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Glaucoma Patient Knowledge, Perceptions, and Predispositions for Telemedicine

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Abstract

Purpose—The purpose was to identify factors associated with older glaucoma patients' knowledge of, perceptions of, and predispositions for telemedicine use.

Methods—Established patients age ≥ 60 years with a diagnosis of primary open angle glaucoma, glaucoma suspect, or ocular hypertension followed by a glaucoma fellowship-trained ophthalmologist were enrolled in the study at an academic, urban, tertiary referral eye clinic. Enrolled patients were administered a Life Space questionnaire (LSQ), scored 0–9, and Preferences for Telemedicine questionnaire (PTQ), a Likert scale validated tool. Chi-square testing analyzed PTQ responses by age, race, education, employment status, LSQ score, and distance traveled from home address to clinic. A Mann-Whitney U test was used to compare PTQ responses by visual field index and visual acuity for the better and worse eye.

Results—Of 110 patients enrolled, 71% of patients agreed or were neutral to receiving telediagnosis and 74% of patients agreed or were neutral to receiving teleintervention. Patients aged 60–69 years compared to those ≥ 70 had significantly greater knowledge about types of telemedicine: telediagnosis (53% vs 31%, $p=0.02$), teleintervention (49% vs 24%, $p=0.006$), teletriage (80% vs 47%, $p=0.0004$), and telemonitoring (55% vs 27%, $p=0.003$). Patients of European descent had significantly more knowledge about teletriage compared to those of non-European descent (72% vs 53%, $p=0.04$). Patients with more education (> high school) compared to those with less education (≤ high school) had more knowledge about telemedicine (39% vs. 16%, $p=0.007$) and all the uses of it: telediagnosis (61% vs. 45%, $p<0.001$), teleintervention (54% vs. 14%, $p<0.001$), teletriage (86% vs. 35%, $p<0.001$), and telemonitoring (59% vs. 18%, $p=0.001$). Patients with a LSQ score ≥ 6, meaning they traveled a greater distance from home in the previous 3 days, displayed significantly more knowledge about telediagnosis (49% vs 25%, $p=0.02$), teleintervention (43% vs 19%, $p=0.01$), and telemonitoring (47% vs 25%, $p=0.03$) than those with an LSQ < 6. Responses to the PTQ were not significantly different by distance traveled.

Conclusions—Knowledge of telemedicine was variable but between one-third and one-half of patients had favorable attitudes toward using telemedicine for glaucoma care.

Keywords

Telemedicine; glaucoma; patient preferences; telehealth; mobility

Introduction

Glaucoma is one of the most common chronic eye diseases of aging and is the second most common cause of blindness worldwide.¹ The prevalence of POAG increases with age, affecting more than 1.8% of the population over 40 but increasing to 23.2% among African Americans and 9.4% among non-Hispanic whites over the age of 75.² With the rapid growth in older populations, the number of POAG cases will increase 250% by 2050, directly affecting over 7 million lives.³ These numbers are specifically for POAG and do not include those who are monitored and treated for elevated intraocular pressure or for glaucoma suspect status, which along with POAG can all be considered glaucoma associated diseases (GAD). While the number of patients with glaucoma will nearly double over the next 20 years, the number of US ophthalmologists is expected to grow only 0.67%.^{4,5} The at-risk population for glaucoma in the US is large, with older age as the primary risk factor as well as people of African descent or Hispanics 40 years old, Asians, non-Hispanic European descent 50 years old, older persons with diabetes, and those with a family history of glaucoma. POAG is at least 4–5 times higher in African Americans, progresses more rapidly and appears about 10 years earlier as compared to those of European descent.^{6–8} Fortunately, vision loss from glaucoma can be prevented by early detection, consistent follow-up, and control of intraocular pressure with medication or surgery.

Older adults with glaucoma, especially in advanced stages, experience reductions in health-related quality of life with an increased risk for depression, social disengagement, employment challenges, problems accessing health care, and ultimately, mortality.^{9–15} Ophthalmologists rarely practice in rural areas, such as in Alabama where those of African descent represent the majority of the population.¹⁶ This produces a problem accessing ophthalmological care, especially subspecialist glaucoma care. Accessibility (i.e., transportation, nearness of clinic to where one resides) is the most commonly cited barrier to eye care by people of African descent.¹⁷ Interventions to improve early detection of glaucoma and increase follow-up rates, including how to make care more accessible for older glaucoma patients, will likely improve the health and well-being of persons with this condition.

Telemedicine is a potential strategy to improve glaucoma detection and management as well as to improve effectiveness, access, and adherence with eye care. Telemedicine is already used in eye care, predominantly in the areas of screening for diabetic retinopathy and retinopathy of prematurity, using digital fundus photography to achieve effectiveness and cost-effectiveness.^{18–26} In the past 20 years, there has been a growing interest in using telemedicine in the detection and management of glaucoma, with numerous articles describing pilot programs in various parts of the world.^{18,27–40} This literature has largely

focused on emphasizing the public health need for telemedicine services for glaucoma in rural and outlying areas, demonstrating feasibility of data transmission, and the importance of multi-disciplinary collaboration among types of providers.^{27,28,30,33,37,41–44} Yet, little is known about patients' current knowledge of and predispositions for such a care delivery model. The purpose of this analysis is to identify factors associated with older glaucoma patients' knowledge of, perceptions of, and predispositions for telemedicine use.

Methods

This study was approved by the Institutional Review Board at the University of Alabama at Birmingham (UAB) and followed the tenets of the Declaration of Helsinki. This was a cross-sectional study of glaucoma patients who were seen by either of two glaucoma fellowship-trained attending ophthalmologists in the Glaucoma Clinic of the Callahan Eye Hospital Clinic at UAB. This glaucoma clinic sees patients from the regional community seeking eye care as well as referrals from other eye care providers in the state of Alabama. Patients are insured with Medicare, Medicaid, or private insurance. In 2017, the UAB Glaucoma Clinic saw over 9,700 patients with POAG, ocular hypertension, or glaucoma suspect, of whom 41% were of African descent and 52% of European descent.

Potential study participants were identified from the scheduled list of patients for the two glaucoma specialists based on their age and status as an established patient with a glaucoma-associated diagnosis previously made by the glaucoma specialist. Eligibility criteria for enrollment were English-speaking, had attended >1 visit at the glaucoma clinic previously, and were aged ≥ 60 years old with a diagnosis of either POAG, ocular hypertension, and/or glaucoma suspect. Enrollment took place from May 5, 2015, through July 18, 2015. Eligible patients were asked by a research coordinator to participate after checking in for their scheduled glaucoma appointment. Participants provided written informed consent after the nature and purpose of the study were described. Three questionnaires were interviewer-administered in a private room prior to the patient's eye exam by the research coordinator: a general patient demographic questionnaire (age, gender, race/ethnicity), a Life Space Questionnaire (LSQ), and a Preferences for Telemedicine Questionnaire (PTQ).^{45,46}

The LSQ has been validated for use in community-dwelling older adults to measure the spatial extent of mobility of an individual and has established test-retest reliability, and construct and criterion validity.^{45,47} The LSQ asks nine questions about recent movement and travel within the past 3 days through concentrically larger areas of life-space. The LSQ has been used in many studies on mobility and health-related quality of life. It identifies a person's ability to be mobile and provides more information than simply analyzing the physical distance from a person's home to the clinic. A person with a lower LSQ could be hypothesized to have less ability to travel long distances to a clinic for health care and thus may be more interested in a telemedicine approach to care. It begins with asking about movement outside of the participant's bedroom and then expands to areas immediately outside the home, neighborhood, town, county, and region of the country (Appendix 1).⁴⁵ The LSQ is scored based on 1 point for each "Yes" answer to the nine questions, with scores ranging from 0–9. Higher scores represent greater mobility. A LSQ score of 6 was chosen as

the cutoff value as previous authors had found a mean and median LSQ score of 6 in population-based samples with similar characteristics as our sample.⁴⁵

The PTQ has 14 questions (see Appendix 1). The first five questions are “Yes/No” questions evaluating the participant’s general knowledge of telemedicine and related telemedicine applications such as teleradiology, teleintervention, teletriage, and telemonitoring. The research coordinator gave a brief description of the potential ways in which telemedicine could be used for the patient’s glaucoma care. The next section evaluated perceived benefits of telemedicine. Responses were based on a 5-point Likert scale from strongly agree (1) to strongly disagree (5). The third section evaluated perceived concerns with telemedicine. Responses were based on a 5-point Likert scale ranging from not at all concerned (1) to extremely concerned (5). Finally, the last section measured predisposition for the use of telemedicine to receiving a diagnosis (teleradiology) or an intervention (teleintervention). Responses were based on a 5-point Likert scale ranging from strongly agree (1) to strongly disagree (5). Likert scale responses were collapsed into three groups for ease of comparison: strongly agree/somewhat agree, neutral, and somewhat disagree/strongly disagree, as well as not at all concerned/slightly concerned, neutral, and very concerned/extremely concerned.

Glaucoma severity was determined based on the most recent visual field index (VFI) score, within the previous year, obtained from automated visual field testing with Swedish interactive thresholding algorithm (SITA) 24–2. VFI is a measure in the Statpac software of the Humphrey Field Analyzer (HFA; Carl Zeiss Meditec, Dublin, California, USA). It is scored as a percentage ranging from 100 (normal visual field) to 0 (absolute perimetric loss).⁴⁸ Reliability indices were not assessed and no visual fields were excluded. Visual acuity was defined as the best corrected distance visual acuity at the scheduled visit expressed as logarithm of the minimum angle resolvable (logMAR).⁴⁹ The VFI and visual acuity were obtained by chart review performed by the research coordinator after the scheduled visit was complete.

Demographic and clinical characteristics were summarized for the sample overall. Chi-square tests were used to compare the PTQ responses by age group (60–69 vs. ≥70), race (European descent vs. non-European descent), employment status (yes vs. no), educational attainment (≤ high school (HS) degree vs. > HS degree), distance traveled to the clinic from the patient’s home address (quartiles of miles compared), and LSQ score (<6 vs. ≥6). Mann-Whitney U tests were used to compare the PTQ responses by VFI and visual acuity for the better and worse eye.

Results

A total of 110 patients were enrolled during the study period. Mean age of participants was 71.2 years (SD ±6.7, Table 1). About half (47%) self-reported as African descent, 52% were of European descent, and <1% listed other. Level of education completed (≤ HS 46%) and employment (20% currently employed) were used as markers of socioeconomic status. On average, the distance between the patients’ home address and the clinic address was 40.3 miles (SD ±48.4). Mean VFI for the better eye was 76.3 (SD ±34.4) and 55.1 (SD ±40.2) in

the worse seeing eye. The mean visual acuity logMAR was 0.26 (SD $\pm$ 0.4) in the better-seeing eye and 0.48 (SD $\pm$ 0.6) in the worse seeing eye.

Overall, results from the PTQ showed only 31 (28%) participants had ever heard about telemedicine. However, when asked about specific aspects about telemedicine, participants seemed more familiar with the functions of telemedicine: telediagnosis (n=45, 41%), teleintervention (n=39, 35%), teletriage (n=69, 63%), and telemonitoring (n=44, 40%). For the perceived benefits domain, the majority of participants agreed to statements about telemedicine's benefits including 73% for continuing education, 72% for cost reduction, 91% for improved access, and 70% for improved quality (Table 2). When asked about their concerns related to telemedicine, the majority of the sample was not concerned about issues related to confidentiality (n=71, 65%), absence of direct contact with providers (n=61, 55%), and legal responsibility in case of medical errors (n=55, 50%). 43 (39%) of participants were willing to receive a remote medical diagnosis via telemedicine while 35 (32%) were neutral about it. About half held a favorable opinion about receiving a remote medical intervention or treatment via telemedicine (n=50, 46%) with 31 (28%) being neutral.

Analysis of the PTQ responses by patient demographic and clinical characteristics revealed that the younger age group (60–69) compared to the older age group ($\geq$ 70) had more knowledge about telediagnosis (53% vs. 31%, $p=0.02$), teleintervention (49% vs. 24%, $p=0.06$), teletriage (80% vs. 47%, $p=0.0004$), and telemonitoring (55% vs. 27%, $p=0.003$) (Table 3a-SDC). The European descent group had more knowledge about teletriage (72% vs. 53%, $p=0.04$) than the non-European descent group (Table 3a-SDC). Patients with more education ($>$ high school) compared to those with less education ($\leq$ high school) had more knowledge about telemedicine (39% vs. 16%, $p=0.007$) and all the uses of it: telediagnosis (61% vs. 45%, $p<0.001$), teleintervention (54% vs. 14%, $p<0.001$), teletriage (86% vs. 35%, $p<0.001$), and telemonitoring (59% vs. 18%, $p=0.001$). Patients who were employed had greater knowledge about telemedicine than those who were unemployed (45% vs. 24%, $p=0.04$), as well as telediagnosis (68% vs. 34%, $p=0.004$), teletriage (82% vs. 58%, $p=0.04$), and telemonitoring (59% vs. 35%, $p=0.04$). Those with a higher LSQ score ($\geq$ 6) compared to a lower score ($<$ 6) had more knowledge about telediagnosis (49% vs. 25%, $p=0.02$), teleintervention (43% vs. 19%, $p=0.01$), and telemonitoring (47% vs. 25%, $p=0.03$) (Table 3a-SDC). The PTQ responses were not significantly different by quartiles of distance traveled. Few associations were found between perceived benefits, perceived concerns, and predisposition for telemedicine based on age, race, education, employment, LSQ score, and distance traveled (Tables 3a and 3b-SDC).

Table 4-SDC displays the PTQ responses by glaucoma severity based on VFI and visual acuity for the better and worse eye. The mean VFI was higher (better) among those with knowledge of telemedicine compared to those without knowledge of telemedicine (Table 4-SDC). In both better and worse eyes, the mean VFI was significantly higher among those who disagreed with the potential benefit of telemedicine improving the quality of care than in those who agreed or were neutral about the perceived benefit ($p=0.003$ for both better and worse eye). There were no associations between perceived concerns and predisposition domains based on VFI.

Similarly, mean visual acuity was significantly better in both the better eye and worse eye of those who responded “Yes” to knowledge of telediagnosis as opposed to those who answered “No” ($p=0.02$, $p=0.04$, respectively). There were no significant associations with PTQ responses in the perceived concerns and predisposition domains based on visual acuity.

Discussion

While telemedicine is already in use in some types of clinical ophthalmology, namely diabetic retinopathy and retinopathy of prematurity screening, its use in the detection and management of glaucoma is only emerging. A deeper understanding of patient knowledge, attitudes, and beliefs is needed in order for such a model of care to be successfully embraced by patients. We examined older glaucoma patients’ knowledge of, perceived benefits, perceived concerns, and predisposition for potentially using telemedicine for their glaucoma care. The present study found that the overall knowledge of telemedicine and its applications was low while the predisposition for the use of telemedicine for glaucoma care was moderate amongst a group of older glaucoma patients seen in a tertiary, academic referral clinic. Specifically, knowledge of telemedicine and various types of its applications was higher among younger, employed, European descent patients with more than a high school education, a higher LSQ score, and those with better visual function.

Several studies have published on patient satisfaction levels associated with the use of telemedicine programs in ophthalmology, showing high levels of patient satisfaction.^{50,51} However, few previous studies have looked specifically at patient predispositions regarding telemedicine in ophthalmology prior to its implementation. Understanding patients’ perceptions of this model of care prior to their actual experience with it is important in order to maximize patient embrace of the technology. Valikodath et al. surveyed 97 patients and found a low (32%) willingness to participate in a telemedicine program for diabetic retinopathy screening.⁵² Our study found a slightly higher level of interest in using a telemedicine program at 39–46% of patients who agreed to the possibilities of receiving a telediagnosis or teleintervention. If we consider those who answered “Neutral” to these questions as people who may become agreeable to the use of telemedicine if they were provided with more information, then only 26–29% of participants were disagreeable to potential telemedicine use. Similar to the Valikodath et al. study, we also found that patients’ perceptions about the benefits and concerns of telemedicine for glaucoma care were unrelated to patient demographics. It is interesting to note that in our study, the distance that patients traveled from their home to the glaucoma clinic was not associated with any of the PTQ response domains. This is surprising as we had hypothesized that patients living a far distance from the clinic would have a greater predisposition for telemedicine as it would be more convenient for them. The Valikodath et al. study evaluated the perceived convenience of telemedicine and found that patients with better access to care did not find telemedicine to be potentially more convenient.⁵² Perhaps the physical distance between a patient and the site of medical care is only one of several barriers that could potentially affect access to care. It is possible that the present study population represented patients who had good access to care based on the fact that they were already established patients in the clinic, regardless of the actual mileage from their home to the clinic.

While several studies have assessed patient satisfaction with telemedicine programs, few exist that have evaluated patients' predisposition for telemedicine prior to implementation. Another study that used the same PTQ survey that we employed found similar results in terms of low knowledge of the term "telehealth" but higher familiarity with its clinical applications amongst a large sample of the general population of Quebec, Canada, a largely rural area.⁴⁶ The Quebec study also found that nearly 50% of residents were agreeable to receiving telediagnosis or teleintervention, although the methods of the paper did not discuss how the Likert scale responses were converted into the "Yes/No" categories they displayed. Thus it is difficult to compare to our results. Gagnon et al. did find an association between increasing age and a decrease in predisposition to use telemedicine.⁴⁶ Our study only included patients aged 60 and older and had fewer participants than that study which may account for the lack of such a finding in our study.

The current study has several limitations. The cohort of patients was limited in size and only represented older patients seen in an urban, academic, tertiary care clinic with fairly severe glaucomatous disease. Additionally, the patients in this study, while seen in an urban clinic, travel a great distance, mean 40.3 miles, from home to be seen. Generalizability to other glaucoma patient populations may be limited. It is possible that a larger sample including younger patients as well as those with less severe glaucoma would have more knowledge about telemedicine and have a higher predisposition for its use. Another potential limitation is that the LSQ was used to capture the mobility of our patients with the thought that less mobile patients would be more interested in telemedicine. It is possible that the older patient population in our study had a higher LSQ score due to the fact that older patients travel for visits to their doctors frequently, thus making the LSQ score artificially high. A third limitation is the lack of use of open-ended questions in our survey which may have limited our ability to capture other perceived benefits or concerns of our sample regarding their preferences for telemedicine. Another limitation is that the visual fields were not assessed based on reliability indices. This could have affected the strength and nature of the associations between glaucoma severity and survey response. Future directions for research on patient preferences could include prospective studies evaluating patient preferences before and after the implementation of a telemedicine model for glaucoma care as well as the use of educational material to describe telemedicine and its benefits.

In conclusion, knowledge of telemedicine was variable but between one-third and one-half of patients had favorable attitudes toward potentially using telemedicine for glaucoma care. This has positive implications for the success of future telemedicine programs deployed for glaucoma care. Additionally, telemedicine programs may have greater acceptance by patients if education about the nature and benefits of telemedicine is provided to patients prior to the deployment of a specific telemedicine program. As the glaucoma patient population grows due to the increase in older adults, the use of telemedicine programs in the detection and management of glaucoma may become more necessary to maintain access to care for patients.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Demographic and clinical characteristics (N=110)

Characteristics	Mean ($\pm$ SD) or n (%)
Age, years	71.2 ($\pm$ 6.7)
Gender, female	63 (57.3)
Race	
African descent	52 (47.3)
European descent	57 (51.8)
Other	1 (0.9)
Currently employed, yes	22 (20.0)
Education level, high school	51 (46.4)
Life Space Questionnaire Score	5.9 ($\pm$ 1.3)
Distance between clinic and patient home address, miles	40.3 ($\pm$ 48.4)
Glaucoma Severity	
Visual Field, better eye VFI ¹	76.3 ($\pm$ 34.4)
Visual Field, worse eye VFI ¹	55.1 ($\pm$ 40.2)
Visual Acuity, better eye VA logMAR ²	0.26 ($\pm$ 0.4)
Visual Acuity, worse eye VA logMAR ²	0.48 ($\pm$ 0.6)

¹N=93²N=100

Abbreviations: SD, standard deviation; VFI, Visual Field Index; VA, visual acuity; logMAR, logarithm of the minimum angle of resolution

Table 2.

Participants' responses to Preferences for Telemedicine survey

Preferences for Telemedicine Survey Items	n (%)	n (%)	n (%)
Knowledge of Telemedicine Applications	Yes	No	
Telemedicine: use of technology for remote health care	31 (28)	79 (72)	-
Telediagnosis: obtain a remote medical opinion or diagnosis from a physician via telemedicine	45 (41)	65 (59)	-
Teleintervention: receive a medical intervention or treatment supervised remotely by a specialist via telemedicine	39 (35)	71 (65)	-
Teletriage: obtain telephone advice from a healthcare professional	69 (63)	41 (37)	-
Telemonitoring: remotely monitor individual health status via telemedicine	44 (40)	66 (60)	-
Perceived Benefits	Agree	Neutral	Disagree
Continuing education to health care providers	80 (73)	29 (26)	1 (1)
Cost reduction of health system	79 (72)	25 (23)	6 (5)
Improved access to care for people in remote regions	100 (91)	8 (7)	2 (2)
Improved quality of care	77 (70)	26 (24)	7 (6)
Perceived Concerns	Not Concerned	Neutral	Concerned
Confidentiality of personal information	71 (65)	12 (10)	27 (25)
Absence of direct contact with healthcare providers	61 (55)	16 (15)	33 (30)
Legal responsibility in the case of medical errors	55 (50)	17 (15)	38 (35)
Predisposition	Agree	Neutral	Disagree
Telediagnosis: receive a remote medical diagnosis from a physician via telemedicine	43 (39)	35 (32)	32 (29)
Teleintervention: receive a remote medical intervention or treatment from a physician via telemedicine	50 (46)	31 (28)	29 (26)