Received: 16 March 2022 | Accepted: 30 June 2022

DOI: 10.1111/opo.13032

OPO THE COLLEGE OF OPTOMETRISTS

ORIGINAL ARTICLE

An analysis of glaucoma repeat measures assessment results: Are core competencies enough?

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Abstract

Purpose: The need to validate core competency skills in qualified optometrists wishing to take part in extended roles in glaucoma care has been questioned. This analysis examines the ability of qualified optometrists to perform relevant core competency skills under standardised objective assessment conditions to explore whether such validation is justified. It also investigates if there are associations between performance, gender and length of time since qualification.

Methods: Anonymised data from the Cardiff University assessment programme for the Wales Optometry Postgraduate Education Centre (WOPEC) Local Optical Committee Support Unit glaucoma referral filtering and monitoring pathway delivered between January 2017 and March 2020 were analysed. Results were combined with demographic data from the General Optical Council register of optometrists in the UK to investigate associations between performance and practitioner characteristics, namely length of time since qualification and gender.

Results: The assessment results of 2215 optometrists practising in England (approximately 15% of all UK registered optometrists and 30% of all optometrists registered in England) were analysed. Failure rates for first time assessment in each of five objective structured clinical examination style practical assessments were 8.5% (van Herick); 8.8% (slit lamp binocular indirect ophthalmoscopy); 10.1% (Goldmann applanation tonometry calibration); 21.9% (Goldmann applanation tonometry) and 23.3% (case scenario interpretation and management). There were either no associations or at most very weak associations between performance and practitioner characteristics.

Conclusions: Our results suggest that these competencies are not universally present in optometrists practising in England and that ongoing training and assessment of these competencies is justified for entry into extended roles. There are no meaningful associations between performance in these assessments and gender or time since qualification.

KEYWORDS
assessment, assessment validity, core competencies, extended roles, glaucoma, optometry

INTRODUCTION

Over the past three decades, the role of optometrists in UK glaucoma service delivery has undergone an evolution. In addition to opportunistic case findings during routine sight tests,[1,2] many practitioners provide services in enhanced primary care pathways including glaucoma referral filtering schemes (GRFS),[3] community glaucoma assessment and monitoring services[4] and as part of secondary care extended roles.[5,6]

Evolving guidelines from the National Institute for Health and Care Excellence (NICE) and other professional bodies[7–10] have defined the characteristics and accreditation requirements for the participation of optometrists and other non-medical health care practitioners (HCPs) in this hierarchy of pathways, that at higher levels represents an extension of the core optometric role. More specifically within secondary care, competencies required by HCPs to undertake 'expanded roles' were set out in the Ophthalmic Common Clinical Competency Framework.[11] Such enhanced pathways are now commonplace,[12] and evidence confirms their popularity with practitioners, patients and commissioners.[13–15]

These innovations in glaucoma service delivery have stimulated the development of postgraduate specialist glaucoma training for optometrists ranging from simple competency validation programmes to The College of Optometrists (UK) professional higher qualifications at certificate, higher certificate and diploma levels.[6,16]

Despite continued uptake of such training,[17] opinion pieces in the optical press have highlighted a debate that questions the need for optometrists to obtain any additional validation, noting that many competencies required for these qualifications already exist within optometric core competencies at registration.[18,19]

Common to all these pathways, and central to this debate, is a range of clinical competencies used in the detection and management of glaucoma, namely the measurement of intraocular pressure (IOP), the visualisation and assessment of the optic nerve head, assessment of the anterior chamber angle depth and integration of clinical data to formulate a management plan. Even though these skills are placed within core optometric competencies at qualification, most GRFS pathways and higher qualifications in glaucoma require them to be revalidated. So, the question arises, how well do optometrists perform these competencies, and do they in fact require further training and validation before working within enhanced pathways?

In 2016, the Wales Optometry Postgraduate Education Centre (WOPEC) designed a training and assessment programme to support the Local Optical Committee Support Unit (LOCSU) glaucoma referral filtering and monitoring pathway. WOPEC developed and continued to deliver an accreditation route for those wishing to establish glaucoma repeated measures schemes (GRMs), one of the pathways now defined within GRFS. The programme offers a review of relevant theoretical knowledge, and an objective structured clinical examination (OSCE) style assessment of competencies.

> **Key points**
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> - There is an ongoing debate about the need to revalidate optometric competencies present at qualification for entry into extended roles.
> - This study examined the ability of qualified optometrists to perform core competency skills related to glaucoma care under assessment conditions, and found a small but significant proportion of practitioners were not able to demonstrate the competencies on first assessment.
> - There are no meaningful associations between performance in these assessments and gender or time since qualification, so assessing all practitioners wishing to be accredited for extended roles, irrespective of years of qualification, is a justifiable strategy.

Over a 3-year period, more than 2000 optometrists in England (approximately 30% of all registered optometrists in England) undertook the WOPEC LOCSU training and assessment programme. This study examines the results of those assessments, which offer a unique insight into the ability of a large sample of qualified optometrists' ability to perform these core competency skills under standardised objective assessment conditions.

When combined with demographic data from the General Optical Council (GOC) register of optometrists in the UK, the data offer an insight into the potential associations between performance and practitioner characteristics, namely length of time since qualification and gender. Any relationship between such characteristics and assessment of competence is of considerable interest within health care education[20] and society at large,[21] and both characteristics are highly relevant given the need to embed equality, diversity and inclusivity within the design of postgraduate education and assessment.[22,23]

METHODS

Data from the WOPEC LOCSU training and assessment programme delivered between January 2017 and March 2020 were analysed. This interval was chosen because the programme was updated for delivery from January 2017 onwards and then suspended due to COVID restrictions in 2020.

The programme was delivered to optometrists wishing to take part in locally commissioned GRM schemes across England (previously termed LOCSU level 1 and level 2 glaucoma care pathways in 2017). The programme aimed to validate relevant knowledge and skills related to the ability to identify and appropriately refer patients attending sight tests in the community who may have or be at risk of developing glaucoma. Validation of competencies was a requirement stipulated by primary care health care commissioners prior to optometrists being permitted to take part in these GRM schemes.

Programme design: Training and assessment

The skills and knowledge taught and assessed by the WOPEC LOCSU programme mapped to the elements of GOC stage 2 competencies for optometrists, namely 2.2.5 appropriate referral, 3.1.3 examination of the fundus, 3.1.5 interpretation of visual field plots, 3.1.6 use of contact tonometry, 6.1.5 recognition of ocular abnormalities and 6.1.8 evaluation of glaucoma risk factors.[24] Even though the assessment of anterior chamber angle is not explicitly detailed in GOC stage 2 competencies, it maps to a stage 1 competency 5.1.4, namely the ability to examine for abnormalities of the anterior chamber.[24]

A blueprinting process was used to define the learning objectives derived from GOC competencies and map them to the assessment elements of the WOPEC LOCSU programme. The practical components of the assessments are detailed in Table 1. The theoretical components of the programme are not included in this analysis as it is the practical examination skills that are the focus of the debate about the adequacy of core competence.

Practitioners were initially required to complete four theoretical lectures/tutorials delivered via Cardiff University's online teaching platform. There was no practical hands-on teaching of clinical skills, but short videos were used with the intention of reminding practitioners of the correct techniques to be used with the slit lamp BIO (binocular indirect ophthalmoscopy) for examination of the optic disc and the use and calibration of the Goldmann applanation tonometer (GAT). Practitioners were advised to practise the techniques before attending for assessment.

Assessment was all summative, consisting of online multiple-choice questions (MCQs) for the theoretical component (12 MCQs per lecture), and an objective structured clinical examination (OSCE) style station for practical skills. The MCQ assessment was single best answer format with five options, a pass mark of 60% and a second attempt was allowed. Participants failing for a second time were offered the opportunity to discuss reasons for failure, and further assessment attempts were permitted after that. Practitioners had to complete the theoretical training and pass the MCQ assessment before being allowed to progress to the practical assessment.

The practical assessment consisted of five OSCE style stations, which were designed to assess the practitioner's practical ability to perform indirect ophthalmoscopy using a slit lamp bio-microscope, assess the peripheral anterior chamber depth of a patient using van Herick's technique, measure the intraocular pressure of a patient using GAT, set up and calibrate the GAT on a slit lamp and to assess their clinical application of knowledge in interpreting one case scenario. The case was selected from an available range to ensure exam security.

Each station was designed and documented using Cardiff University's standard paper-based OSCE template. The documentation also included participant instructions including an example mark sheet, candidate instruction sheets, an equipment list, a candidate answer sheet, assessor marking criteria and a station specific plan for reasonable adjustments for disability should they be needed. Each station was observed by a trained assessor. For each

TABLE 1 Practical assessment of the Wales Optometry Postgraduate Education Centre (WOPEC) Local Optical Committee Support Unit (LOCSU) glaucoma training programme

Practical station description	Construct being tested	Station detail
Slit lamp binocular indirect ophthalmoscopy (BIO)	The candidate demonstrates their ability to perform slit lamp BIO by correctly identifying disc features including cup to disc ratio in 2 model eyes	Simulation using model eyes supplied by Bristol Medical Pro[25]
Van Herick peripheral anterior chamber depth assessment	This station tested the candidate's ability to assess the peripheral anterior chamber depth using van Herick's technique and to grade the angle based on their findings	Standardised patient
Measurement of intraocular pressure (IOP) using a Goldmann applanation tonometry (GAT)	This station tested the candidate's ability to measure the IOP using a GAT on the right and left eyes of a patient	Standardised patient Candidate and assessor IOP result differed by no more than 3 mmHg in either eye
Calibration of a GAT	This station tested the candidate's ability to set up the GAT on the slit lamp correctly, accurately calibrate the GAT tonometer and interpret the findings	Equipment skills task
Case scenario	This station tested the candidate's ability to describe the optic discs and visual fields and give a diagnosis and management based on interpretation of clinical findings The setting for the scenario is a community optometry practice	Clinical case consisting of optic disc images, visual field plots and clinical record card

station, candidates were permitted 2 min set up time and 5 min to complete the station. The assessor used a global rating scale informed by a checklist of specified criteria to mark each station (Appendix A1). The global rating scale had categories ranging from 'Excellent' to 'Fail' and was used for assessors to judge overall competence and record their final pass/fail decision. Any candidate demonstrating unsafe technique was failed. To be accredited, candidates needed to pass all the practical stations. Resits of failed stations were permitted, but in this analysis, we have considered only first attempt results. This is because we consider first attempt results as most relevant to the debate about whether core competence should, or should not, be reassessed in qualified optometrists.

Assessor training

Assessors attended a 2-day training and accreditation programme. Lectures addressed assessment theory, the role of the assessor and event planning. Attendees took part in two rounds of mock station assessments with group members acting the role of assessor and candidate. The training team observed and double-marked these sessions with feedback being given during reflection sessions. Attendees then carried out a formal mock assessment for each station and were observed and double-marked by two lead assessors.

Ethics approval

Ethical approval for this study was granted by the Cardiff University School of Optometry and Vision Sciences ethics committee (project number 1544).

Data handling and analysis

Assessment results—Dataset 1

Records of assessment events from January 2017, when the updated programme was introduced, to March 2020, when COVID restrictions halted assessment sessions were analysed. Only complete records of results for qualified optometrists on the GOC register of individual practitioners as of November 2020 sitting the assessment for the first time were included in Dataset 1—assessment results.

Practitioner characteristics—Dataset 2

The GOC register of individual practitioners in Dataset 1 was consulted in November 2020, and information on the registration status, gender and date of most recent registration was compiled to form Dataset 2—Practitioner characteristics.

Data anonymisation

Both datasets were stripped of unique identifiers with the exception of the GOC registration number, which linked the two. Both datasets were passed securely to the National Health Service (NHS) Wales Informatics Service using their secure data transfer system. The NHS Wales Informatics Service works with NHS datasets linking them for research purposes which qualified it to act as a trusted third party to conduct this anonymisation. The service combined the datasets, removing the GOC number and inserted a new unique identifier. No cipher linked the new combined dataset with the original two datasets, rendering the new dataset truly anonymised. None of the research team at Cardiff University had access to a combined dataset linked to an identifiable individual, and all analysis was done on the anonymised combined dataset.

Data analysis

Both datasets were initially analysed using Microsoft Excel for Microsoft 365 MSO (Version 2109 Build 16.0.14430.20154. microsoft.com) 32-bit, and all statistical analyses were computed using IBM SPSS Statistics software v27 (ibm.com).

Statistical analysis was used to explore if the probability of whether an individual will pass or fail the assessments (Dataset 1—Results) could be predicted by selected practitioner characteristics provided from the GOC registration data (Dataset 2—Practitioner characteristics), namely gender and time since registration. We ran chi-square analyses to explore potential relationships between the independent variables (IV) namely practitioner characteristics and dependent variables (DV) namely pass/fail rates for each test before then computing binomial logistic regressions and ordinal logistic regressions to explore these relationships in more detail.

RESULTS

Between January 2017 and March 2020, 2277 optometrists were recorded as having sat the practical assessments for the first time. In total, 62 (2.7%) of these first time records were removed for the following reasons: 25 records had no station specific results recorded, 21 were no longer on the register (as of November 2020), six showed an unexplained disparity between time of registration and assessment, five were student optometrists at the time of the assessment and in five cases the results were missing. The remaining 2215 records represent the results for optometrists who sat the assessment for the first time during the above time period (Dataset 1—results). The optometrists included in this analysis account for approximately 15% of all UK registered optometrists,[26] and 30% of all optometrists registered in England (7405 optometrists in July 2021–personal communication).

These assessments occurred at 202 separate assessment events across England, and the locations are mapped in Figure 1. Event locations were classified by NHS England regions with the greatest number being held in the Midlands region (45) and the least in the Eastern region (17). The frequency of events by region is detailed in the table inset in Figure 1.

The majority of events, 116 (57%), took place in 2017 with a decreasing number occurring in each following year: 46 (23%) in 2018, 32 (16%) in 2019 and only eight (4%) in the first 3 months of 2020, after which events were suspended due to COVID restrictions. Following the same pattern, the majority of optometrist assessments, 1519 (69%), occurred in 2017 with a subsequent reduction in each following year: 358 (16%) in 2018, 278 (12%) in 2018 and 60 (3%) in the first 3 months of 2020.

Assessment results (Dataset 1)

The failure rate for first attempts at individual stations ranged from 8.5% to 23.3%. The Van Herick station was failed by 8.5% of candidates, the Volk BIO assessment by 8.8%, the GAT calibration by 10.1%, the GAT station by 21.9% and the case scenario by 23.3% of candidates (Table 2).

Practitioner characteristics (Dataset 2)

The GOC register was consulted in November 2020 and selected demographic details of the candidates formed Dataset 2. All the included practitioners were registered as qualified optometrists.

Gender

1305 (58.9%) sitting the assessments were female, and 910 (41.1%) were male.

Date to most recent entry onto the General Optical Council (GOC) register

The range of years to entry on the register was <1 year to 54 years, with a mean value of 7.8 years (median 4 years and a mode of less than a year). The majority of practitioners, 1206 (54.4%) were qualified for 5 years or less. 924 (41.7%) were qualified for 2 years or less, 288 (13%) were qualified between 3 and 5 years, 640 (28.8%) between 6 and 15 years and 369 (16.7%) 16 years or more.

In deciding on how to organise this data for analysis, we grouped practitioners to reflect the times since qualification that would, in our opinion, be of most interest in the context of career progression, with a focus on those most recently qualified, namely the very newly qualified (≤2 years), those between 3 and 5 years from registration, those 6 years to 15 years and those 16 years or more. These ranges are detailed in Figure 2.

Statistical analysis

Chi-square analyses were computed to explore any associations between the dependent variables, that is, the pass/fail rates of each assessment, and two independent

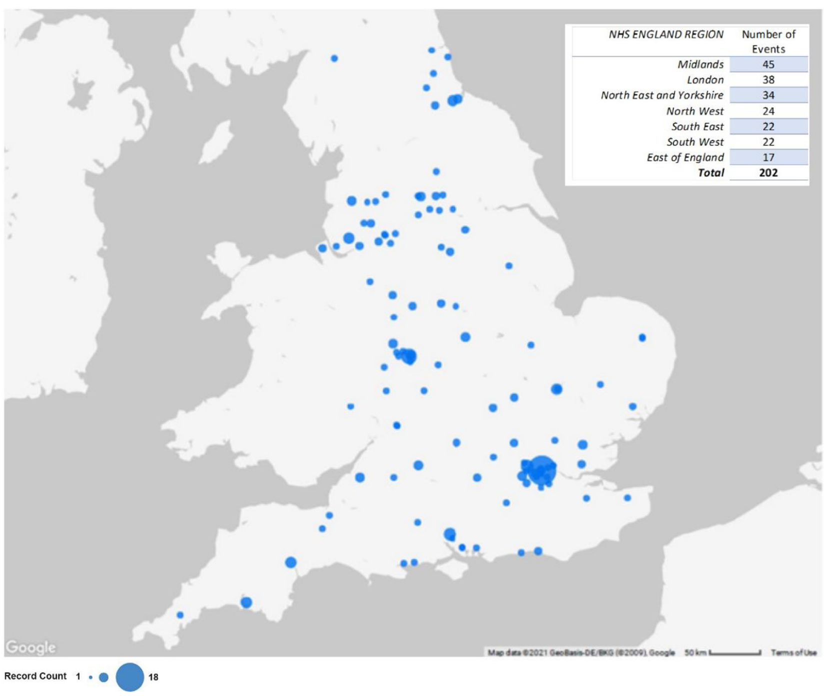

FIGURE 1 Map showing frequency of assessment events held in England from January 2017 to March 2020. Inset showing number of events by National Health Service (NHS) England region.

TABLE 2 Number and percentages of practitioners passing assessments by practical station

	Practical station				
***n* = 2215**	**Volk BIO**	**Van Herick**	**GAT**	**GAT calibration**	**Case scenario**
Number of candidates passed at first attempt	2019	2027	1731	1992	1698
Percentage of candidates passed at first attempt	91.2%	91.5%	78.1%	89.9%	76.7%
Number of candidates failed on first attempt	196	188	484	223	517
Percentage of candidates failed at first attempt	8.8%	8.5%	21.9%	10.1%	23.3%
Percentage failed and unsafe (number)[a]	0	0	1% (25)	0	0

Abbreviations: BIO, binocular indirect ophthalmoscopy; GAT, Goldmann applanation tonometry.

[a]Subset of failed at first attempt.

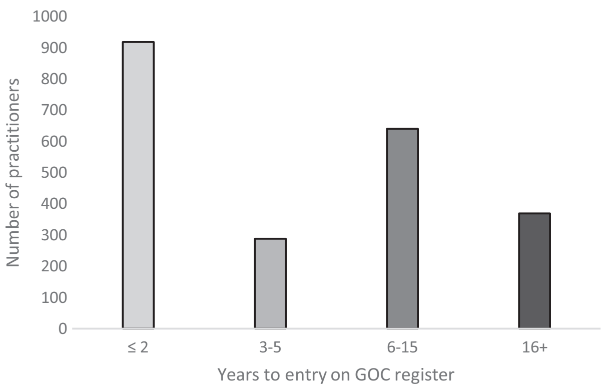

FIGURE 2 Chart showing number of practitioners grouped by the age ranges used in the regression analysis.

variables: gender (male or female) and years since registration (≤2 years, 3–5 years, 6–15 years, 16 + years).

The only marginally significant association (though small effect size) evident was between gender and the pass/fail rate of the case scenario assessment ($\chi^2(1) = 3.61$, $p = 0.06$, Cramer's V = 0.04). Of the female optometrists, 78.1% passed first time compared to 74.6% of males. No significant associations were identified for the slit lamp BIO, Van Herick, Goldmann tonometry or calibration assessments.

Binomial logistic regressions

Following the chi-square analyses, binomial logistic regressions were performed to determine the effects of gender and years since registration on the likelihood of passing or failing each of the five practical assessments.

As implied by the chi-square analyses, the regression model was only statistically significant for the case scenario assessment ($\chi^2(4) = 10.89$, $p = 0.03$). However, the model only accounted for 0.7% of the variance in pass or fails (Nagelkerke R^2). In this case, the two independent variables were statistically significant, that is, gender ($p = 0.03$) and years since registration ($p = 0.01$). Being female was associated with a decreased likelihood in failing the case scenario assessment by 1.26 higher odds (95% CI: 1.03 to 1.55). Being qualified for 6–15 years was associated with a decreased likelihood of failing the case scenario assessment by 1.38 (95% CI: 1.08 to 1.77), higher odds than being registered ≤2 years.

Ordinal logistic regression

Despite the model showing significance for one of the five practical assessments, the variability was very low. This is likely due to the relatively low number of participants who failed. That is, regardless of the model, most optometrists passed these assessments (76.7% to 91.5% pass rates). To compensate for the lack of variability in the pass and fail groups, optometrists' results from the five individual practical assessments were combined into an overall score. Each optometrist was assigned a score from 0 to 5 based on how many assessments they had passed (regardless of which specific assessment). We then grouped these scores into an ordinal scale from 1 to 5, whereby 1 = passed none or one (only one participant passed no assessments), 2 = passed two, 3 = passed three, 4 = passed four, 5 = passed all five assessments. According to these classifications, optometrists were distributed according to the first row in Table 3.

We again computed chi-square analyses to explore any associations between the independent variables (optometrists' characteristics) and the dependent variable (overall score). Table 3 summarises the results from the cross-tabulations.

A significant association was observed for just one independent variable, years since registration ($\chi^2(12) = 27.63$, $p = 0.006$, Cramer's V = 0.06). A cumulative odds ordinal logistic regression with proportional odds was then run to determine the effect of gender and years since registration on the number of tests that optometrists passed.

Although the final model significantly predicted the dependent variable over and above the intercept-only model ($\chi^2(5) = 13.80$, $p = 0.02$), the overall variance caused by the model was just 0.7% (Nagelkerke R^2). The tests of

TABLE 3 Number of tests passed by optometrists according to characteristics

	Categories	Number of tests passed				
		0 or 1 test	2 tests	3 tests	4 tests	5 tests
Overall	—	0.9%	3.9%	13.1%	31.1%	51.0%
Gender	Male	1.0%	4.1%	13.7%	29.9%	51.3%
	Female	0.8%	3.8%	12.7%	31.9%	50.8%
Years since registration*	≤2 years	0.9%	3.5%	14.7%	33.2%	47.8%
	3–5 years	0.0%	11.2%	15.0%	33.2%	46.2%
	6–15 years	1.3%	3.1%	10.6%	30.6%	54.4%
	16+ years	0.8%	5.1%	12.2%	24.9%	56.9%

*$p \leq 0.005$.

model effects demonstrated that, as anticipated from the chi-square analyses, years since registration was the only significant predictor within the model ($\chi^2(3) = 13.40$, $p = 0.004$), and gender did not contribute to the number of assessments optometrists would pass.

In terms of years since registration, the regression model demonstrated that optometrists who had been registered longer were more likely to pass more assessments. Specifically, optometrists who have been registered 16 + years are significantly more likely to pass more assessments than optometrists who have been registered ≤2 years (Wald $\chi^2(1) = 6.34$, $p > 0.01$) or 3–5 years (Wald $\chi^2(1) = 6.27$, $p > 0.01$). Similarly, optometrists who have been registered for 6–15 years are significantly more likely to pass more assessments than those who have been registered ≤2 years (Wald $\chi^2(1) = 7.29$, $p = 0.007$) or 3–5 years (Wald $\chi^2(1) = 6.46$, $p = 0.01$).

DISCUSSION

Failure rates

What are we to make of failure rates that for the four practical skills ranged from 8% to 21%? On initial inspection, pass rates above 90% appear respectable, but this translates to almost one in 10 optometrists tested failing in their ability to carry out a competency under exam conditions on the first attempt, with the fail rate rising to one in five for GAT. It is also important to note that participants were not being spot tested. They not only knew of the content of the upcoming assessments, but also undertook a preparatory theory module with advice on how to practise the techniques to be assessed. Even if we take into account the detrimental effects of test anxiety on assessment performance,[27] we would suggest that these failure rates suggest a small but significant proportion of optometrists did not have these skills as a competency at the time of assessment.

For GAT, a possible reason for the high failure rate could be that the technique is not in common usage. This is supported by a national survey of optometrists by Myint et al.,[28] which found that only 16% of respondents used Goldmann or Perkins applanation tonometry routinely to measure intraocular pressures for the detection of chronic open-angle glaucoma. In contrast, the lower failure rate of 9% for the slit lamp BIO assessment is likely to reflect the wider use of this method among optometrists.[28]

Comparisons with other health care professions are not straightforward given a lack of large-scale research into re-evaluation of core competencies post-qualification. Results from the clinical skills assessment (CSA), the OSCE-based skills assessment portion of the Membership of the Royal College of General Practitioners (MRCGP) UK exam,[29] show that for the 13 station clinical case assessment OSCEs there is an annual first attempt failure rate in the region of 15%–20%,[30] with approximately 40% of those failing being given feedback about inadequate competency in physical examination or instrument use.[31] These results share some similarities with our dataset, but it must be noted that the MRCGP data are from a qualifying exam rather than reassessment after qualifying.

The question of what a reasonable expected level of success in a core competency is, therefore, open to discussion. In everyday life, for competencies such as safely stopping a car, one would consider a success rate of 90% to be dangerously inadequate, but in the case of other driving skills such as reverse parking, assessed and passed during the same test, a full level of mastery may never be reached. Maybe the answer lies in an interrogation of the adequacy of the term 'core competency' to describe those skills assessed at qualification. Does the term describe an expectation of ongoing full competence post-qualification, or does it more realistically describe a skill or ability that is taught and assessed at qualification, but then may or may not be used regularly depending on the post-registration clinical path followed by the practitioner? This might be more accurately described as a 'competency at qualification'. As optometrists, along with other professions, increasingly specialise, the expectation that all skills successfully mastered at qualification are retained may be unrealistic. If, as research suggests, some techniques are not often used, then it is not unreasonable to expect a poorer performance on assessment. If, on the contrary, a skill is a requirement of a specific role, as is the case in GRM pathways, or is a requirement for general optometric work, then it is reasonable to expect a high level of proficiency. As our data show, the fail results for a significant minority suggest that ongoing training and a validation requirement of these competencies is indeed justified.

Are practitioner characteristics predictive of success or failure?

Do certain groups of practitioners do better or worse than others and hence can training and validation be targeted? The short answer suggested by our analysis is no. A consistent finding across the various analyses we applied to the data was that practitioner characteristics either poorly predicted or did not predict performance at all. The main conclusion is that most people pass these assessments, and of the small number of those who did not, there is no dominating practitioner characteristic that can predict success or failure.

The regression analysis did show that gender and years since qualification were statistically significant in predicting performance in the case scenario assessments (but only accounted for 0.7% variability), but no characteristic predicted performance in the case of the individual Volk, GAT or Van Herick assessments.

Our investigation of overall performance using the number of assessments passed to rank performance again showed that practitioner characteristics were not strongly predictive of ranking, with only years since qualification coming out as a statistically significant predictor. Practitioners registered for 6–15 years and 16 years or more were more likely to pass more assessments than those registered for 2 years or less. Again, it is important to note that only 0.7% of the variance was explained by years since registration, which makes this predictive effect of interest but of little practical use. Put another way, a wide enough mix of practitioners performed well in the ranking to make predicting and hence planning for success or failure based on years since qualification unsafe.

The finding that gender is of little or no use in predicting performance is in step with reports of medical school and postgraduate performance where females tend to perform the same or only slightly better than males[20,32–35] and markedly different to school and university settings where females consistently outperform males in main measures of performance across the UK.[36]

Assumptions

Because the demographic data (Dataset 2) were collected from the GOC register at one point in time (November 2020) and not at the time of the assessment, it is possible that practitioner characteristics may have changed in this interval and we have made certain assumptions because of this.

Regarding gender, we assume that the number of practitioners who may have changed their gender identity in the time between their assessment and the collection of the GOC data is likely to be negligible. Estimating the number of people who identify as transgender in the population is problematic[37,38] and census data do not yet exist for the UK,[39] but estimates for the UK[40] and the US[41] suggest approximately 0.4% of the population identify as transgender, which if used as a guide to possible numbers who may have changed their gender, would suggest less than 10 individuals in our group.

The GOC register lists the date of entry onto the register, which we have used as a proxy for date of qualification. However, an optometrist may leave the register and then rejoin at a future date; hence, the date of registration is not always equal to the number of years an optometrist has been qualified. Using our initial dataset as a reference point, we found that of 2585, only 21 (0.008%) practitioners were no longer on the register when it was consulted in November 2020. Based on this, we assume that leaving the register is an unlikely occurrence, and leaving and then re-joining even more so. We, therefore, assume that the date of registration can be considered equivalent to date of first qualification.

Are these tests a valid measure of competency?

How valid are these practical assessments in judging practitioners' ability to perform these competencies in practice? Common sense might suggest that a good way of testing whether someone can do something is to get them to do it, but there are also theoretical frameworks for considering if assessments are valid in testing what they claim to be testing. The OSCE itself is widely used in the assessment of clinical skills,[42,43] and the framework for considering the validity of OCSE style assessments most often promoted[44] is one set out by Kane et al.[45] These authors argue that it is the uses to which the test results will be applied (or inferences made from them) that need to be examined to determine whether the assessments are valid, not the test in itself. The more complex and wide ranging the inferences that are made, the more stringent the requirement to provide evidence to support the implications.

Initially, Kane et al.'s framework requires the setting out of a clear statement of the intended interpretations and uses of the assessment (IUA). It then requires an examination of the evidence that supports the IUA, and finally, a wider consideration of consequences that flow from the passing or failing of the assessment.

The IUA for the results of these assessments is the validation of the following competencies: the ability to prepare a GAT for use, the measurement of intraocular pressure using GAT, the visualisation of the optic nerve head using slit lamp BIO microscopy, the assessment of the anterior chamber angle depth using Van Herick's technique and the ability to interpret a standardised clinical scenario describing the optic discs and visual fields, proposing a diagnosis and management plan from a community optometrist's perspective. The first four are narrowly defined observable behaviours. The case scenario assessment tests a candidate's ability to integrate clinical data and propose appropriate management for a patient in a simulated case scenario. This is a less well-defined ability which, unlike the first four stations, could be said to make a wider inference about a candidate's higher-order clinical decision-making ability and so tests a wider construct.

The consideration of evidence to support this IUA can be grouped under four headings[34] which describe the assessment: its content, its internal structure, the response process and its consequences. The content of these OSCEs maps to the learning objectives of the course (Table 1). The assessments, with the exception of the case scenario, are testing isolated clinical skills which are well suited to OSCE assessment.[46] In the case of the GAT, GAT calibration, and Van Herick stations, the skill itself is being assessed directly on a volunteer patient, and in the case of the BIO microscopy station the skill is being assessed using a model eye simulator.[25] The case scenario assesses the clinical application of knowledge and reasoning to simulated clinical data, which may be less well suited to the OSCE method of assessment according to some,[44] but is nevertheless widely used,[46] including in the final assessment for UK optometrists to enter the GOC register.[47]

A consideration of the internal structure of the test falls under four further subheadings. The OSCE assessment should have sufficient stations, usually quoted as 14–18, to ensure sufficient sampling and hence defensible pass/fail decisions,[46] but this recommendation is always found in the context of ensuring adequate sampling of far wider underlying construct/s.[48] With the exception of the case scenario, the clinical skills tested in these assessments *are* the construct being sampled. An appropriate scoring scheme should be used, in this case a checklist with an overall global rating scale of performance. The use of checklists versus rating scales for OSCEs is an open debate,[49] but the use of the global rating scale is promoted for the assessment of advanced clinical skills.[50] Psychometric analysis of OSCE station scores is relevant when a number of stations contribute to a composite result, which aims to assess a broader underlying construct[51] which was not the case here. The standard setting for each station used a criterion-based reference standard determined by the WOPEC education team.

The response process involved an appropriate marking scheme described above, an examiner training programme and a system of randomly allotted case scenarios to ensure test security. The consequences of failing a station were limited to the reasonable requirement that candidates needed to retake the assessment if they wanted to be validated. Individualised verbal feedback with email follow-up aimed to maximise the educational impact of the experience, which is an important motivating factor for the development of clinical skills.[52,53]

Guided by the Kane et al. framework, our assumption is that these assessments are a valid measure of practitioner competency in the four observable practical skills, but that validity is questionable for the case scenario. This is because the case scenario seeks to measure a wider construct, for which assessment design would usually be expected to involve additional sampling using a range of differing assessment methods. It is important to note that we considered only first attempt results for individual competencies and not resit pass rates or overall pass rates for the programme. Our interest was in using the data to explore only these individual competencies, and we felt that the results for first attempts were of greatest relevance when considering skills defined as core to a practitioner's ability.

Is this a representative sample and of whom?

One might debate if this group of optometrists constitutes a representative sample of optometrists in England or more widely the UK, and hence whether or not the results allow us to generalise about competencies of optometrists as a whole. The sample size is large, at approximately 15% of optometrists in the UK and 30% of optometrists in England, and the assessments were undertaken at multiple sites over a wide geographical area. However, the sample is biased as it only includes optometrists practising in England, the distribution is heavily skewed to recently qualified practitioners, and it is not a random sample, but a self-selected group that came forward for assessment. For these reasons, we would suggest that it would be unsafe to draw wider conclusions about the competencies of UK optometrists or optometrists in England based on these findings.

However, it is this very self-selection that gives us data of interest in relation to our research question. For, even if this sample cannot tell us anything about the competencies of the two-thirds of practitioners who did not come forward for assessment, it does allow us to say that the sample is almost 100% representative of those who did, and it is this group that are of primary interest when considering if existing competencies of those wishing to undertake this type of extended role are adequate.

Weaknesses

The demographic data were collected at a single point in time after completion of the assessments, which introduces the possibility that some practitioner characteristics may have changed during this interval. As discussed, for the predicators included we feel it is reasonable to assume that this will have happened in only a few instances and hence, given the size of the dataset, will not have a meaningful impact on our conclusions. Conversely, we did not look at type and number of further qualifications as a predictor because these were much more likely to have changed over the interval. This is an unavoidable disadvantage of retrospective analysis of existing data, and a prospective design would have allowed for the collection of a much wider range of characteristics.

The original data did not detail individual assessor results, and to keep the dataset anonymised we did not analyse the results by assessment location. Therefore, we were not able to explore inter-assessor or inter-assessment location variability. This is a weakness of the study and a potential source of bias.

The lack of strong associations between performance and the two practitioner characteristics studied in this dataset should not preclude future analysis of results in other high-stakes assessment situations. Such analysis has considerable value in identifying possible bias in teaching and assessment methodologies and should ideally be considered routinely even if, as in this case, no such associations are revealed.

This group of optometrists does not constitute a representative sample of optometrists practising in the UK as it is composed only of practitioners who came forward for the specific purpose of glaucoma repeat measures accreditation. It would, therefore, be unsafe to draw wider conclusions about the competencies of UK optometrists or optometrists in England based on these findings.

CONCLUSIONS

A small but significant proportion of practitioners (8%–21%) were not able to demonstrate some of the competencies assessed under test conditions. This suggests that these competencies are not universally present in optometrists practising in England and that ongoing training and assessment of these competencies is warranted for entry into extended roles.

Our findings support the consideration of dedicated practical skills training sessions for optometrists, particularly for GAT, not only in preparation for accreditation schemes such as this one, but also for any future enhanced services undertaken by optometrists where GAT will be required.

Even though our analysis shows some statistically significant associations with practitioner characteristics and performance, these are not definitive enough to inform a tailored approach to teaching and assessment meaningfully. Assessing all practitioners wishing to be accredited, irrespective of years of qualification, is a justifiable strategy.

AUTHOR CONTRIBUTIONS

Marek Karas: Conceptualization (lead); data curation (lead); formal analysis (equal); investigation (lead); methodology (lead); project administration (lead); visualization (lead); writing – original draft (lead); writing – review and editing (equal). **Sophie Bartlett:** Conceptualization (supporting); data curation (equal); formal analysis (lead); methodology (equal); writing – review and editing (equal). **Angela Whitaker:** Conceptualization (supporting); data curation (supporting); formal analysis (equal); methodology (supporting); writing – review and editing (equal). **Nik Sheen:** Conceptualization (supporting); formal analysis (supporting); investigation (supporting); methodology (equal); writing – review and editing (equal). **Rachel North:** Conceptualization (supporting); formal analysis (supporting); methodology (supporting); supervision (supporting); writing – review and editing (equal). **Barbara Ryan:** Conceptualization (equal); formal analysis (supporting); investigation (equal); methodology (equal); supervision (lead); writing – original draft (supporting); writing – review and editing (equal).

ACKNOWLEDGEMENTS

Sasha Macken for her help in organising the initial datasets and Prof. Alison Bullock for her comments on the initial manuscript.

CONFLICT OF INTEREST

No conflicting relationship exists for any author.

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How to cite this article: Karas M, Bartlett S, Whitaker A, Sheen N, North R, Ryan B. An analysis of glaucoma repeat measures assessment results: Are core competencies enough? *Ophthalmic Physiol Opt*. 2022;00:1–12. https://doi.org/10.1111/opo.13032

APPENDIX 1

TABLE A1 Summary of assessment criteria

Slit lamp binocular indirect ophthalmoscopy (BIO)	Van Herick peripheral anterior chamber depth assessment	Measurement of intraocular pressure (IOP) using a Goldmann applanation tonometry (GAT)	Calibration of a GAT	Case scenario
Correctly identifying disc features including cup to disc ratio in RE model eye	Demonstrate appropriate hygiene	Demonstrate appropriate hygiene	Safely insert a tonometer head probe onto the tonometer	Correctly interpret images of optic discs
Correctly identifying disc features including cup to disc ratio in LE model eye	Treat a patient in a professional manner and give clear instruction	Treat a patient in a professional manner and give clear instruction	To correctly position the baseplate on the slit lamp	Correctly interpret visual field print outs
	Correctly set up the slit lamp to enable accurate measurement of the peripheral chamber depth with van Herick technique in the *temporal* right and left eye	Correctly set up the slit lamp and GAT to enable a safe and accurate measurement of IOP in the right and left eye	To correctly position the Goldmann tonometer on the slit lamp	Use IOP, optic disc, visual field examination and other clinical findings to give a preliminary diagnosis taking these factors into account
	Grade results for the *temporal* right and left eye	Obtain accurate results for the right and left eye	Attach a calibration bar	Determine appropriate management based on findings
	Interpret grading and decide if the angle is open or closeable based on your results		Calibrate the tonometer at 0 g, 2 g and 6 g	