the medical encounter was transcribed verbatim with identifiers removed. A detailed coding tool was developed over a one-year period with input from the communication experts and ophthalmologists on the study team. Using this coding tool, three coders denoted (yes/no) whether the patient expressed medication side effects, difficulty with drop administration, and nonadherence during their medical visit and recorded the content of what the patients said. Next, a single coder categorized the patient

statements into the following areas: (a) expresses a problem with eye drop administration, (b) expresses a problem with side effects of the glaucoma medications, and (c) expresses non-adherence to glaucoma medication regimen to their ophthalmologist.

Data Analysis

Descriptive analyses were performed using IBM SPSS Statistics version 21. The statistical significance level was set at $p < 0.05$. Descriptive statistics were calculated for the patient demographic variables. Generalized estimating equation (GEE) analyses were performed using SAS version 9.3 to examine whether patient age, gender, race, number of glaucoma medications, health literacy, depression, the number of prescription non-glaucoma medications, and self-reported medication problems (side effects and eye drop administration) were associated with whether the patient expressed problems with the side effects of glaucoma medications and whether the patient expressed problems with administering glaucoma medications during the office visit with their ophthalmologist. Additionally, GEE analysis was performed to examine whether patient age, gender, race, number of glaucoma medications, health literacy, depression, the number of prescription non-glaucoma medications, whether the patient expressed any problems with administering glaucoma medications, whether the patient expressed any problems with glaucoma medication side effects, and medical adherence were associated with the expression of medication non-adherence during the office visit with their ophthalmologist. Provider race, age and gender were excluded from the GEE models because they were not significantly associated with the outcome variables in bivariate analysis. All GEE models were clustered by provider.

RESULTS

Two hundred seventy-nine patients participated in the study. Table 1 illustrates the characteristics of study participants. One hundred sixty-five (59%) patients were female and 99 (36%) were African American. Ninety-one (33%) patients were taking two or more glaucoma medications.

Less than half of patients (40.5%) reported problems with eye drop administration and 13.3% reported problems with side effects of their glaucoma medications. The average medication adherence rate was 89% (range = 0–100%). Thirty-four (15%) patients reported being less than 80% adherent and 193 (69.2%) patients reported being more than 80% adherent.

Side Effect Problems

One hundred twenty-five (45%) patients expressed a problem related to medication side effects during their medical encounter with their ophthalmologist. Table 2 presents the GEE results predicting whether patient characteristics are associated with patients' expression of problems relating to side effects. Patients with lower health literacy were significantly less likely to express a problem with glaucoma medications side effects ($p = 0.018$). Patients who reported a side effect problem during the post-medical visit interview to the research assistant were significantly more likely to have expressed a problem with side effects to

their ophthalmologist (p = 0.017). No other patient characteristics were significantly associated with whether a patient expressed a problem or concern with side effects of glaucoma medications.

Eye Drop Administration Problems

Twenty-six (9%) patients expressed a problem with eye drop administration during their office visit with their ophthalmologist. Table 2 presents the GEE results predicting whether patient characteristics influence patients' expression of eye drop administration problems. Patients with lower health literacy were significantly less likely to express a problem with eye drop administration (p = 0.003). Patients who reported an eye drop administration problem during the post-medical visit interview with the research assistant were significantly more likely to express a problem with eye drop administration to their ophthalmologist (p < 0.0001). No other patient characteristics – gender, race, number of glaucoma medications, number of other non-glaucoma prescription medications, depression, and new or prevalent glaucoma medication user – were significantly associated with expression of problem with eye drop administration.

Expression of Non-Adherence

Sixty-two (22%) patients expressed glaucoma medication non-adherence to their ophthalmologist during their medical visit. Table 3 presents the results of the GEE analysis predicting whether patient characteristics are associated with the expression of non-adherence to glaucoma medication regimens. Patients who had fewer non-glaucoma prescription medications (p = 0.001) and patients who had two or more glaucoma medications (p = 0.025) were significantly less likely to express non-adherence to their ophthalmologist. Patients who expressed at least one problem with eye drop administration (p < 0.003) and patients who expressed at least one problem with glaucoma medication side effects (p = 0.013) were significantly more likely to express a problem with medication adherence to their ophthalmologist. Patients who reported greater than or equal to 80% medication adherence were significantly less likely to express a problem with medication adherence to their ophthalmologist (p < 0.0001). No other patient characteristics were significantly associated with whether a patient expressed a problem with glaucoma medication non-adherence to their ophthalmologist.

DISCUSSION

This is the first study to investigate whether patient characteristics influence patient expression of medication problems to their eye care providers during ophthalmology office visits. Although only 13.3% of glaucoma patients reported a side effect problem during their interview with the research assistant, almost half of patients expressed a problem with glaucoma medication side effects to their ophthalmologist. Patients who reported problems with side effects to the research assistant were significantly more likely to express a problem with side effects to their ophthalmologist. Additionally, we found that patients with lower health literacy were less likely to express a problem with side effects of glaucoma medications. Patients with lower health literacy may have greater difficulty communicating with their physicians about their medications. Prior work has found health literacy to be a

barrier to patient-provider communication and medication adherence.[24] Providers should consider using brief health literacy screening instruments, like the REALM, in their practices and spending more time assessing medication-related problems with patients who have lower health literacy.

In contrast to previous studies, we did not find that age or race were associated with patient expression of medication side effects.[9,10] Providers should consider asking more open-ended questions regarding medication side effects so that patients know specifically that the provider would like them to communicate their concerns. Eye care providers can ask open-ended questions such as “Some patients experience side effects when using glaucoma medications, what have you noticed?” or by asking targeted close-ended questions such as “Are you having any side effects, like red or itchy eyes from your glaucoma medications?” to engage their patients in a discussion whether the patient has been experiencing side effects. This study showed an association between patient expression of side effects and an expression of non-adherence. Since prior literature has found side effects to be a major barrier to medication adherence,[9,25–27] eye care providers should be aware that patients expressing problems with side effects may also be struggling with medication adherence.

Less than 10% of patients expressed a problem with eye drop administration to their ophthalmologist compared to 40.5% who reported a problem during the post-medical visit interview with the research assistant. Prior research has found a significant relationship between poor eye drop technique and non-adherence.[6,13,16,25,28,29] Since patients rarely expressed problems with eye drop administration, they may not recognize if they have poor eye drop technique or they may feel uncomfortable discussing their concerns with their ophthalmologist.[6] Lower health literacy was significantly associated with being less likely to express problems with eye drop administration. Additionally, patients who self-reported eye drop administration problems were significantly more likely to express a problem with glaucoma medication administration to their ophthalmologist. We found that neither age nor gender were associated with whether patients expressed a problem with eye drop administration to their ophthalmologist, which contradicts the results of a prior study.[11] However, this may be the result of so few patients in this study expressing an eye drop administration problem to their ophthalmologist. Eye care providers can ask open-ended questions such as “What problems are you having when you administer or use your glaucoma eye drops?” or “Some patients have a hard time putting in their own eye drops, what issues do you have when you use your eye drops?” to initiate a discussion about administering eye drops.

One in five patients expressed medication non-adherence during their medical encounters compared to 12.2% that reported less than perfect adherence on the post-visit interview. This small percentage of patients expressing non-adherence to their ophthalmologists is concerning since prior research has shown adherence to be a significant problem in the glaucoma patient population.[2,30,31] Furthermore, previous research has found that about one-half of individuals discontinue glaucoma medication therapy within six months of beginning it.[2] In this study, patients who were using more non-glaucoma prescription medications were more likely to express non-adherence. Prior work has found that the more medications a patient is taking, the more problems the patient will have with medication

adherence.[3,32] Interestingly, patients taking two or more glaucoma medications were significantly less likely to express non-adherence to their ophthalmologist.

Patients who reported their glaucoma medication adherence was greater than 80% were significantly less likely to express non-adherence to their ophthalmologist. This may be due, in part, to patients over-reporting their medication adherence.[21] Eye care providers may want to take the time to discuss strategies to improve medication adherence to patients taking more than one prescription medication, and to problem-solve any potential barriers to medication adherence. Providers could initiate conversations about adherence strategies by asking open-ended questions such as, “Some patients have a hard time remembering to take their glaucoma medications, tell me how you remember to take your medications?” Additionally, providers may want to provide suggestions to help patients incorporate medication taking into their daily routine, by stating, “Some patients keep their glaucoma medications next to their toothbrush, and use their glaucoma medication after they brush their teeth.”

This study has several limitations and therefore results should be interpreted with caution. The provider sample size is relatively small with 15 ophthalmologists. Also, patients and providers knew the visit was being recorded but they were not aware of the study hypotheses. Additionally, we cannot estimate the effect of selection bias since the clinic staff did not track the number or characteristics of patients they approached who refused to participate in the study.

CONCLUSIONS

This study provides important information on the relationship between glaucoma patient characteristics and expression of side effects, eye drop administration difficulties, and medication non-adherence to ophthalmologists during medical visits. Specifically, we found that patients with lower health literacy are less likely to express medication related problems and patients that express medication problems often express non-adherence. This study showed an association between patient expression of side effects and an expression of non-adherence. In order to improve medication adherence, providers should work with patients to assess their unique medication-related problems and develop strategies to overcome these problems.

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References

1. Friedman DS, Wolfs RC, O'Colmain BJ, Klein BE, Taylor HR, West S, Leske MC, Mitchell P, Congdon N, Kempen J. Prevalence of open-angle glaucoma among adults in the United States. Arch Ophthalmol. 2004; 122:532–8. [PubMed: 15078671]
2. Nordstrom BL, Friedman DS, Mozaffari E, Quigley HA, Walker AM. Persistence and adherence with topical glaucoma therapy. Am J Ophthalmol. 2005; 140:598–606. [PubMed: 16226511]
3. Gurwitz JH, Glynn RJ, Monane M, Everitt DE, Gilden D, Smith N, Avorn J. Treatment for glaucoma: adherence by the elderly. Am J Public Health. 1993; 83:711–6. [PubMed: 8484454]
4. Hollo G, Kothy P, Geczy A, Vargha P. Personality traits, depression, and objectively measured adherence to once-daily prostaglandin analog medication in glaucoma. J Glaucoma. 2009; 18:288–92. [PubMed: 19365193]
5. Taylor SA, Galbraith SM, Mills RP. Causes of non-compliance with drug regimens in glaucoma patients: a qualitative study. J Ocul Pharmacol Ther. 2002; 18:401–9. [PubMed: 12419091]
6. Winfield AJ, Jessiman D, Williams A, Esakowitz L. A study of the causes of non-compliance by patients prescribed eyedrops. Br J Ophthalmol. 1990; 74:477–80. [PubMed: 2390523]
7. Tsai JC. A comprehensive perspective on patient adherence to topical glaucoma therapy. Ophthalmology. 2009; 116:S30–6. [PubMed: 19837258]
8. Friedman DS, Hahn SR, Gelb L, Tan J, Shah SN, Kim EE, Zimmerman TJ, Quigley HA. Doctor-patient communication, health-related beliefs, and adherence in glaucoma results from the Glaucoma Adherence and Persistency Study. Ophthalmology. 2008; 115:1320–7. 7 e1–3. [PubMed: 18321582]
9. Sleath BL, Blalock SJ, Muir KW, Carpenter DM, Lawrence SD, Giangiacomo AL, Goldsmith JA, Hartnett ME, Slota C, Robin AL. Determinants of Self-Reported Barriers to Glaucoma Medicine Administration and Adherence: A Multisite Study. Ann Pharmacother. 2014; 48:856–62. [PubMed: 24692604]
10. Sleath B, Robin AL, Covert D, Byrd JE, Tudor G, Svarstad B. Patient-reported behavior and problems in using glaucoma medications. Ophthalmology. 2006; 113:431–6. [PubMed: 16458967]
11. Sleath B, Rubin RH, Wurst K. The influence of Hispanic ethnicity on patients' expression of complaints about and problems with adherence to antidepressant therapy. Clin Ther. 2003; 25:1739–49. [PubMed: 12860495]
12. Sleath B, Chewning B, Svarstad B, Roter D. Patient expression of complaints and adherence problems with medications during chronic disease medical visits. J Soc Admin Pharm. 2000; 17:71–80.
13. Sleath BL, Krishnadas R, Cho M, Robin AL, Mehta R, Covert D, Tudor G. Patient-reported barriers to glaucoma medication access, use, and adherence in southern India. Indian J Ophthalmol. 2009; 57:63–8. [PubMed: 19075417]
14. Davis TC, Long SW, Jackson RH, Mayeaux EJ, George RB, Murphy PW, Crouch MA. Rapid estimate of adult literacy in medicine: a shortened screening instrument. Fam Med. 1993; 25:391–5. [PubMed: 8349060]
15. Spitzer RL, Kroenke K, Williams JB. Validation and utility of a self-report version of PRIME-MD: the PHQ primary care study. Primary Care Evaluation of Mental Disorders. Patient Health Questionnaire. JAMA. 1999; 282:1737–44. [PubMed: 10568646]
16. Spitzer RL, Williams JB, Kroenke K, Hornyak R, McMurray J. Validity and utility of the PRIME-MD patient health questionnaire in assessment of 3000 obstetric-gynecologic patients: the PRIME-MD Patient Health Questionnaire Obstetrics-Gynecology Study. Am J Obstet Gynecol. 2000; 183:759–69. [PubMed: 10992206]
17. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. J Gen Intern Med. 2001; 16:606–13. [PubMed: 11556941]
18. Nau DP, Steinke DT, Williams LK, Austin R, Lafata JE, Divine G, Pladevall M. Adherence analysis using visual analog scale versus claims-based estimation. Ann Pharmacother. 2007; 41:1792–7. [PubMed: 17925497]

19. Amico KR, Fisher WA, Cornman DH, Shuper PA, Redding CG, Konkle-Parker DJ, Barta W, Fisher JD. Visual analog scale of ART adherence: association with 3-day self-report and adherence barriers. J Acquir Immune Defic Syndr. 2006; 42:455–9. [PubMed: 16810111]
20. Ivanova JI, Birnbaum HG, Hsieh M, Yu AP, Seal B, van der Molen T, Emani S, Rosiello RA, Colice GL. Adherence to inhaled corticosteroid use and local adverse events in persistent asthma. Am J Manag Care. 2008; 14:801–9. [PubMed: 19067497]
21. Zeller A, Ramseier E, Teagtmeyer A, Battegay E. Patients' self-reported adherence to cardiovascular medication using electronic monitors as comparators. Hypertens Res. 2008; 31:2037–43. [PubMed: 19098375]
22. Dreer LE, Girkin C, Mansberger SL. Determinants of medication adherence to topical glaucoma therapy. J Glaucoma. 2012; 21:234–40. [PubMed: 21623223]
23. Sleath B, Blalock S, Covert D, Stone JL, Skinner AC, Muir K, Robin AL. The relationship between glaucoma medication adherence, eye drop technique, and visual field defect severity. Ophthalmology. 2011; 118:2398–402. [PubMed: 21856009]
24. Muir KW, Santiago-Turla C, Stinnett SS, Herndon LW, Allingham RR, Challa P, Lee PP. Health literacy and adherence to glaucoma therapy. Am J Ophthalmol. 2006; 142:223–6. [PubMed: 16876500]
25. Sleath B, Ballinger R, Covert D, Robin AL, Byrd JE, Tudor G. Self-reported prevalence and factors associated with nonadherence with glaucoma medications in veteran outpatients. Am J Geriatr Pharmacother. 2009; 7:67–73. [PubMed: 19447359]
26. Dreer LE, Girkin CA, Campbell L, Wood A, Gao LY, Owsley C. Glaucoma medication adherence among African Americans: program development. Optom Vis Sci. 2013; 90:883–97. [PubMed: 23873033]
27. Tsai JC, McClure CA, Ramos SE, Schlundt DG, Pichert JW. Compliance barriers in glaucoma: a systematic classification. J Glaucoma. 2003; 12:393–8. [PubMed: 14520147]
28. Lacey J, Cate H, Broadway DC. Barriers to adherence with glaucoma medications: a qualitative research study. Eye (Lond). 2009; 23:924–32. [PubMed: 18437182]
29. Olthoff CM, Hoevenaars JG, van den Borne BW, Webers CA, Schouten JS. Prevalence and determinants of non-adherence to topical hypotensive treatment in Dutch glaucoma patients. Graefes Arch Clin Exp Ophthalmol. 2009; 247:235–43. [PubMed: 18802720]
30. Okeke CO, Quigley HA, Jampel HD, Ying GS, Plyler RJ, Jiang Y, Friedman DS. Adherence with topical glaucoma medication monitored electronically the Travatan Dosing Aid study. Ophthalmology. 2009; 116:191–9. [PubMed: 19084273]
31. Schwartz GF, Quigley HA. Adherence and persistence with glaucoma therapy. Surv Ophthalmol. 2008; 53 (Suppl1):S57–68. [PubMed: 19038625]
32. Djafari F, Lesk MR, Harasymowycz PJ, Desjardins D, Lachaine J. Determinants of adherence to glaucoma medical therapy in a long-term patient population. J Glaucoma. 2009; 18:238–43. [PubMed: 19295380]

Table 1

Characteristics of Glaucoma Patients (N=279).

	Percent (N)
Gender	
Male	40.9 (114)
Female	59.1 (165)
Race	
African American	35.5 (99)
Non-African American	64.2 (179)
Number of Glaucoma Medications Used	
One	67.0 (187)
Two or more	32.6 (91)
REALM	
Eighth grade or lower	14.0 (39)
Ninth grade or higher	84.2 (235)
Health Insurance Coverage	
Patient has health insurance	97.5 (272)
Patient does not have health insurance	2.5 (7)
Prescription Drug Insurance	
Patient has prescription drug insurance	94.3 (263)
Patient does not have prescription drug insurance	5.7 (16)
Patient Self-Reported Administration Problems	
None	59.5 (166)
A Little or a Lot	40.5 (113)
Patient Self-Reported Side Effect Problems	
None	86.7 (242)
A Little or a Lot	13.3 (37)
Patient Self-Reported Medication Adherence	
80% or greater on VAS	85.0 (193)
Less than 80% on VAS	15.0 (34)
	Range; Mean (Standard Deviation)
Age	21–93; 65.8 (12.8)
PHQ-9 Score	0–18; 2.18 (3.3)
Number of Prescription Medications in Addition to Glaucoma Medications	0–22; 3.9 (3.5)

Table 2

Generalized estimating equation results predicting whether patients express a problem with side effects or difficulties administering their glaucoma medications to their ophthalmologist (N=273).

Independent Variables	Patient expressed concern/ problem with side effects of glaucoma medications OR (95% CI)	Patient expressed concern/problem with the administration of glaucoma medications OR (95% CI)
Patient Age	1.02 (1.00, 1.04)	1.03 (0.99, 1.07)
Patient Gender	1.02 (0.55, 1.90)	0.80 (0.41, 1.55)
Patient Race, African American	0.79 (0.44, 1.41)	1.15 (0.45, 2.95)
Number of glaucoma medications	1.24 (0.73, 2.09)	0.35 (0.12, 1.05)
Health Literacy, reads at an eighth-grade level or below	0.47 (0.25, 0.88)*	0.26 (0.11, 0.63)**
Depression, PHQ-9	1.01 (0.91, 1.11)	1.05 (0.98, 1.13)
Number of other prescription medications	1.00 (0.93, 1.08)	1.04 (0.92, 1.19)
Patient self-reports side effects of glaucoma medications	1.86 (1.12, 3.08)*	-
Patient self-reports problems with administration of glaucoma drops	-	3.13 (1.82, 5.37)***

OR=odds ratio, CI=confidence interval,

* p<0.05,

** p<0.01,

*** p<0.001

Table 3

Generalized estimating equation results predicting whether patients express an adherence problem to glaucoma medications to their ophthalmologist (N=273).

Independent Variables	Patient Expressed Concern/Problem with Non-adherence to Glaucoma Medication OR (95% CI)
Age	1.00 (0.98, 1.02)
Gender	0.80 (0.47, 1.38)
Race, African American	0.61 (0.30, 1.22)
Number of glaucoma medications, 2 or more medications	0.52 (0.29, 0.92)*
Health literacy, reads at an 8th-grade level or below	1.73 (0.61, 4.90)
Depression, PHQ-9	0.99 (0.91, 1.08)
Number of non-glaucoma prescription medications	0.87 (0.81, 0.94)***
Patient expresses a problem with administration of glaucoma medication	2.89 (1.44, 5.80)**
Patient expresses a problem with side effects of glaucoma medication	2.03 (1.16, 3.54)*
Visual Analog Scale, ≥ 80%	0.22 (0.12, 0.40)***

OR=odds ratio, CI=confidence interval,

* p<0.05,

** p<0.01,

*** p<0.001