Glaucoma Virtual Monitoring Clinic: Development and Implementation in a Portuguese Public Hospital

Programa de Monitorização Não-Presencial de Glaucoma: Desenvolvimento e Implementação num Hospital Público Português

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ABSTRACT

INTRODUCTION: A virtual clinic is a new model of glaucoma care in which the ophthalmologist is removed from the face-to-face patient consultation. Virtual glaucoma services are intended to improve both patients' experiences and clinics' capacity. In this study, we describe the development of a glaucoma virtual monitoring clinic within a public hospital of the Portuguese national healthcare service and describe its implementation outcomes.

METHODS: A prospective, service evaluation study was performed including patients referred for an in-house glaucoma monitoring service structured as an asynchronous virtual clinic at the Ophthalmology Department, Centro Hospitalar Vila Nova de Gaia/Espinho, Portugal. Consecutive patients with stable disease and low risk of glaucoma progression were considered for enrolment. Feasibility of development of the glaucoma virtual clinic (GVC), improvement of patient journey times, and patients' experiences at the service were studied.

RESULTS: A total of 177 patients attended the GVC during its first year of activity. The most prevalent diagnosis were primary open-angle glaucoma (50.3%) and ocular hypertension (26.0%). The journey time at the GVC had an average reduction of 37.8% when compared to the conventional clinic (56 minutes *vs* 90 minutes, respectively, $p<0.001$). Most patients (88.7%) attending the GVC were subsequently scheduled for a follow-up visit at an adequate monitoring interval. Twenty patients were referred for an anticipated face-to-face appointment. Evaluation of patients' experiences showed high levels of satisfaction with the service. Patient–doctor relationship, previous experience of care within the hospital, level of information about the disease status, and knowledge about the GVC were found to be important factors for acceptance of this model of care. Greater efficiency and less waiting times at the appointment were pointed by patients as strengths of the GVC.

CONCLUSION: Virtual monitoring services are a clinically efficient, alternative model for glaucoma care within the hospital setting. In this study, we demonstrated the feasibility of implementing this model of care in our ophthalmology service and reported a decrease of patient journey time, a low rate of referral back to face-to-face appointments, and high levels of patient acceptance and satisfaction in the virtual glaucoma monitoring clinic.

KEYWORDS: Glaucoma; Outpatient Clinics, Hospital/organization & administration; Referral and Consultation; Remote Consultation.

RESUMO

INTRODUÇÃO: A consulta não-presencial é um modelo de prestação de cuidados de saúde recentemente proposto para a monitorização clínica de doentes com glaucoma. O objetivo deste modelo de consulta é melhorar a experiência do doente e a capacidade de resposta dos serviços de saúde. O presente estudo teve como objetivo descrever os resultados da implementação de um novo programa de consulta não-presencial de monitorização de glaucoma.

MÉTODOS: Estudo prospetivo de avaliação de um programa de consulta não-presencial para monitorização assíncrona de doentes com o diagnóstico de glaucoma em seguimento regular no Serviço de Oftalmologia do Centro Hospitalar Vila Nova de Gaia/Espinho, Portugal. Doentes com doença controlada e com baixo risco de progressão foram considerados elegíveis para participar no programa. Os parâmetros avaliados incluíram a capacidade de implementação e viabilidade do referido programa, a melhoria dos tempos de permanência do doente no hospital e a experiência pessoal do doente.

RESULTADOS: No primeiro ano de funcionamento, 177 doentes frequentaram o programa de consulta não-presencial de monitorização de glaucoma. Os diagnósticos mais prevalentes foram glaucoma primário de ângulo aberto (50,3%) e hipertensão ocular (26,0%). O tempo de permanência no hospital foi reduzido em 37,8% quando comparado com a consulta presencial (56 minutos *vs* 90 minutos, respetivamente, $p<0,001$). A maioria dos doentes (88,7%) observados em consulta não-presencial manteve consultas de seguimento regulares, de acordo com intervalos de monitorização adequados. Vinte doentes foram referenciados para uma consulta presencial antecipada. A avaliação da experiência dos doentes demonstrou uma elevada satisfação com o novo programa de consulta não-presencial. A relação médico-doente, a experiência prévia no hospital, o nível de conhecimento relativo à doença e o grau de informação sobre a consulta não-presencial foram fatores importantes para a aceitação do programa. Maior eficiência e menor tempo de espera foram realçados como pontos fortes da consulta não-presencial.

CONCLUSÃO: A consulta não-presencial de glaucoma é um modelo seguro e eficiente para a monitorização de doentes com glaucoma. No presente estudo, demonstrámos a viabilidade de implementação deste programa no nosso serviço de Oftalmologia, com uma redução do tempo de permanência do doente no hospital, uma frequência baixa de referenciação para consulta presencial antecipada e uma elevada satisfação por parte dos doentes que frequentam este modelo de consulta.

PALAVRAS-CHAVE: Ambulatório Hospitalar/organização & administração; Consulta Remota; Encaminhamento e Consulta; Glaucoma.

INTRODUCTION

Glaucoma is a group of optic neuropathies characterized by retinal ganglion cell loss and damage to the optic nerve. It represents one of the leading causes of preventable and irreversible visual loss worldwide.[1-3] Glaucoma is a chronic and progressive disease whose prevalence increases with advancing age.[2] After the diagnosis, regular monitoring with structural and functional testing is required, allowing for assessment of progression at an early stage and decision on treatment interventions.[4]

Delivery of high-quality glaucoma care has become a challenge in ophthalmology outpatient services, resulting in capacity problems in many ophthalmology services, giving the increased demand in aging populations, the earlier detection due to improvements in diagnostic technologies, and the need for long-term care.[5-7] Recommended monitoring intervals and frequency of testing, established in accordance with the risk for disease progression, are often not followed because of limitations in clinics' capacity.[8,9] Furthermore, overbooked clinics may require patients to perform the monitoring exams at a different day of that of the consultant's appointment, or to be inappropriately rescheduled, leading to unnecessary visits and longer waiting times. New models of glaucoma care delivery are needed to offer high-quality glaucoma care.

The implementation of asynchronous 'virtual clinics' in glaucoma care has been proposed for monitoring of patients with stable disease and low risk of progression to significant visual loss. The rationale for the implementation of 'virtual clinics' is to help improve the patient journey and the clinics' capacity. In this model of care, the consultant ophthalmologist is removed from the face-to-face patient consultation, with clinical decisions being taken at a different time from that of the patient's visit: the patient attends an outpatient clinic appointment, in which patient data is collected

through a series of tests; following the visit, the results are reviewed by a consultant ophthalmologist, with glaucoma related outcomes being later communicated to the patient.[10-13] Previous evidence has demonstrated the safety, efficiency, and acceptability to patients of this model of care.[14-19]

In this setting, we developed a virtual glaucoma monitoring service at the Ophthalmology Department of a tertiary referral hospital in Portugal. The new service aimed to reduce the patient journey time and the number of hospital visits, while improving the access to the conventional clinic to patients with more complex and severe disease, and ensuring that patients presenting with disease progression or other ocular complains at the virtual clinic were rescheduled for an appointment with their consultant ophthalmologist.

In the present study, we sought to assess the feasibility of developing a glaucoma virtual clinic within a Portuguese public hospital and to analyse its implementation outcomes.

MATERIAL AND METHODS

A prospective, observational, hospital-based service evaluation study was performed including patients referred for an in-house glaucoma monitoring service structured as an asynchronous virtual clinic at the Ophthalmology Department, Centro Hospitalar Vila Nova de Gaia/Espinho, Vila Nova de Gaia, Portugal. The study was conducted in accordance with the tenets of the Declaration of Helsinki and was approved by the ethics committee at Centro Hospitalar Vila Nova de Gaia/Espinho (Document Number: 39/2021).

The Glaucoma Virtual Clinic (GVC) service started running in 2021. Appropriate patients were selected by the consultant ophthalmologist at a face-to-face appointment and invited to be transferred to the new virtual clinic (performed by E.S., J.S. and D.M.). Informed consent was obtained from all patients. Data concerning the first year of activity of the GVC is presented.

PATIENT ELIGIBILITY

Consecutive patients with stable disease and a monitoring frequency greater than six months were considered for enrolment at the GVC, in accordance with published consensus guidelines.[20] Eligibility criteria included: ocular hypertension (OHT) patients; glaucoma suspect patients; primary or secondary open-angle glaucoma patients with mild to moderate disease; and pseudo-phakic primary angle closure glaucoma (PACG) patients with mild to moderate disease. Exclusion criteria for enrolment at the GVC were defined as severe disease or high risk for glaucoma progression, intra-ocular pressure (IOP) above targeted value, history of non-compliance, poor quality diagnostic testing, including poor visual field technique, and presence of other ocular comorbidities requiring face-to-face evaluation. Risk of disease progression and stability were evaluated by the consultant ophthalmologist in charge of each patient (performed by E.S., J.S. or D.M.). Diagnosis and disease severity were established in accordance with the European Glaucoma Society guidelines and the Hoddap-Parrish-Anderson criteria, respectively.[21,22]

VIRTUAL CLINIC JOURNEY

The GVC was set up within the Ophthalmology Department and was staffed by experienced orthoptic technicians. Sessions in which ophthalmic equipment was in less demand and orthoptic technicians were free to perform tests for additional patients were identified, avoiding the need to for new equipment acquisition or hiring of new staff.

Testing in the GVC was performed in a streamline manner by the orthoptic technicians and following a standard operating procedure (Fig. 1): check-list type interview in order to assess therapeutic compliance ("yes" or "no"), identify ocular symptoms ("yes" or "no"; if "yes", specify); Snellen visual

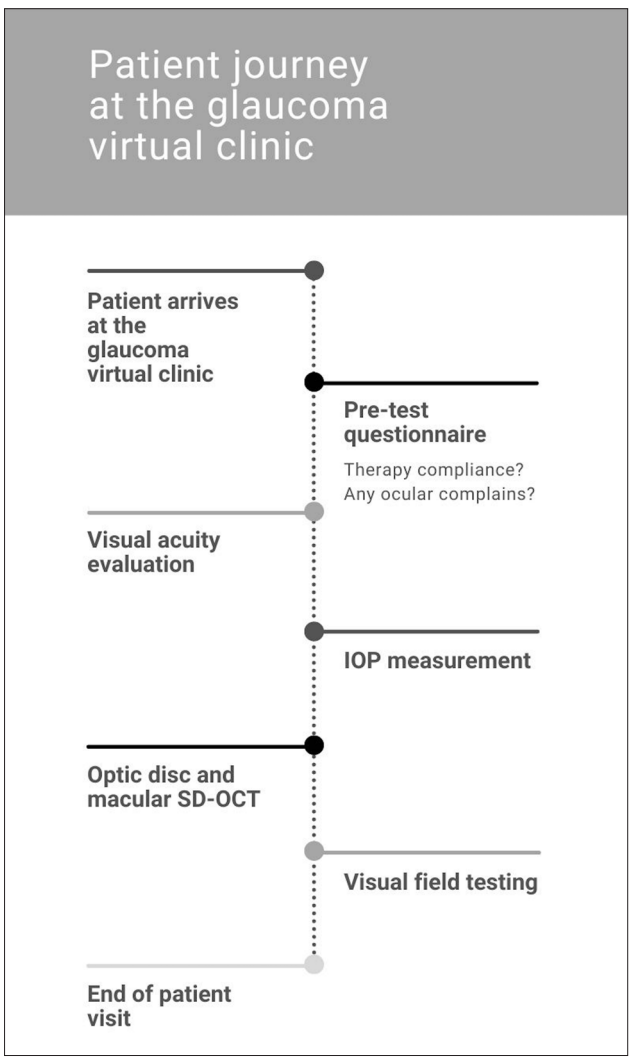

Figure 1. Flow-chart illustrating patient journey the glaucoma virtual monitoring service.

IOP – intraocular pressure; SD-OCT – spectral-domain optical coherence tomography.

acuity evaluation; IOP measurement with rebound tonometry (iCare IC100, iCare Finland Oy, Tuike Vantaa, Finland) or Goldman applanation tonometry if IOP > 21mmHg; spectral-domain optical coherence tomography (SD-OCT) of the retinal nerve fibre layer and macula (Spectralis – Glaucoma module premium edition, Heidelberg Engineering Inc., Franklin, MA, USA); and standard automated perimetry SITA-standard 24-2 (Humphrey Field Analyzer, Carl Zeiss Meditec, Dublin, CA, USA). After completing the tests, the patient was discharged home, with data being reviewed posteriorly by the consultant ophthalmologist and results communicated to the patient by letter.

REVIEW PROCESS

Review of the data acquired during the GVC visit was performed by the consultant ophthalmologist (E.S., J.S. or D.M.) within 45 days, choosing one of the following outcomes: maintain regular follow-up at adequate monitoring intervals; or schedule a second, anticipated face-to-face appointment for further review of the GVC results.

The criteria for evaluation at an anticipated face-to-face consultation were ocular symptoms, significant visual loss (≥ 2 Snellen lines), IOP higher than the targeted value, progression in visual field testing, and increase in optic nerve head cupping or retinal nerve fibre layer loss in SD-OCT.

Because it was the first year of activity of the virtual clinic, all patients who were maintained at regular follow-up were also scheduled for a face-to-face appointment, respecting the monitoring interval defined by the consultant ophthalmologist.

PATIENTS' EXPERIENCES IN THE VIRTUAL CLINIC

Patients' acceptance and satisfaction with the new service were analysed following the GVC visit. All patients were contacted by telephone and asked to complete an anonymous patient satisfaction questionnaire (Table 1) (performed by C.F., J.F. and P.M.). The patient satisfaction questionnaire focused on the evaluation of patient-reported experience measures (PREMs) and was adapted from a survey previously used in glaucoma virtual clinics evaluation.[18] During the questionnaire, the patients were inquired about their satisfaction with the medical care and efficiency at the GVC, the attitude of the staff, the level of information they had about the GVC prior to their attendance, and whether they had received and understood the outcome letter. Two open-answer questions were performed at the end of the interview to identify aspects of the GVC the patients liked or disliked, and suggestions for improvement.

DATA COLLECTION

Data was collected from the patients' medical records including age, gender, glaucoma diagnosis and severity (if applicable), duration of follow-up at the conventional clinic (months), number of glaucoma medications, and history of previous ocular surgery or glaucoma laser treatment. The results from the GVC visit were also analysed, including therapy compliance, presence of ocular complains, visual acuity (VA), IOP measurements, and visual field-testing results (visual field reliability and mean deviation).

Furthermore, the following data were retrieved:

- Adequacy of the referral to the GVC.
- Journey time (minutes) at the virtual clinic visit.
- Journey time (minutes) at the previous face-to-face appointment.
- Time from virtual clinic visit to consultant ophthalmologist review and issue of outcome letter (days).
- Time necessary for review of the GVC results by the consultant ophthalmologist (minutes).
- Outcome of the GCV visit (regular follow-up or anticipate face-to-face appointment).
- Reason for scheduling of an anticipated face-to-face appointment, false positive rate of referral for the face-to-face appointment, and decision at the appointment (monitoring or treatment).
- Patient satisfaction based on the responses to the telephone questionnaire.

Table 1. Patient satisfaction questionnaire.

Responses: *Excellent, Satisfactory, Poor, No answer*
- How did you find the INFORMATION PROVIDED to you before you attended the clinic?
- What do you think about the overall EFFICIENCY of your appointment?
- How did you find the QUALITY OF CARE during your appointment?
- How would you rate the SPEED at which you received the DOCTOR'S LETTER, following your appointment?
- How would you rate the CONTENT of the DOCTOR'S LETTER?
- How would you rate the CONFIDENCE you felt while attending the virtual clinic service?
- Was it clear to you that you would not be seen in person by a doctor? YES or NO
- Was there anything about the service you particularly LIKED or do you have any SUGGESTIONS to improve this service?

OUTCOME MEASURES

Main outcomes measures of the study were feasibility of developing and implementing a glaucoma virtual clinic in a Portuguese public hospital, improvement of patient journey time within the clinic, and patient satisfaction with the new service. Secondary outcome measures included adequate referral of patients to the virtual clinic, frequency of ocular complains and non-compliance at the GVC, frequency and false positive rate of referral for anticipated face-to-face appointment, and time taken for consultant's review.

STATISTICAL ANALYSIS

Statistical analysis was performed using SPSS Statistics for Windows, version 26.0 (SPSS, Chicago, IL). Continuous variables were described as mean and standard deviation when following a normal distribution, or otherwise as median and range. Categorical variables were described using absolute and relative frequencies. The Wilcoxon Sign Rank Test was used to compared paired, continuous variables without normal distribution. VA measurements were converted to logarithm of the minimal angle of resolution (logMAR) for analysis purposes.[23] Statistical significance was set at $p<0.05$.

RESULTS

A total of 196 patients were enrolled at the GVC between January and December 2021. Six patients failed to attend their appointment (3.1%), twelve patients were erroneously scheduled for a conventional monitoring appointment (6.1%), and one patient died after enrollment (0.5%), with a total of 177 patients attending the GVC service during the first year of its implementation.

COHORT CHARACTERIZATION

The demographic and clinical features of the patients who attended the GVC are presented in Table 2. Mean age at diagnosis was 69.4 years (± 8.9) and 54.8% of patients were female. The three most common diagnosis in our sample were primary open-angle glaucoma (POAG, 50.3%, n=89), OHT (26.0%, n= 46) and glaucoma suspect (10.7%, n=19). Two-hundred and fifteen eyes (60.7%) had an established diagnosis of glaucoma, with 123 eyes (57.2%) presenting with mild disease and 60 eyes (25.9%) with moderate disease. Median duration of previous follow-up at the conventional clinic was 84 months (range 24-240) and median number of glaucoma medications at the time of the GVC visit was 1 (range 0-3). Seventy-four patients (41.8%) had a history of previous ocular surgery, and 9 patients (5.1%) had been submitted to glaucoma laser treatments.

Table 2. Clinical and demographic characteristics of patients attending the virtual clinic.

Age, (years, mean ± SD)	69.5 ± 8.9
Gender, (female, n [%])	97 (54.8%)
Follow-up time, [months, median (range)]	84 (24-240)
Number medications [median (range)]	1 (0-3)
Diagnosis	
Primary open-angle glaucoma, (n [%])	89 (50.3%)
Ocular hypertension, (n [%])	46 (26.0%)
Glaucoma suspect, (n [%])	19 (10.7%)
Pseudoexfoliative glaucoma, (n [%])	9 (5.1%)
Normotension glaucoma, (n [%])	6 (3.4%)
Primary angle-closure glaucoma, (n [%])	6 (3.4%)
Pigmentary glaucoma, (n [%])	1 (0.6%)
Glaucoma secondary to corticosteroids, (n [%])	1 (0.6%)
Ocular surgery, (yes, n [%])	74 (41.8%)
Cataract surgery, (n [%])	63 (35.6%)
Glaucoma surgery, (n [%])	3 (1.6%)
Combined surgery, (n [%])	8 (4.6%)
Other procedures, (n [%])	1 (0.6%)
Laser treatment, (yes, n [%])	9 (5.1%)
Laser iridotomy, (n [%])	6 (3.4%)
Selective laser trabeculoplasty, (n [%])	2 (1.1%)
Micropulse transscleral cyclophotocoagulation, (n [%])	1 (0.6%)

SD - standard deviation

VIRTUAL CLINIC VISIT OUTCOMES

Adequacy of referral to the GVC was determined by verification of the eligibility criteria for each patient, with 149 patients (84.2%) being correctly referred. Of the 28 patients who did not meet the eligibility criteria, 13 (46.4%) were enrolled during the first three months of the virtual clinic activity. These were patients with severe disease or who were unable to comply with the monitoring exams.

Median visual acuity at the GVC was 0.2 logMAR (range 0-2.0) and mean IOP was 16mmHg (± 4, range 5-30). Median mean deviation measurements on standard automated perimetry were -3.46 (range -27.50-2.42). Most patients reported good therapeutic compliance (98.8%, n=171). Ocular complains were registered in 10 patients (5.6%): five patients had ocular surface related symptoms (2.8%); and 6 patients complained of decreased VA (3.4%). A total of 3 patients (1.6%) could not comply with one or more of the monitoring exams.

JOURNEY TIME AND REVIEW OUTCOMES

The median journey time at the GVC visit was 56 minutes (range 20-149), compared with 90 minutes (range 21-166) at the patient's previous face-to-face appointment, corresponding to an average reduction of 37.8% in the time spent at the hospital ($p<0.001$). The median time taken for the consultant ophthalmologist to review the GVC results was 11 minutes (range 4-33), with a median of 35 days (range 1-96) between the GVC visit and the consultant's review and issue of the outcome letter.

Table 3 shows the outcomes of the consultant's review. Most patients were maintained in regular follow-up at individualized monitoring intervals (88.7%, n=157). Twenty patients (11.3%) were referred for an anticipated face-to-face appointment with their consultant ophthalmologist, 45.0% of which (n=9) underwent treatment adjustments or were planned for therapeutic interventions. Reasons for anticipation of face-to-face appointment included ocu-

Table 3. Virtual clinic review outcomes.	
Decision after consultant's review	
Maintain regular follow-up, (n [%])	157 (88.7%)
Anticipate face-to-face appointment, (n [%])	20 (11.3%)
Reason for anticipation of face-to-face appointment	
Ocular symptoms or decrease in visual acuity, (n [%])	10 (5.6%)
Visual field progression or poor-quality testing, (n [%])	7 (4.0%)
IOP above target value, (n [%])	2 (1.1%)
Therapy non-compliance, (n [%])	1 (0.6%)
Outcome of anticipated face-to-face appointment	
Monitor, (n [%])	11 (6.2%)
Treatment adjustment or intervention, (n [%])	9 (5.1%)

IOP – intra-ocular pressure

lar surface related symptoms or decrease in VA in 10 patients (5.6%), visual field progression or poor technique in 7 patients (4.0%), IOP higher than the targeted value in 2 patients (1.1%), and therapy non-compliance in 1 patient (0.6%). The false positive rate of referrals to an anticipated conventional appointment was 45.0% (n=9).

PATIENTS' SATISFACTION OUTCOMES

A total of 128 patient satisfaction questionnaires were completed, with an overall response rate of 65.0%. Most responders rated the information provided about the appointment prior to attending as 'Excellent' (65.2%, n=73). Nevertheless, 25.0% stated to be unaware that they would not be seeing a doctor during their visit. Both the efficiency and quality of care during the appointment were considered 'Excellent' by most patients (74.1%, n= 83; and 88.4%, n=99; respectively). When questioned about how confident patients felt about attending a virtual clinic, only 6 patients (5.5%) reported to feel poorly confident.

In relation to the responses to the open-ended questions at the end of the telephone interview, greater efficiency and less waiting times at the appointment were pointed by patients as strengths of the virtual clinic. Furthermore, patient-doctor relationship and previous experiences of care within the hospital were mentioned as factors contributing to the sense of trust in this new model of care. Level of information about the disease status and knowledge about the virtual clinic service were found to be important factors for acceptance of the service, with some patients reporting that insufficient information regarding the change to the GVC resulted in anxiety at the appointment and afterwards. Lack of opportunity to discuss their health status with the consultant ophthalmologist was mentioned by a few patients as a downside of the virtual clinic.

Table 4. Summary of the patient satisfaction questionnaire responses.	
Information provided	
Excellent, (n [valid %])	73 (65.2%)
Satisfactory, (n [valid %])	20 (17.8%)
Poor, (n [valid %])	19 (17.0%)
Efficiency at the virtual clinic	
Excellent, (n [valid %])	83 (74,1%)
Satisfactory, (n [valid %])	27 (24.1%)
Poor, (n [valid %])	2 (1.8%)
Quality of care at the virtual clinic	
Excellent, (n [valid %])	99 (88.4%)
Satisfactory, (n [valid %])	12 (10.7%)
Poor, (n [valid %])	1 (0.9%)
Speed of doctor's letter	
Excellent, (n [valid %])	51 (45.5%)
Satisfactory, (n [valid %])	56 (50.0%)
Poor, (n [valid %])	5 (4.5%)
Content of doctor's letter	
Excellent, (n [valid %])	76 (67.9%)
Satisfactory, (n [valid %])	35 (31.2%)
Poor, (n [valid %])	1 (0.9%)
Confidence while attending the service	
Excellent, (n [valid %])	63 (57.3%)
Satisfactory, (n [valid %])	41 (37.3%)
Poor, (n [valid %])	6 (5.5%)

DISCUSSION

In the present study, we analyzed the feasibility and implementation outcomes of a new asynchronous glaucoma virtual clinic at the Portuguese public hospital. The reasoning for its implementation was based on our understanding of the need to improve glaucoma patients' health-related outcomes and experiences. We sought to improve the patients' experiences at the outpatient clinic by providing patients with less time-consuming appointments, fewer dislocations to the hospital, and good levels of satisfaction when attending the service. Additionally, we aimed to ameliorate health-related outcomes by enabling adequate monitoring for patients with stable disease and low risk of progression, without compromising close face-to-face follow-up and prompt intervention for patients presenting with more advanced disease or at high risk for severe visual loss. A growing number of publications have demonstrated the safety and efficacy of virtual clinics for triaging and monitoring of glaucoma patients in busy outpatient clinics.[10,13,14-19] Reports on glaucoma virtual clinics performance show improved capacity, enhanced patient access to glaucoma care, and costs reduction.[10,13,15,24-26]

Successful implementation of an in-house, technician-led glaucoma virtual clinic sharing several similarities to

our GVC has been reported by Kotecha *et al* and Huang *et al*.[10,13] In fact, because our GVC was staffed by the same orthoptic technicians who operate the conventional clinic, transition to their new role at the virtual clinic occurred easily, with no reports of difficulty in communicating and interacting with patients. During the first year of its implementation, the GVC was attended mainly by POAG patients, OHT patients, and glaucoma suspect patients, with the majority being followed at the conventional clinic for several years. Most glaucoma patients had mild to moderate disease, as defined by the eligibility criteria. Nonetheless, 15.8% of patients were inadequately enrolled at our clinic. These were patients with severe disease or who were unable to comply with the monitoring exams. Appropriate use of the eligibility criteria presented a challenge in the implementation of our GVC, but we believe that this improved over time, as almost half of the patients who were incorrectly enrolled attended the virtual clinic in the first trimester of its activity.

An excellent level of self-reported therapy compliance (98.8%) was seen in GVC patients', and ocular complains were seldomly described (5.6%). Furthermore, there was a low rate for referral to an anticipated face-to-face appointment (11.3%). These findings suggest that our aim for improving conventional clinic capacity is sustainable, as 88.7% of patients were maintained at regular follow-up visits and, therefore, could continue to attend the virtual clinic. We had a high rate of false positive referral to the anticipated face-to-face appointment (45.0%). Still, the absolute frequency was low (9 patients) and distributed over a one-year period, thus not interfering significantly with the conventional clinic service.

In relation to patient journey times, the GVC reduced the overall time spent at the hospital in 37.8% and more than half of the patients had a journey time of less than one hour. These results are in line with those reported in literature.[10,13] Time spent by the consultant ophthalmologist reviewing the GVC results was 11 minutes in average. Huang *et al* have reported mean consultant review time at their virtual glaucoma clinic to be of 5.8 minutes.[13] A possible explanation to our longer review time is that the consultant ophthalmology must review each of the monitoring exams in different software suites, with no interoperability between them. Transition to a software suite that could aggregate all tests in the same platform could possibly reduce review time and improve our clinic's efficiency.

Finally, patients' experiences within the GVC showed overall high levels of satisfaction with the service. Different studies have analyzed the patient's perceptions and experiences when moving to this model of care, showing that good levels of satisfaction can be achieved in patients attending a glaucoma virtual clinic.[11,12,17] Acceptance to move to this form of care delivery appears to be improved by effective doctor-patient communication, including reassurance about disease status and information on the virtual clinic service. In our sample, most patients made positive comments about the GVC, highlighting the quick and efficient service. Some patients expressed concerns about not seeing the consultant ophthalmologist on the day of the hospital visit, and 17.0% felt they were poorly informed about their move to the GVC service. Although informed consent to attend the GVC was obtained from all patients after explanation about the new model of care, our results suggest that some patients might have misunderstood the concept of the virtual clinic or had problems recalling the decision, which was taken during the previous face-to-face appointment. Moreover, busy outpatient clinics may make it difficult to the consultant ophthalmologist to take the appropriate amount of time to discuss with the patient the move to the GVC and clarify possible doubts. To improve this situation, we have designed information leaflets informing existing patients of their transfer to the GVC and how the service works, that will be provided by the consultant ophthalmologist at the face-to-face appointment.

Our study presented important limitations. Firstly, no comparison group attending the conventional glaucoma clinic was included in our study, which might limit data interpretation, especially in relation to the patients' satisfaction outcomes. Telephone interviews were conducted a few months after the virtual clinic appointment, allowing for memory bias. Because GVC patients were admitted to sessions in which ophthalmic equipment and orthoptic technician were in less demand, no dedicated technicians and work periods were attributed to the virtual clinic, possibly elongating patient journey times at the hospital. Furthermore, no analysis was performed on cost reduction and no direct measure of the overall clinic's capacity before and after the GVC implementation was obtained. The strengths of our study are the use of defined criteria for patient enrollment at the virtual clinic, the development of protocols based on consensus guidelines for ensuring patients' safety in glaucoma virtual clinics, and the assessment of patients' satisfaction using a questionnaire focused on PREMs evaluation.[18,20]

CONCLUSION

In conclusion, our study demonstrates that the implementation of an asynchronous glaucoma virtual clinic for the monitoring of low-risk glaucoma patients is feasible within the Portuguese national healthcare service. The virtual glaucoma clinic showed to be a clinically efficient, alternative model for glaucoma care within the hospital setting, as we reported a decrease of patient journey time, a low rate of referral back to face-to-face appointments, and high levels of patient acceptance and satisfaction.

CONTRIBUTORSHIP STATEMENT / DECLARAÇÃO DE CONTRIBUIÇÃO:

CF, JF, PM, and DM: Study design and article writing; Data collection, statistical analysis and interpretation; Writing and approval of the final version.

ES, JS, and DM: Critical review of the manuscript and approval of the final version.

CF, JF, PM, e DM: Desenho do estudo e elaboração do ar- tigo; Recolha, análise estatística e interpretação de dados: Redação e aprovação da versão final.

ES, JS, e DM: Revisão crítica do manuscrito e aprovação da versão final.

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Protection of Human and Animal Subjects: The authors declare that the procedures followed were in accordance with the regulations of the relevant clinical research ethics committee and with those of the Code of Ethics of the World Medical Association (Declaration of Helsinki as revised in 2013).

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