Title: Expansion of Patient Eligibility for Virtual Glaucoma Clinics: A Long-Term Strategy to Increase the Capacity of High-Quality Glaucoma Care

Authors: Eleni Nikita [1], Gus Gazzard [1,2,3], Dawn A. Sim [1,2,3], Sandro Fasolo [1], Karsten Kortuem [1], Hari Jayaram [1,2,3]

Institutions:

1. Moorfields Eye Hospital NHS Foundation Trust, London, UK
2. UCL Institute of Ophthalmology, London, UK
3. NIHR Moorfields Biomedical Research Centre, London, UK

Contributorship Statement: EN, SF, KK carried out the data collection and analysis, EN, HJ & GG contributed to the first draft and all authors approved the final version of the manuscript. All authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Keywords: Glaucoma, Telemedicine, Eligibility Criteria

Word Count: 2983

Running Title: Expanded Patient Eligibility Criteria for Virtual Glaucoma Clinics

Précis: Expanding the eligibility criteria for virtual glaucoma clinics can provide a safe, long-term solution to increase capacity for the delivery of high-quality glaucoma care to a growing ageing population with high patient satisfaction.

Acknowledgments:

GG is employed by UCL and supported by grants from the National Institute for Health Research (HTA 09/104/40), Moorfields Eye Charity, British Council to Prevent Blindness, Fight For Sight and the International Glaucoma Association. HJ is supported by the Moorfields Eye Charity. GG and HJ are grateful for the support of the National Institute for Health Research Biomedical Research Centre for Ophthalmology at Moorfields Eye Hospital and the UCL Institute of Ophthalmology. The views expressed in this paper are those of the authors and not necessarily those of any funding body or the UK Department of Health.

Abstract:

Aims:

The Virtual Glaucoma Clinic (VGC) is a well-established diagnostic pathway for delivery of glaucoma care. Current United Kingdom national guidance recommends VGCs for patients with ocular hypertension, glaucoma suspects, or early glaucoma. This study evaluates whether expanded eligibility criteria, including other glaucoma phenotypes and disease stages, can deliver safe and effective care with a positive patient experience.

Methods:

Records of over 8000 patients were reviewed in order to determine suitability for VGC attendance using expanded eligibility criteria. Patients with 3 prior consecutive visits within the glaucoma service were included. Follow-up interval, clinic type, visual acuity (VA), intraocular pressure (IOP), and visual field performance were recorded. Patient satisfaction was recorded for a sample of 118 patients.

Results:

2017 patients over 31 months were included. Two-thirds of eyes had ocular co-morbidities, a fifth of eyes had undergone prior cataract surgery and ten percent of eyes had undergone a prior laser treatment for glaucoma. After three visits, 32% of patients remained in the VGC, 42% were seen in face-to-face clinics and 25% were discharged. There were no clinically significant changes in VA, IOP and visual field performance during follow up. 72% of patients expressed a preference to continue their care within VGCs.

Conclusions:

This study demonstrates that VGCs with expanded patient eligibility criteria can deliver high-quality glaucoma care that is safe, effective and with high levels of patient satisfaction. This approach provides a long-term solution to adapt delivery of glaucoma care to our expanding and ageing population.

Introduction

Glaucoma is the leading cause of preventable sight loss in the United Kingdom and is responsible for almost a third of new vision impairment certifications. [1] The delivery of high-quality glaucoma care across the United Kingdom was a challenge even prior to the COVID-19 pandemic, primarily as a consequence of increasing life expectancy. In 2016, the president of the Royal College of Ophthalmologists (RCOphth) summarised the landscape as *"a perfect storm of increased demand, caused by more eye disease in an ageing population requiring long term care"*.[2]

In response, the RCOphth commissioned the "Way Forward" project, to increase awareness of the growing challenges associated with the delivery of glaucoma care and develop solutions to the demand : capacity mismatch within outpatient care settings.[3] This project predicted a 44% increase in the number of people with glaucoma in the UK from 2015 to 2035. The projected rise was already tangible, with hospital-initiated appointment rescheduling becoming a frequent occurrence, leading to significant lengthening of patient monitoring intervals. [4] The RCOphth also issued national guidance in 2016 regarding the conduct and patient eligibility criteria for "virtual glaucoma clinics" (VGCs) to help increase capacity.[5] This guidance was based upon prior evidence demonstrating the safety [6], efficiency [7 8] and acceptability to patients [9 10] of this model of care.

However, delayed follow up and a lack of capacity within hospital eye services continued to be responsible for cases of permanent and severe vision loss.[11 12] In early 2020, a formal investigation by the Healthcare Safety Investigation Branch starkly highlighted the problems with a lack of timely monitoring for glaucoma patients and made recommendations including the need for appropriate specialist-led clinical decision making and further clinical pathway redesign.[13]

The urgency in this daunting clinical challenge has only been magnified by the recent COVID-19 pandemic which will undoubtedly influence how we deliver glaucoma care to our patients in the medium to long term. [14] Approximately 120,000 patients attended outpatient consultations within the glaucoma service across the Moorfields Network over the past year and almost 40,000 glaucoma outpatient appointments were deferred between April-July 2020. In accordance with the RCOphth guidance

[5], we have used technician-led VGCs for those patients at lowest risk [15] for several years. However, prior to the pandemic, 86 percent of all glaucoma attendances across the Moorfields Network continued to involve a face-to-face (F2F) appointment within the hospital setting. To address this sudden and increased demand for capacity within glaucoma services, an expansion of the patient eligibility criteria for VGCs to include most glaucoma phenotypes and more advanced stages of disease, along with the appropriate specialist oversight, is essential in order to deliver safe and timely care to patients.

This pilot study aimed to evaluate whether expanded criteria for VGCs, reviewed by fellowship trained glaucoma specialists, can facilitate the expansion of glaucoma care that is safe, effective and with a positive patient experience.

Materials and Methods

This study was registered and approved by the Clinical Audit and Assessment Committee at Moorfields Eye Hospital (Ref: CA18/GL/13-108).

Clinical records of 8000 patients in the Moorfields South Division were retrospectively reviewed by a consultant ophthalmologist (EN) to determine suitability for VGC, according to newer expanded inclusion and exclusion criteria (Supplementary Table 1). Patients deemed suitable for VGCs were sent an appointment letter by post including a detailed information sheet about the clinic, approved by Moorfields' communications department.

Patient attendances were handled by ophthalmic technicians who received bespoke training and accreditation through our institution to independently manage VGCs. Technician training was based upon the RCOphth guidance for non-medical eye healthcare professionals delivering patient care in a multidisciplinary team setting. [16] Patients were asked a standardised set of questions relating to their medical and ophthalmic history (Supplementary Table 2), followed by measurement of visual acuity (VA) and intraocular pressure (IOP) using the Ocular Response Analyser (ORA; Reichert Ophthalmic Instruments, Inc., Buffalo, NY, USA). This data was entered into an electronic medical record (EMR) (Medisoft, Leeds, UK). Further testing involved standard automated perimetry using the SITA Standard 24-2 algorithm (Humphrey Visual Field Analyser, Carl Zeiss Meditec AG, Jena, Germany),

Optical Coherence Tomography (OCT) imaging of the peripapillary retinal nerve fibre layer (3D- Topcon 2000, Oakland, USA) and capture of a non-mydriatic colour optic disc photograph (Kowa Medical, Hamamatsu, Japan). Anterior segment OCT (3D-Topcon 2000, Oakland, USA) was performed for all new patients, but only upon prior request from clinicians for follow up attendances. All diagnostic tests fed their outcomes directly into the EMR.

All clinical attendances in the VGC were reviewed by a Fellowship trained Consultant Ophthalmologist (EN). Clinical data from patients attending the VGC were collected in a linked-anonymised manner across three consecutive VGC appointments over a four-year period between January 2016 and January 2020.

Outcomes from VGC attendances were collated using Microsoft SQL Server Reports Software, combining data from our electronic medical record (EMR) system (Medisoft, Leeds, UK) and patient administration system (PAS, Silverlink Software, UK). Individual patient encounters were reviewed manually within the EMR in order to confirm the diagnosis and outcome. Outcomes were categorised into three groups: 1) Discharge from the glaucoma service 2) Ongoing follow-up in a VGC, and 3) Referral to a face-to-face (F2F) consultant-led glaucoma clinic. The clinical reasons for future F2F review rather than ongoing care in the VGC were explored using a random sample of 248 patients. In the event that new co-morbidities, other than glaucoma were discovered, an internal referral letter was sent by the clinician to the relevant service. Further analysis of the number and type of such referrals was not performed as a part of this study.

Quantitative data generated per patient at each glaucoma visit, along with ocular diagnoses and details of previous surgeries were extracted into Microsoft Excel. Statistical analyses were performed using Graphpad Prism (San Diego, CA, USA).

Evaluation of Patient Satisfaction

In order to evaluate patient acceptance and satisfaction, all patients who attended VGCs between April-June 2018 were sent an initial invitation and two follow-up email reminders inviting them to participate in an anonymous online survey hosted by Survey Monkey® based upon on a standard Moorfields' patient feedback form. To further understand patient perceptions of the VGC, patients were also asked their

opinion on the environment of our virtual hub, their understanding of not seeing a doctor in-person on the day of review, their rating of the content of the outcome letter sent to them by post, suggestions for improvement and their preference for their upcoming review (VGC versus F2F). We also allowed for free text comments to be added to responses.

Results

Two thousand and seventeen patients fulfilled the expanded criteria specified in Supplementary Table 1 for attendance at VGCs and the characteristics of this population are summarised in Table 1. There is marked ethnic diversity amongst the patient population study, which is reflective of the nature of the catchment area served by Moorfields. Most eyes were either glaucoma suspects (40%) or had a diagnosis of Primary Open Angle Glaucoma (35%). A fifth of eyes had undergone prior cataract surgery and two percent had undergone prior trabeculectomy. Ten percent of eyes had undergone a prior laser treatment for glaucoma, with six percent of eyes having undergone prior laser peripheral iridotomy.

Ocular co-morbidities are described in detail in Table 2. The majority of eyes (64%) had co-existing ocular co-morbidities, amongst which cataract (37%) and diabetic eye disease (10%) were the most common.

Clinic Outcomes of VGC Attendances

The clinical outcomes of patients invited to attend the expanded criteria VGCs are summarised in the flowchart in Figure 1.

Outcome of first visit

Five hundred and fifty nine (27.5%) patients were new appointments and 1468 (72.5%) were follow ups. Six hundred and fifty of 2017 patients were rebooked into a VGC (32%), 987 were booked into F2F clinics (49%), 273 were discharged (14%) and 107 did not attend clinics (DNA) (5%). Amongst the discharged patients, 34 (12.5%) were new referrals. All DNAs were rebooked for a further VGC appointment. In total, 37% of patients were booked into a subsequent VGC appointment.

Outcome of second visit

The median interval between first and second visit was 6.6 months. Five hundred and sixty one of 1744 remaining patients were rebooked into a VGC (32%), 934 were booked into F2F clinics (54%), 121 were discharged (7%) and 128 were DNAs (7%). All DNAs were rebooked into VGC again. In total, 39% of patients were booked into a subsequent VGC appointment.

Outcome of third visit

The median interval between second and third visit was 5.8 months. Five hundred and eighty seven of the remaining 1623 patients were rebooked into a VGC (36%), 844 were booked into F2F clinics (52%), 109 were discharged (7%) and 83 were DNAs (5%). Sixteen patients amongst DNAs were deceased. All remaining DNAs were rebooked into a VGC again. In total, 41% of patients were booked into a subsequent VGC appointment.

Summary after 3 visits

Amongst the original cohort of 2017 patients who were initially reviewed in the VGC, 654 patients remained in the VGC (32%), 844 went to F2F clinics (42%), 503 were discharged (25%) and 16 died (<1%). A need for drainage angle assessment, ineligibility for VGC attendance and unreliable diagnostic tests were the leading reasons for subsequent rebooking into a F2F clinic and are summarised in Table 3.

Amongst the original cohort of 559 new patients, 128 were discharged by the 3rd visit (23%). All of them had at least one FTF review before being discharged.

Ophthalmic Outcomes of VGC Attendances

Visual Acuity

The mean (±SD) visual acuity of all eyes at the first VGC attendance was 84±11 letters compared to 83±12 letters at the third attendance. The mean difference between the first and third VGC attendance of -0.9 letters (95% CI: -1.4,-0.4) reached statistical significance (paired *t*-test, p=0.0003) but is not considered to be clinically significant.

Intraocular Pressure

The mean (±SD) IOP of all eyes at the first VGC attendance was 16.7±4.4 mmHg compared to 16.4±4.6 mmHg at the third attendance. The mean difference between the first and third VGC attendance of -0.3 mmHg (95% CI: -0.5, 0.0) was not statistically significant (paired *t*-test, *p*=0.05).

Visual Field Performance

The mean (±SD) Humphrey Visual Field mean deviation of all eyes at the first VGC attendance was -3.2±4.3 dB compared to -3.4±4.2 dB at the third attendance. The mean difference between the first and third VGC attendance of -0.2 dB (95% CI: -0.3, 0.0) reached statistical significance (paired *t*-test, *p*=0.03) but is not considered to be clinically significant.

Patient Centred Outcomes of VGC Attendances

The online survey was completed by 118 of the 193 invited patients invited (response rate of 61%) and the results are summarised in Table 4. The majority of patients found all aspects of the service to be either “excellent” or “satisfactory”. Over seventy percent of patients clearly understood they that a doctor would not be present during their VGC attendance, and if given the choice, would chose to have another VGC appointment rather than a traditional F2F appointment.

Two hundred and fifty-eight free text comments were documented. Positive feedback included the reduced time spent at the appointment, the friendliness of the staff, the cleanliness of the environment and the general efficiency of the process. The main themes for suggested improvement related to the absence of an interaction with a doctor on the day, adoption of a system that would allow the immediate resolution of queries and for clinical letters to be more patient friendly.

Discussion

Increasing demand for clinic capacity has a significant impact upon service delivery throughout all healthcare systems. Prior to this pilot study in the Moorfields South Division, eleven percent of glaucoma appointments were being rescheduled and F2F

clinics were overbooked by twenty percent. This had a negative impact upon staff morale and turnover, increased rates of patient non-attendance and the risk of clinical incidents associated with delayed care.[13] Historically, staff shortages have been managed using temporary staff incurring unsustainable financial costs. A major advantage of VGCs is the ability for senior clinicians to make more rapid clinical decisions using a standardised dataset when compared to traditional F2F consultations, enabling a more efficient use of specialist time.

Current national guidance regarding patient eligibility for VGCs only includes a small cross-section of patients seen regularly in glaucoma clinics, namely those with ocular hypertension, suspected glaucoma, mild-moderate Primary Open Angle Glaucoma in the worse eye or mild-moderate Primary Angle Closure Glaucoma in the worse eye in those who have undergone previous bilateral cataract surgery.[5] A national survey showed that although most clinicians work in line with these recommendations, almost a third of respondents included patients outside of the specified criteria [17]. The formal expansion of eligibility criteria for VGCs appeared to be the most rational approach to resolve the operational and clinical challenges to reduce the mismatch between existing outpatient capacity and demand. The U.K. National Health Service organises itself around a single definition of quality: care that is safe, effective and that provides as positive an experience for patients as possible.[18] This study therefore aimed to evaluate whether these changes could be implemented whilst continuing to deliver high quality glaucoma care.

We expanded existing criteria based upon the RCOphth guidance [5] to include patients with most glaucoma phenotypes and severities, provided that patients with advanced glaucoma had been stable for over a year. This resulted in a massive capacity expansion, with a three-fold increase in the eligible patient population, as 1546 patients from our cohort either had secondary glaucoma or other co-morbidities and hence would have been excluded from VGCs had current RCOphth guidance been followed. Despite diagnostic diversity and high incidence of ocular co-morbidities, only 42% of patients were redirected to a F2F clinic following 3 consecutive visits, primarily to perform gonioscopy to evaluate drainage angle anatomy in 28%. Historically, gonioscopy has been considered the “gold standard” technique for drainage angle evaluation leading to reluctance for this to be replaced

by imaging. However, this is likely to change as contemporary literature suggests anterior segment OCT imaging allows more accurate, objective and reproducible assessments of anatomy.[19-21] Moreover, recent changes to RCOphth Guidance on the management of angle closure suspects abandon prophylactic iridotomy for most PACS patients, which will further dramatically reduce the need for F2F gonioscopy.

Our study also demonstrated that a further 10% of patients, who were directed into F2F clinics, could have remained in VGCs had graders followed the modified guidance on VGC eligibility criteria. The revised guidance may be perceived as only a small change stratification into glaucoma care pathways. In reality however, it mandated a significant change is approach and evidence suggests that the adoption journey for organisational changes of this nature is complex and requires time, persistence and constant engagement.[22]

The discharge rates in VGCs resemble those seen in F2F clinics (10% on average and 25% cumulatively over the three-year period), which appear to be low, considering that 40% of eyes were glaucoma suspects. However, a third of our patient cohort was reviewed in the VGC setting for the first time, which can account for lower than expected discharge rates. Additionally as NICE guidance recommends 2-3 year follow up of glaucoma suspects prior to discharge to community monitoring, the observed discharge rate is compatible with national guidance.[23]

Most importantly this study demonstrated that safe and effective glaucoma monitoring can be delivered using the expanded VGC eligibility criteria. Over the course of the study no evidence of clinical deterioration was observed through comparison of visual acuity, intraocular pressure and severity of visual field loss - the primary objective indicators of glaucoma stability. Our results also confirm the findings of a previous study, which reported that clinical findings and data relating to newly referred patients can be safely evaluated in a virtual clinic with satisfactory accuracy. [24]

Patient satisfaction, the third pillar of high-quality care [18], was extremely high for all components of care in this virtual setting. The majority of patients expressed a wish to continue their glaucoma monitoring within this new model of care - with over 100

comments praising the efficiency of the clinic from a patient's perspective. An internal audit found that the average patient journey within the VGC was 37 minutes, compared to the trust-wide average of 92 minutes for F2F glaucoma clinic appointments. Whilst high patient satisfaction levels of VGCs and reduced patient journey times do not guarantee safety, they provide evidence of an efficient service which should be a pre-requisite for any service redesign strategy aiming to cope with increasing demand.

A small proportion of patients expressed some concerns regarding the lack of an immediate response to their queries and absence a doctor on the day. A legacy of the COVID-19 pandemic has been the increased utilisation of patient helplines, remote telephone consultations and video consultations. These adjuncts will be incorporated into standard operating procedure for VGCs and will enable a more responsive service to patients' concerns, which will be supported by a written summary of the discussion to be posted out after the consultation. Our patient satisfaction survey was developed internally, without formal external validation to assess how well it measures main elements of glaucoma care and patient experience. To the best of our knowledge, there are no validated instruments currently available for this purpose, apart from questionnaires designed for cataract patients. [25] We also aimed to minimise sampling bias in the patient satisfaction survey by inviting patients within a fixed 3 month timeframe. It is likely that the level of engagement differed according to age, occupation and other factors including access to a computer. However, we felt that an online, anonymous survey would yield less selection and response bias than a face-to-face survey.

Incentivizing clinicians to meet patient satisfaction benchmarks has become more prevalent and can be a source of controversy [26-29]. However, it is clear that results from patient satisfaction surveys can facilitate positive changes and quality improvements in health-care delivery that are responsive to patients' needs. The need for such surveys is crucial for the future development and improvement of VGCs, as this method of care will likely become the core modality for a significant proportion of glaucoma patients under secondary care within the United Kingdom.

There is a paucity of literature relating to patient satisfaction with teleophthalmology

clinics [9 10 30-33]. Extensive research in this domain has been performed within specialties such as dermatology and oncology, reporting an overall high satisfaction level and acceptance, because of increased accessibility, reduced patient journey times and reduced travel costs [27 34 35]. A prior study at Moorfields to explore patients' perspectives on VGCs reported that most are accepting this model of service, as long as they are informed on status of their condition and are reassured by the staff that they meet [10]. A study from Swansea reported high levels of patient satisfaction with glaucoma virtual clinics, but the emphasis of the questionnaire used was heavily weighted towards patient education [9]. However, both of these studies lacked any anonymity of feedback which is a potential source of bias, an issue that did not influence the online patient satisfaction survey utilised in this study.

Over 40,000 glaucoma outpatient appointments were cancelled across the Moorfields network due to the COVID-19 pandemic. The most efficient method to handle this backlog whilst incorporating social distancing measures is to maximize the utilization of VGCs for a significant proportion of these patients. VGCs are well established in the UK and supported by RCOphth guidance [5] but with limited eligibility criteria. This study provides firm evidence that VGCs with expanded patient eligibility criteria are able to deliver high-quality glaucoma care that is safe, effective and with high levels of patient satisfaction. A similar methodology may be applied to other high-volume outpatient ophthalmic specialties including monitoring of diabetic retinopathy and age-related macular degeneration in order to optimize resource utilization. This approach provides not only a strategy for the recovery from the COVID-19 pandemic but a long-term solution for the safe, effective and efficient delivery of glaucoma care to our expanding and ageing population.

Figure 1. Flowchart illustrating follow up outcomes of patients during the study.

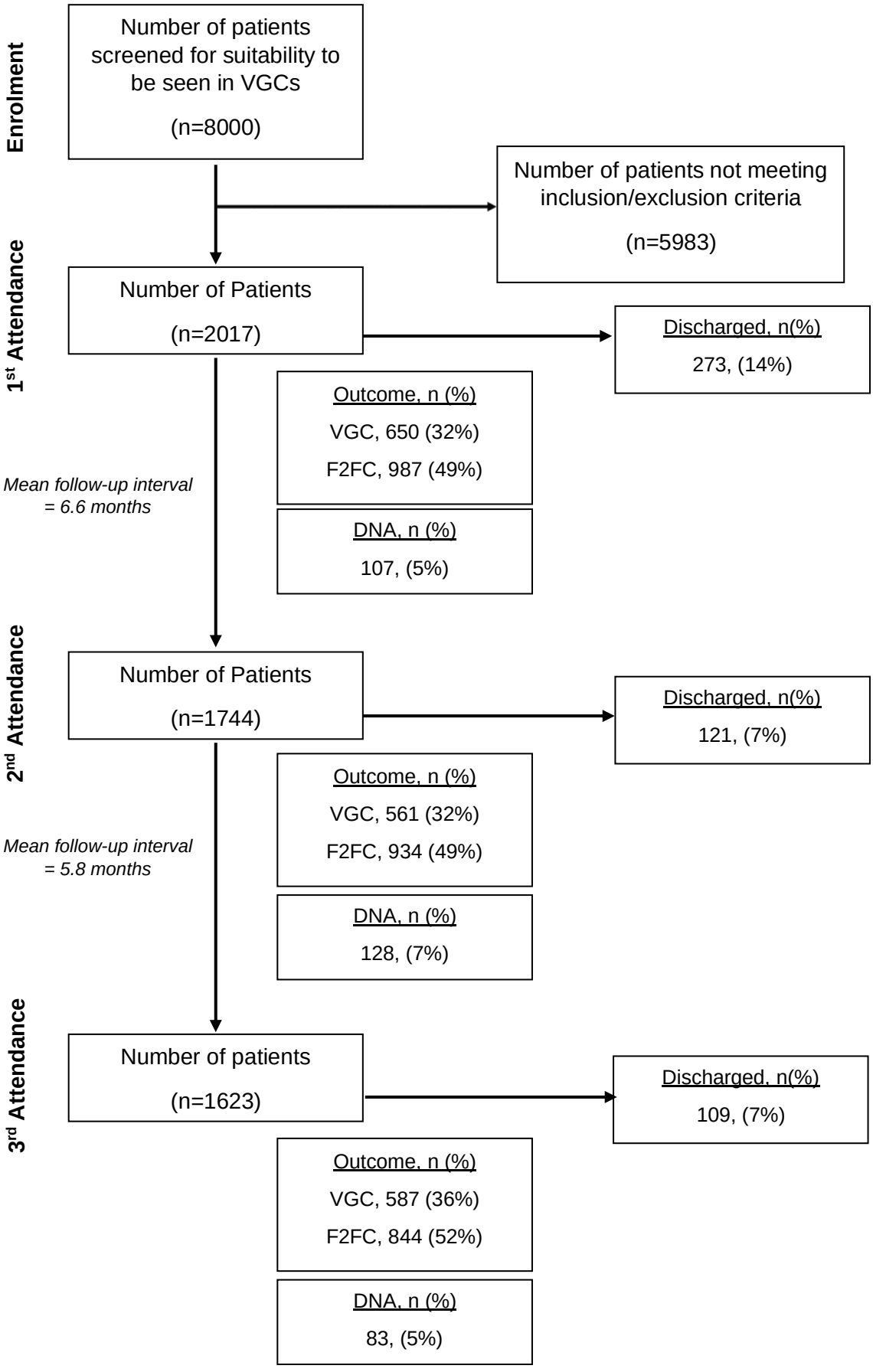

Table 1. Summary of Patient Characteristics

Variable	**Value**
No. of patients	2017
Age in years, median ± SD (range)	73 ± 13.92 (34-94)
Ethnicity, number of patients (%) • Caucasian • African/Caribbean • Asian or Asian Indian • Mixed • Not Specified	 909 (45%) 352 (17%) 273 (14%) 28 (1%) 455 (23%)
Sex, number of patients (%) • Male • Female	 983 (49%) 1034 (51%)
Glaucoma Related Diagnosis, number of eyes (%) • Glaucoma Suspect • Primary Open Angle Glaucoma • Ocular Hypertension • Primary Angle Closure Glaucoma • Secondary Glaucoma	 1607 (40%) 1414 (35%) 838 (21%) 121 (3%) 54 (1%)
Previous ocular surgery, number of patients (%) • No • Yes	 1602 (79%) 415 (21%)
Previous ocular surgery, number of eyes (%) • Cataract Surgery • Trabeculectomy • Retinal Detachment Repair • Penetrating Keratoplasty	 844 (21%) 66 (2%) 11 (0.3%) 8 (0.2%)

Previous Laser Treatment, number of eyes (%)
• All Glaucoma Laser (LPI, SLT, Cyclodiode)
  ○ Laser Peripheral Iridotomy
• All Retinal Laser
  ○ Panretinal Photocoagulation
  ○ Macular Laser
  ○ Retinopexy
• YAG Capsulotomy
• Laser Refractive Surgery
	
	404 (10%)
	229 (6%)
	124 (3%)
	75 (2%)
	43 (1%)
	6 (0.1%)
	123 (3%)
	8 (0.2%)

Table 2. Summary of Ocular Co-Morbidities

Variable	Value
No of patients with co-morbidities	**1546 (77%)**
No. of Eyes	4034
Corneal Pathology, number of eyes (%)	
• Corneal Dystrophy	15 (0.4%)
• Keratoconus	14 (0.4%)
• Corneal Scarring	10 (0.3%)
• Band Keratopathy	8 (0.2%)
• Bullous Keratopathy	3 (0.1%)
Anterior Segment Pathology, number of eyes (%)	
• Primary Angle Closure	114 (3%)
• Pigment Dispersion	35 (1%)
• Pseudoexfoliation	33 (1%)
• Angle Recession	4 (0.1%)
Lens Pathology, number of eyes (%)	
• Cataract	1497 (37%)
• Previous Cataract Surgery - Pseudophakic	839 (21%)
• Previous Cataract Surgery - Aphakic	5 (0.1%)
Chorioretinal Pathology, number of eyes (%)	
• Diabetic Eye Disease	398 (10%)
• Age-Related Macular Degeneration	249 (6%)
• Epiretinal Membrane	95 (2%)
• Retinal Vascular Occlusions	76 (2%)
• Macular Oedema	64 (2%)
• Other Macular Pathology	39 (1%)
• High Myopia	36 (1%)
• Choroidal Naevus / Melanoma	15 (0.4%)
• Other Retinal Pathology	13 (0.3%)
• Previous Retinal Detachment	11 (0.3%)
Other Ocular Pathology, number of patients (%)	
• Quiescent Uveitis	26 (0.6%)
• Amblyopia	19 (0.5%)
• Optic Disc Drusen	5 (0.1%)
• Optic Disc Pit	3 (0.1%)
• Myelinated Nerve Fibres	3 (0.1%)

Table 3: Causes for F2F booking following initial VGC review

Reason	Number (%)
Anterior chamber angle assessment	69 (*28*)
Patients not eligible for VGC	47 (*19*)
Unreliable Diagnostic Tests	31 (*13*)
Glaucoma progression	28 (*11*)
To discuss drop related topics	16 (*6*)
To discuss a new diagnosis of glaucoma	12 (*5*)
To discuss surgery	6 (*2*)
Unclear diagnosis	5 (*2*)
To discuss other patient queries	2 (*1*)
Non-familiarity with guidelines (patients actually eligible for VGC)	32 (*13*)

Table 4. Summary of Results of Patient Satisfaction Survey

	Excellent n (*%*)	**Satisfactory** n (*%*)	**Poor** n (*%*)
1. How did you find the INFORMATION PROVIDED to you, before you attended the clinic?	65 (*55*)	52 (*44*)	1(*1*)
2. What do you think about the overall EFFICIENCY of your appointment?	75 (*64*)	39 (*33*)	4(*3*)
3. How would you rate the STAFF you met at your appointment?	85 (*72*)	30 (*25*)	4 (*3*)
4. How did you find the CLINIC ENVIRONMENT (e.g. waiting area, consultation room, examination room)?	78 (*66*)	40 (*34*)	0 (*0*)
5. If you have previously attended the same clinic, how would you rate the SPEED at which you received the DOCTOR'S LETTER, following your appointment?	43 (*37*)	56 (*48*)	6 (*5*)
6. If you have previously attended the same clinic, how would you rate the CONTENT of the DOCTOR'S LETTER	36 (*30*)	61 (*52*)	7 (*6*)
7. If you were given the choice, which clinic would you chose to attend again?	***Virtual Clinic***	***Face to Face Clinic***	
	83 (*72*)	32 (*28*)	
8. Was it clear to you, from your previous consultation and correspondence, that you would not be seen in person by a doctor?	***Yes***	***No***	
	85 (*73*)	32 (*27*)	
9. Was there anything about the service you particularly LIKED?	• Not having to queue • Quick efficient, friendly and very professional. • Prompt and professional care • Other places are clean, but I think Purley exceptional • The quiet environment • Local venue/transport, speed of tests • Calm atmosphere		
10. Do you have any SUGGESTIONS to improve this service?	• Send doctor's report by email on request • Perhaps a doctor on site, so you get your results there and then • If we could have a consultant there when we have the appointment to explain technical terms • Better communication between Purley and doctor so questions followed up • I would like a doctor to answer my questions today		

Supplementary Table 1: Expanded Inclusion and Exclusion Criteria for Virtual Glaucoma Clinics

Inclusion criteria	Exclusion criteria

Glaucoma Phenotype:
• All new glaucoma referrals, apart from suspected/known advanced glaucoma or referral for consideration of surgery
• Ocular Hypertension/Glaucoma Suspect
• Any Primary or Secondary Glaucomas, of any stage in one or both eyes
• Advanced glaucoma in any eye, if stable for >1 year
• Angle closure glaucoma of any stage in one or both eyes with
  • Pseudophakia
  • Patent Laser Peripheral Iridotomies
  • No documented Peripheral Anterior Synechiae
• Patients judged to be clinically stable and suitable for 6-12 month follow-up interval
	Medical/Social Factors:
	• Dementia
	• Parkinson's disease
	• Previous glaucoma surgery, unless if patient had a documented flat trabeculectomy bleb with good intraocular pressure on drops
	• Previous complaint to PALS
	• Wheelchair bound patients
	• Need for translation services

Visual Field Classification: • Reliable Visual Field Performance • Visual Field Stability for > 1 year • Mild to moderate VF loss (>-6D in the better eye)	*Visual Field Classification:* • Unreliable Visual Field Performance • Visual Field Progression within the past 1 year
Ocular Co-Morbidity: • Any concomitant significant ocular pathology that does not require active management e.g. quiescent PDR, quiescent uveitis, treated or non-exudative age-related macular degeneration	*Ocular Co-Morbidity:* Any concomitant significant ocular pathology requiring active management e.g. active Proliferative Diabetic Retinopathy, active uveitis
Current RCOphth Guidance	
Glaucoma Phenotype: • Ocular hypertension • Suspected open angle glaucoma • Early or moderate primary open angle glaucoma in the worse eye • Bilateral pseudophakia and a primary diagnosis of early or moderate primary angle closure glaucoma in the worse eye	*Medical/Social factors* • Patients in whom it is anticipated that the quality of data collected will be of insufficient reliability for the delegated glaucoma reviewer to make a safe clinical decision(e.g. unable to perform visual fields, poor disc imaging) • Patients with co-existing ocular comorbidities (e.g. uveitis, age-related macular degeneration) who require monitoring of their condition

Supplementary Table 2

Dear Sir/Madam,

Thank you for attending the Glaucoma Monitoring Clinic. In order to make your visit as efficient as possible, we would be very grateful if you could answer the following questionnaire before you are seen for your tests.

1. Which eye drops are you currently using and for which eye(s)?

2. Have you been able to put your eye drops in daily as instructed?

3. If not, when did you stop using the drops?

4. If so, what problems made you stop using your drops?

5. Do you have any other problems with your eyes or vision to report?

References

1. Rahman F, Zekite A, Bunce C, Jayaram H, Flanagan D. Recent trends in vision impairment certifications in England and Wales. Eye (Lond) 2020;**34**(7):1271-78 doi: 10.1038/s41433-020-0864-6[published Online First: Epub Date]|.

2. MacEwen C. Eye risk from 'overstretched NHS': BBC News, 2016:https://www.bbc.co.uk/news/health-35743550.

3. The Way Forward: Options to help meet demand for the current and future care of patients with eye disease. London: Royal College of Ophthalmologists, 2017.

4. Tatham A, Murdoch I. The effect of appointment rescheduling on monitoring interval and patient attendance in the glaucoma outpatient clinic. Eye (Lond) 2012;**26**(5):729-33 doi: 10.1038/eye.2012.22[published Online First: Epub Date]|.

5. Standards for Virtual Clinics in Glaucoma Care in the NHS Hospital Eye Service. Ophthalmic Services Guidance: Royal College of Ophthalmologists, 2016.

6. Clarke J, Puertas R, Kotecha A, Foster PJ, Barton K. Virtual clinics in glaucoma care: face-to-face versus remote decision-making. Br J Ophthalmol 2017;**101**(7):892-95 doi: 10.1136/bjophthalmol-2016-308993[published Online First: Epub Date]|.

7. Trikha S, Macgregor C, Jeffery M, Kirwan J. The Portsmouth-based glaucoma refinement scheme: a role for virtual clinics in the future? Eye (Lond) 2012;**26**(10):1288-94 doi: 10.1038/eye.2012.120[published Online First: Epub Date]|.

8. Wright HR, Diamond JP. Service innovation in glaucoma management: using a Web-based electronic patient record to facilitate virtual specialist supervision of a shared care glaucoma programme. Br J Ophthalmol 2015;**99**(3):313-7 doi: 10.1136/bjophthalmol-2014-305588[published Online First: Epub Date]|.

9. Court JH, Austin MW. Virtual glaucoma clinics: patient acceptance and quality of patient education compared to standard clinics. Clin Ophthalmol 2015;**9**:745-9 doi: 10.2147/OPTH.S75000[published Online First: Epub Date]|.

10. Kotecha A, Bonstein K, Cable R, Cammack J, Clipston J, Foster P. Qualitative investigation of patients' experience of a glaucoma virtual clinic in a specialist ophthalmic hospital in London, UK. BMJ Open 2015;**5**(12):e009463 doi: 10.1136/bmjopen-2015-009463[published Online First: Epub Date]|.

11. Davis A, Baldwin A, Hingorani M, Dwyer A, Flanagan D. A review of 145 234 ophthalmic patient episodes lost to follow-up. Eye (Lond) 2017;**31**(3):422-29 doi: 10.1038/eye.2016.225[published Online First: Epub Date]|.

12. Foot B, MacEwen C. Surveillance of sight loss due to delay in ophthalmic treatment or review: frequency, cause and outcome. Eye (Lond) 2017;**31**(5):771-75 doi: 10.1038/eye.2017.1[published Online First: Epub Date]|.

13. Lack of Timely Monitoring of Patients with Glaucoma. Healthcare Safety Investigation 2019/001. United Kingdom: Healthcare Safety Investigation Branch, 2020.

14. Jayaram H, Strouthidis NG, Gazzard G. The COVID-19 pandemic will redefine the future delivery of glaucoma care. Eye (Lond) 2020;**34**(7):1203-05 doi: 10.1038/s41433-020-0958-1[published Online First: Epub Date]|.

15. Kotecha A, Brookes J, Foster PJ. A technician-delivered 'virtual clinic' for triaging low-risk glaucoma referrals. Eye (Lond) 2017;**31**(6):899-905 doi: 10.1038/eye.2017.9[published Online First: Epub Date]|.

16. Ophthalmic Common Clinical Competency Framework: Royal College of Ophthalmologists, 2019.

17. Gunn PJG, Marks JR, Au L, Waterman H, Spry PGD, Harper RA. Acceptability and use of glaucoma virtual clinics in the UK: a national survey of clinical leads. BMJ Open Ophthalmol 2018;**3**(1):e000127 doi: 10.1136/bmjophth-2017-000127[published Online First: Epub Date]|.

18. Quality in the new health system – maintaining and improving quality from April 2013. United Kingdom: National Quality Board, Department of Health and Social Care, 2013.

19. Porporato N, Baskaran M, Husain R, Aung T. Recent advances in anterior chamber angle imaging. Eye (Lond) 2020;**34**(1):51-59 doi: 10.1038/s41433-019-0655-0[published Online First: Epub Date]|.

20. Rigi M, Bell NP, Lee DA, et al. Agreement between Gonioscopic Examination and Swept Source Fourier Domain Anterior Segment Optical Coherence Tomography Imaging. J Ophthalmol 2016;**2016**:1727039 doi: 10.1155/2016/1727039[published Online First: Epub Date]|.

21. Sakata LM, Lavanya R, Friedman DS, et al. Comparison of gonioscopy and anterior segment ocular coherence tomography in detecting angle closure in different quadrants of the anterior chamber angle. Ophthalmology 2008;**115**(5):769-74 doi: 10.1016/j.ophtha.2007.06.030[published Online First: Epub Date]|.

22. NHS Innovation Accelerator: Understanding how and why the NHS adopts innovation, 2018.

23. Glaucoma: Diagnosis and Management: National Institute for Health and Care Excellence (UK), 2017.

24. Rathod D, Win T, Pickering S, Austin M. Incorporation of a virtual assessment into a care pathway for initial glaucoma management: feasibility study. Clin Exp Ophthalmol 2008;**36**(6):543-6 doi: 10.1111/j.1442-9071.2008.01831.x[published Online First: Epub Date]|.

25. Nijkamp MD, Sixma HJ, Afman H, et al. Quality of care from the perspective of the cataract patient: the reliability and validity of the QUOTE-cataract. Br J Ophthalmol 2002;**86**(8):840-2 doi: 10.1136/bjo.86.8.840[published Online First: Epub Date]|.

26. Ackerman SL, Gleason N, Shipman SA. Comparing Patients' Experiences with Electronic and Traditional Consultation: Results from a Multisite Survey. J Gen Intern Med 2020;**35**(4):1135-42 doi: 10.1007/s11606-020-05703-7[published Online First: Epub Date]|.

27. Sprague SL, Holschuh C. Telemedicine Versus Clinic Visit: A Pilot Study of Patient Satisfaction and Recall of Diet and Exercise Recommendations From Survivorship Care Plans. Clin J Oncol Nurs 2019;**23**(6):639-46 doi: 10.1188/19.CJON.639-646[published Online First: Epub Date]|.

28. Zgierska A, Rabago D, Miller MM. Impact of patient satisfaction ratings on physicians and clinical care. Patient Prefer Adherence 2014;**8**:437-46 doi: 10.2147/PPA.S59077[published Online First: Epub Date]|.

29. Falkenberg K. Why rating your doctor is bad for your health. Forbes 2013

30. Kurji K, Kiage D, Rudnisky CJ, Damji KF. Improving diabetic retinopathy screening in Africa: patient satisfaction with teleophthalmology versus ophthalmologist-based screening. Middle East Afr J Ophthalmol 2013;**20**(1):56-60 doi: 10.4103/0974-9233.106388[published Online First: Epub Date]|.

31. Li B, Powell AM, Hooper PL, Sheidow TG. Prospective evaluation of teleophthalmology in screening and recurrence monitoring of neovascular age-related macular degeneration: a randomized clinical trial. JAMA Ophthalmol 2015;**133**(3):276-82 doi: 10.1001/jamaophthalmol.2014.5014[published Online First: Epub Date]|.

32. Sreelatha OK, Ramesh SV. Teleophthalmology: improving patient outcomes? Clin Ophthalmol 2016;**10**:285-95 doi: 10.2147/OPTH.S80487[published Online First: Epub Date]|.

33. Paul PG, Raman R, Rani PK, Deshmukh H, Sharma T. Patient satisfaction levels during teleophthalmology consultation in rural South India. Telemed J E Health 2006;**12**(5):571-8 doi: 10.1089/tmj.2006.12.571[published Online First: Epub Date]|.

34. Barsom EZ, Jansen M, Tanis PJ, et al. Video consultation during follow up care: effect on quality of care and patient- and provider attitude in patients with colorectal cancer. Surg Endosc 2020 doi: 10.1007/s00464-020-07499-3[published Online First: Epub Date]|.

35. Gilling S, Mortz CG, Vestergaard T. Patient Satisfaction and Expectations Regarding Mobile Teledermoscopy in General Practice for Diagnosis of Non-melanoma Skin Cancer and Malignant Melanoma. Acta Derm Venereol 2020 doi: 10.2340/00015555-3459[published Online First: Epub Date]|.