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Barriers to Glaucoma Case Finding as Perceived by Optometrists in Ireland

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Background

This research was designed to provide an in-depth exploration of optometrists' perceptions of the challenges of glaucoma case finding in the Irish health care system.

Methods

A survey was developed, piloted and distributed for anonymous completion by optometrists registered to practice in Ireland. The survey included ten five-level Likert items exploring potential barriers to glaucoma detection, and a free-text box for participants to comment more broadly.

Results

199 optometrists (27% of registrants) responded to the survey. Among the barriers identified, there was notable agreement (71%) with the need for extra training on glaucoma detection. Logistic regression showed that optometrists without postgraduate qualifications were more likely to agree with the need for extra training (OR 3.2 (95% CI 1.3 - 8.1)). Respondents largely agreed (61%) that patient unwillingness to pay additional fees for supplementary glaucoma specific tests was also a barrier. Appointment times of less than 30 minutes were significantly associated with six of the ten proposed barriers to glaucoma detection. A logistic regression analysis (n = 179) confirmed that the time allotted per appointment was a significant predictor of optometrist's agreement time as a barrier, χ^2 (1) = 13.52, p<0.001. Multiple linear regression showed that optometrists with less experience, charging lower fees, and working in large multiples or franchised practices have the shortest appointment times.

Conclusion

The strong link found between postgraduate education and optometrist's confidence in detecting glaucoma indicates that optometrists wishing to increase their scope of practice in Ireland's new legislative environment may more actively seek out training in areas of interest. The responses also indicate a lack of funding for the level of diagnostic testing required for accurate glaucoma diagnosis. Recent increases in the State's eye examination fees look likely to address the identified time and financial barriers to glaucoma detection in Ireland. Future work should look to analyse the effects of increased funding on optometric case finding for glaucoma.

Optometrists play a vital role in the detection of glaucoma, the world's leading cause of irreversible blindness.[1] The most common glaucoma sub-type, primary open angle glaucoma (POAG), is insidious, progressive and irreversible, presenting a significant public health challenge. In Ireland, approximately 8% of blind and partially sighted registrations are attributed to glaucoma.[2] A study carried out in the west of Ireland showed an overall POAG prevalence of 1.88%, with prevalence rising to 3.2% in those over 70 years.[3] As our population grows and ages, and as life expectancy continues to rise, the burden of glaucoma will increase. Between 2006 and 2014, the Irish population grew by 8%, and the number of people over 65 years of age increased by 14%,[4] a trend which is predicted to continue,[5] and which will lead to an inevitable increase in the demand for glaucoma-related care.

As population screening for POAG detection is neither cost effective6 nor feasible,[7] detection is typically opportunistic. In countries where the optometry profession is well established, the responsibility for glaucoma detection largely falls to optometrists based in community practice. There is no available data for optometric glaucoma referrals in Ireland, but figures from the UK, where undergraduate training and practice patterns are relatively similar, show that between 90%[8] and 96%[9] of referrals to ophthalmology for suspect glaucoma originate from optometrists.

The difficulty of the optometrist's role in the ophthalmic care pathway often goes unrecognised. It has been documented that optometrists are seen differently than other healthcare professionals, as patients perceive the profession as having a commercial rather than a healthcare role.[10] The responsibilities of an optometric eye examination are, in fact, quite broad, as optometrists are tasked with investigating and managing refractive and binocular vision anomalies, while also evaluating ocular health to detect ocular pathology including glaucoma. Public perception of optometry practices as retail businesses with little to no health care role[10] affects credibility, which

has impact on patient education in relation to perceived utility of optometrist recommended supplementary tests and recall visits, potentially affecting healthcare outcomes. Additionally, optometric glaucoma referrals have been scrutinised over the past 25 years,[8,9,11–15] with a strong, arguably disproportionate, focus placed on false positive referrals.[16–18] Optometrists' responsibility to detect disease, inherently leads to false positive referrals in a population where the relative prevalence of glaucoma is low,[19] and this effect is likely being compounded by a tendency for optometrists to preference sensitivity over specificity in their diagnostic testing.[20] This practice pattern could be considered pragmatic, given that optometrists are required to detect pathology and are at risk of litigation[21,22] if they fail in this duty of care. It's understood that no medical test has perfect sensitivity and perfect specificity, and glaucoma detection is a particularly ambiguous area given the significant overlaps in the clinical features of suspicious, but normal individuals and those with early glaucoma.[19,23] While decreasing false positive referrals for glaucoma would improve efficiency in a hospital eye care service that is struggling to cope with demand,[24] a myopic focus on false positive referrals could be detrimental. Repeated reports of false positive referrals could create a culture of diminishing sensitivity, where referrals are very specific but glaucoma diagnoses are missed because of reticence to refer or inability to carry out follow up investigations.

This research aims to provide an in-depth exploration of optometrists' perceptions of the challenges for glaucoma detection within the Irish health care system. In case finding for glaucoma, optometrists face the challenge of detecting an insidious disease of relatively low prevalence,[19] using tests with limited diagnostic accuracy.[19,23] Identifying additional barriers to glaucoma detection in optometric practice can help inform and underpin the future service reform required to cater to the increasing demand for ophthalmic care. Consultation with the profession

and investigation of any barriers to clinical practice for glaucoma, represent important precursors to the development of any new glaucoma care schemes.

Methods

A survey to investigate community optometrists' current practice in the detection of POAG was developed. A review of surveys, conducted for similar purposes in the UK, was carried out to inform the design and content of the survey.[25,26] Once developed, the survey was validated. An external reviewer, with expertise in questionnaire design, first evaluated question construction to ensure that it did not contain leading, confusing or double-barrelled questions. A pilot survey was then sent to 20 community optometrists. The pilot group was selected at random from a group of 59 optometrists who had taken part in a Dublin based glaucoma referral refinement scheme. Feedback from the pilot was incorporated into the final survey design.

The survey comprised three sections. The first section was designed to establish optometrists' demographic information such as mode of practice, academic qualifications, and to explore appointment times available for routine eye examination. The second section aimed to establish the range of equipment available within practices and to explore optometrists' level of confidence in performing a range of pertinent examination techniques. The final section addressed optometrists' perceived barriers to glaucoma detection during routine eye examinations. It contained ten five-level Likert items that presented possible barriers that might be perceived by optometrists in relation to glaucoma detection. The Likert items were based on themes identified in a 2010 survey of UK based community optometrists that presented seven main barriers to optometric detection of glaucoma.[26] These barriers were expanded for our survey, to include 10 potential barriers (Table 2). Participants were asked to indicate their level of agreement or

disagreement with each. A final free-text box was provided for participants to expand upon the themes already suggested, or to express their own opinions on the barriers faced by optometrists.

A multi-mode method of distribution was used to maximise survey responses and minimise sampling bias.[27] To capture responses from those who may be unlikely to volunteer to take part in an online or postal survey, the survey was launched in paper format at the Association of Optometrists Ireland (AOI) AGM in November 2014. There was a 9-week run time ending in January 2015. All optometrists on the electronic databases of the Federation of Ophthalmic and Dispensing Opticians (FODO) and the AOI were sent a survey information leaflet, a link to the online survey in Google forms, and a printable version for those who preferred to return the survey by post. The survey was anonymous. Practitioners were assured that all individual results would be kept strictly confidential. Participation in the survey was voluntary and completing the survey constituted informed consent. The study was approved by the Research Ethics Committee at Dublin Institute of Technology.

The data collected was analysed on the statistical package for social sciences (IBM SPSS Statistics for Windows, Version 22.0 Armonk, NY: IBM Corp.) and RStudio (RStudio Team (2015). RStudio: Integrated Development for R. RStudio, Inc., Boston, MA). The results were analysed using descriptive statistics and inferential statistics: chi-square test of independence, multivariate ordinal regression, logistic regression and linear regression.

Results

199 optometrists responded to the survey, equating to 27% of optometrists registered in Ireland (n=754 at 25/07/2014). The study represents a large proportion of the optometrists registered to practice in Ireland, and has a margin of error of 6% at the 95% confidence level. This falls within an

acceptable range for margin of error, allowing a reasonably high degree of confidence in the accuracy of the survey findings.

Demographic information

Analysis of the demographic data showed a broad geographic range including respondents practicing in 25 of the 26 counties in the Republic of Ireland. Co. Dublin, had the highest response (n = 47, 24% of the total response), followed by Co. Cork (n = 15, 8%), reflecting the population distribution in Ireland.[28] Practice summary information is represented in Figure 1 and Table 1.

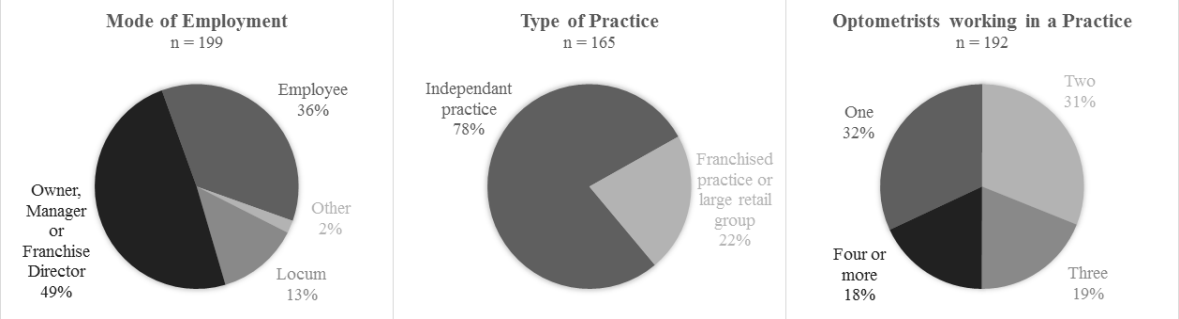

Figure 1: Practice Summary Information. Part 1.

Table 1: Practice summary information. Part 2.

Variable	*n*	*Range*	*Mean*	SD	*Mode*
Time since qualification (years)	199	1-64	20.17	12.46	21
Fee per private eye examination (€)	189	0-98	33.15	9.98	30
Time per appointment (mins)	192	20-60	30.52	8.20	30
Number of optometrists employed within a practice	180	1-19	2.65	2.41	1

Perceived barriers to glaucoma detection

97% of participants responded to the Likert items proposing barriers to glaucoma detection in optometric practice and 94% agreed with one or more of the suggested barriers. The most frequently cited barriers included the need for extra training (71% agreement), patient unwillingness to pay for supplementary tests, defined as any diagnostic investigations that cannot feasibly be offered during a routine eye exam (examples might include repeat IOP measurements or full threshold automated perimetry) (61% agreement), and poor continuity, caused by patients moving between practices (55% agreement). The Likert items presented in the survey and the frequency of agreement with the proposed barriers are represented in Table 2.

Table 2: Frequency of optometrists' agreement with proposed barriers to glaucoma detection during routine eye examinations.

	Barriers presented	Agree Freq. (%)	Neutral Freq. (%)	Disagree Freq. (%)
1	**Training needed:** 'I feel I need extra training on some examination techniques and/or interpretation of some tests results. E.g. new technologies such as OCT.'	137 (71%)	33 (17%)	23 (12%)
2	**Unwilling to pay:** 'Some patients are unwilling to pay an extra fee for supplementary tests that may aid detection of glaucoma. These tests cannot feasibly be offered during the routine exam.'	118 (61%)	45 (23%)	30 (16%)
3	**Continuity:** 'Patients shopping around between practices leads to problems with access to previous clinical records and hampers my ability to detect change over time.'	104 (55%)	43 (23%)	43 (23%)
4	**Finance:** 'It's not financially viable to purchase specialist equipment and/or schedule repeat testing appointments.'	85 (45%)	56 (30%)	49 (26%)
5	**Fail to attend:** 'Patients do not consider the eye exam an important health check and so may fail to attend for recommended follow up tests.'	69 (36%)	59 (31%)	61 (32%)
6	**Time:** 'Time constraints limit my ability to carry out some tests and/or repeat tests.'	54 (29%)	44 (24%)	89 (48%)
7	**Equipment:** 'The equipment available where I work is inadequate; this limits the accuracy of my glaucoma exam.'	45 (24%)	34 (18%)	107 (58%)
8	**Practice Management:** 'Practice staffing and management issues affect my ability to perform necessary tests and/or schedule repeat testing appointments.'	36 (19%)	31 (16%)	124 (65%)
9	**Training not accessible:** 'Training on glaucoma detection is not available or accessible to me.'	28 (15%)	53 (29%)	104 (56%)
10	**Record keeping:** 'Record keeping within the practice is inadequate and hampers my ability to detect change over time.'	15 (8%)	15 (8%)	161 (84%)

To examine the relationship between the group demographics and agreement with the proposed barriers, a chi-square test for association was conducted. Agreement with the need for extra training was significantly associated with postgraduate education. Optometrists without postgraduate qualifications were more likely to agree with the need for extra training in glaucoma detection, OR 4.3 (95% CI 1.7 – 11.6) $\chi 2$ p=0.003. Agreement with a lack of continuity of care as a barrier to glaucoma detection was associated with both employment status and time allowance per appointment. Employees were statistically significantly more likely to agree with a lack of continuity, OR 2.2 (95% CI 1.1 – 4.6) $\chi 2$ p=0.029, than self-employed persons or those in managerial roles, as were optometrists with shorter appointment times (<30 mins), who were more likely to agree with lack of continuity, OR 3.0 (95% CI 1.2 – 7.4) $\chi 2$ p=0.015, than those with more time.

Time allowance per appointment emerged as the variable that was significantly associated with the most barriers (n = 6). Those optometrists with an appointment slot shorter than 30 minutes (26%) were statistically significantly more likely to agree that time constraints, equipment levels, staffing and management issues, inadequate record keeping, financial constraints and lack of continuity of care all limit their ability to detect glaucoma in routine practice (OR 2.9 to 6.6, $\chi 2$ p<0.025 for all).

The results of the full chi-square analysis are shown in Table 3.

Table 3: Chi square test for association

Statistically significant differences (P<0.05) are highlighted in bold and grey.

		Time	Equipment	Practice management	Fail to pay	Continuity	Fail to attend	Finance issues	Record keeping	Training needed	Training not accessible
Appointment slot <30 mins	Freq. <30 mins (%) Freq. ≥30 mins (%) χ^2 p OR (95% CI)	21 (57%) 31 (31%) **0.006** **2.9** **(1.3-6.3)**	20 (53%) 23 (21%) **<0.001** **4.2** **(1.9 – 9.1)**	23 (53%) 13 (13%) **<0.001** **6.6** **(2.8 – 15.1)**	33 (85%) 80 (77%) 0.314 1.7 (0.6 – 4.4)	37 (84%) 64 (64%) **0.015** **3.0** **(1.2 – 7.4)**	20 (50%) 47 (53%) 0.825 0.9 (0.4 – 2.0)	28 (80%) 55 (57%) **0.017** **3.0** **(1.2 – 7.5)**	7 (16%) 6 (5%) **0.020** **3.7** **(1.2 – 11.6)**	38 (88%) 95 (86%) 0.740 1.2 (0.4 – 3.5)	9 (28%) 18 (19%) 0.272 1.7 (0.7 – 4.2)
Employment status	Freq. employed (%) Freq. self-employed/company director (%) χ^2 p OR (95% CI)	34 (45%) 20 (31%) 0.077 1.9 (0.9 – 3.7)	35 (44%) 10 (14%) **<0.001** **5.0** **(2.3 – 11.2)**	31 (37%) 5 (7%) **<0.001** **8.5** **(3.1 – 23.3)**	60 (78%) 57 (81%) 0.598 0.8 (0.4 – 1.8)	64 (78%) 40 (62%) **0.029** **2.2** **(1.1 – 4.6)**	41 (59%) 28 (47%) 0.175 1.6 (0.8 – 3.3)	43 (64%) 41 (63%) 0.895 1.1 (0.5 – 2.1)	12 (13%) 3 (4%) **0.021** **4.2** **(1.1 – 15.5)**	72 (86%) 65 (88%) 0.695 0.8 (0.3 – 2.1)	16 (25%) 11 (17%) 0.260 1.6 (0.7 – 3.9)
Time since qualification	Freq. ≤10 years Freq. >10 years χ^2 p OR (95% CI)	21 (54%) 33 (32%) **0.017** **2.5** **(1.2 – 5.3)**	18 (42%) 27 (25%) **0.038** **2.2** **(1.0 – 4.6)**	14 (33%) 22 (19%) 0.050 2.1 (0.1 – 4.8)	29 (78%) 89 (80%) 0.813 0.9 (0.4 – 2.2)	36 (82%) 68 (66%) 0.054 2.3 (1.0 – 5.5)	21 (58%) 48 (51%) 0.457 1.3 (0.6 – 2.9)	23 (70%) 62 (61%) 0.389 1.4 (0.6 – 3.4)	9 (20%) 6 (5%) **<0.001** **5.2** **(1.7 – 15.6)**	31 (80%) 106 (88%) 0.165 0.5 (0.2 – 1.3)	9 (26%) 19 (20%) 0.464 1.4 (0.6 – 3.5)
Fee for private eye exam	Freq. <€30 (%) Freq. ≥€30 (%) χ^2 p OR (95% CI)	7 (43%) 43 (36%) 0.554 1.4 (0.5 - 4.0)	10 (52%) 31 (25%) **0.012** **3.4** **(1.3 – 9.1)**	8 (36%) 23 (18%) **0.044** **2.6** **(1.0 – 7.1)**	13 (76%) 99 (80%) 0.796 0.9 (0.3 – 2.8)	16 (70%) 82 (70%) 0.994 1.0 (0.4 – 2.7)	11 (58%) 54 (51%) 0.551 1.4 (0.5 – 3.6)	14 (67%) 68 (64%) 0.052 1.2 (0.4 – 3.1)	2 (10%) 10 (6%) 0.651 1.442 (0.3 – 7.1)	17 (85%) 114 (87%) 0.804 0.9 (0.2 – 3.2)	6 (30%) 20 (19%) 0.269 1.8 (0.6 – 5.3)
Tonometers available	Freq. NCT only Freq. GAT or combination χ^2 p OR (95% CI)	30 (37%) 22 (37%) 0.934 1.0 (0.5 – 2.1)	37 (48%) 7 (10%) **<0.001** **8.1** **(3.3 – 19.8)**	21 (25%) 14 (19%) 0.360 1.4 (0.7 – 3.1)	55 (75%) 59 (84%) 0.153 0.6 (0.2 – 1.3)	59 (74%) 44 (68%) 0.424 1.3 (0.7 – 2.8)	39 (55%) 29 (51%) 0.648 1.2 (0.6 – 2.4)	52 (71%) 33 (56%) 0.068 2.0 (1.0 – 4.0)	13 (14%) 1 (1%) **0.002** **13.0** **(1.7 – 101.8)**	77 (89%) 57 (82%) 0.210 1.8 (0.7 – 4.6)	15 (24%) 13 (19%) 0.510 1.7 (0.4 – 5.9)
Perimeter available	Freq. Yes Freq. No χ^2 p OR (95% CI)	48 (40%) 4 (27%) 0.317 1.8 (0.6 – 6.1)	33 (26%) 10 (59%) **0.005** **0.2** **(0.1 – 0.7)**	26 (20%) 9 (45%) **0.012** **0.3** **(0.1 – 0.8)**	99 (80%) 15 (83%) 0.774 0.8 (0.2 – 3.1)	78 (71%) 13 (68%) 0.796 1.2 (0.4 – 3.3)	59 (56%) 9 (47%) 0.504 1.4 (0.5 – 3.7)	71 (62%) 13 (87%) 0.062 0.3 (0.1 – 1.2)	11 (7.4%) 3 (15%) 0.250 0.5 (0.1 – 1.6)	114 (87%) 17 (81%) 0.454 1.6 (0.5 – 5.3)	25 (22%) 2 (14%) 0.499 1.3 (0.6 – 3.1)
CPD support from employer	Freq. Yes Freq. No χ^2 p OR (95% CI)	29 (43%) 17 (35%) 0.385 1.4 (0.7 – 3.0)	13 (18%) 25 (45%) **<0.001** **0.3** **(0.1 – 0.6)**	11 (15%) 20 (35%) **0.006** **0.3** **(0.1 – 0.7)**	63 (88%) 40 (76%) 0.081 2.3 (0.9 – 5.8)	44 (70%) 45 (73%) 0.735 0.9 (0.4 – 1.9)	30 (57%) 31 (55%) 0.896 1.1 (0.5 – 2.2)	43 (62%) 31 (67%) 0.578 0.8 (0.4 – 1.8)	5 (6%) 7 (11%) 0.304 0.5 (0.2 – 1.8)	58 (85%) 57 (89%) 0.518 0.7 (0.3 – 2.0)	9 (15%) 16 (30%) 0.058 0.4 (0.2 – 1.1)
Postgraduate qualification	Freq. No Freq. Yes χ^2 p OR (95% CI)	43 (36%) 11 (50%) 0.198 0.6 (0.2 – 1.4)	38 (31%) 7 (25%) 0.555 1.3 (0.5 – 3.4)	31 (23%) 5 (21%) 0.832 1.1 (0.4 – 3.2)	101 (79%) 17 (85%) 0.528 0.7 (0.2 – 2.4)	91 (73%) 13 (59%) 1.8 0.5 (0.7 – 4.7)	58 (53%) 11 (55%) 0.851 0.9 (0.4 – 2.4)	77 (67%) 8 (42%) **0.037** **2.7** **(1.0 – 7.5)**	2 (7%) 13 (8.8%) *	121 (90%) 16 (67%) **0.003** **4.3** **(1.7 – 11.9)**	28 (26%) 0 (0%) **0.005** **1.4** **(1.2 – 1.5)**

** Expected cell count below five, therefore invalid and removed from the table.*

Regression Analysis

Logistic and linear regression analyses were conducted to allow continuous variables to be incorporated into the analysis, to maintain the Likert scale ratings of the proposed barriers, and to incorporate the effects of confounding factors.

Perceived need for extra training

To explore the impact of potential confounders on the perceived need for extra training, a cumulative odds ordinal logistic regression with proportional odds was run to establish the adjusted odds ratios for completed postgraduate education, subjective competence on binocular indirect ophthalmoscopy (BIO), tonometry equipment available, years since qualification, number of optometrists working within one practice, and access to financial support for continuing professional development (CPD) on the dependent variable, the perceived need for extra training. The final model statistically significantly predicted the dependent variable over and above the intercept-only model, χ^2 (7) = 14.656, p=0.041. The adjusted odds of optometrists without postgraduate education agreeing with the statement that they needed extra training for glaucoma detection was 3.2 (95% CI 1.3 - 8.1) times that for optometrists with postgraduate education, $\chi^2(1)$ = 6.204, p=0.013. Postgraduate education, therefore, remained as a significant predictor of agreement with the need for extra training, even when potential confounding factors were included in the analysis.

The remaining predictor variables used in the regression model were not significant. The model is shown in Table 4.

Table 4: Ordinal regression

Variable	Training Needed OR (95% CI)	Sig.
Tonometry equipment available: NCT only	2.2 (1.0– 4.9)	0.062
GAT only	3.5 (0.6 – 20.0)	0.16
Competence on BIO	1.0 (0.7 – 1.3)	0.88
Support for CPD	0.7 (0.3 – 1.4)	0.30
Years since qualification	1.0 (1.0 – 1.0)	1.0
Postgraduate education	**3.2 (1.3 to 8.1)**	**0.013**
Number of optometrists working within the practice	1.0 (0.9 – 1.2)	0.86

Short appointment times

A logistic regression was conducted, incorporating the full time range of appointment slots (removing outliers) to further analyse the effects of appointment duration as a barrier. The analysis was conducted for 179 optometrists, and found that the test of the full model against a constant only model was statistically significant. Time slot allotted per appointment reliably distinguished between agree and disagree (or neutral) responses relating to whether optometrists have enough time to conduct a "full" test, χ^2 (1) = 13.52, p<0.001. For estimate values, see Table 5. Figure 2 shows the probability of disagreeing with time constraints as a barrier (probability of no barrier) vs. the appointment slot time, and shows that an appointment time of ~45 minutes would result in a 75% probability of no barrier to diagnosis.

Table 5: Time slot logistic regression analysis

	Estimate	Std. Error	z value	Odds Ratio	Confidence Interval	p
Intercept	-2.29	0.67	-3.43	0.10	(0.026 - 0.35)	<0.001
Time slot	0.072	0.022	3.35	1.08	(1.033 - 1.13)	<0.001

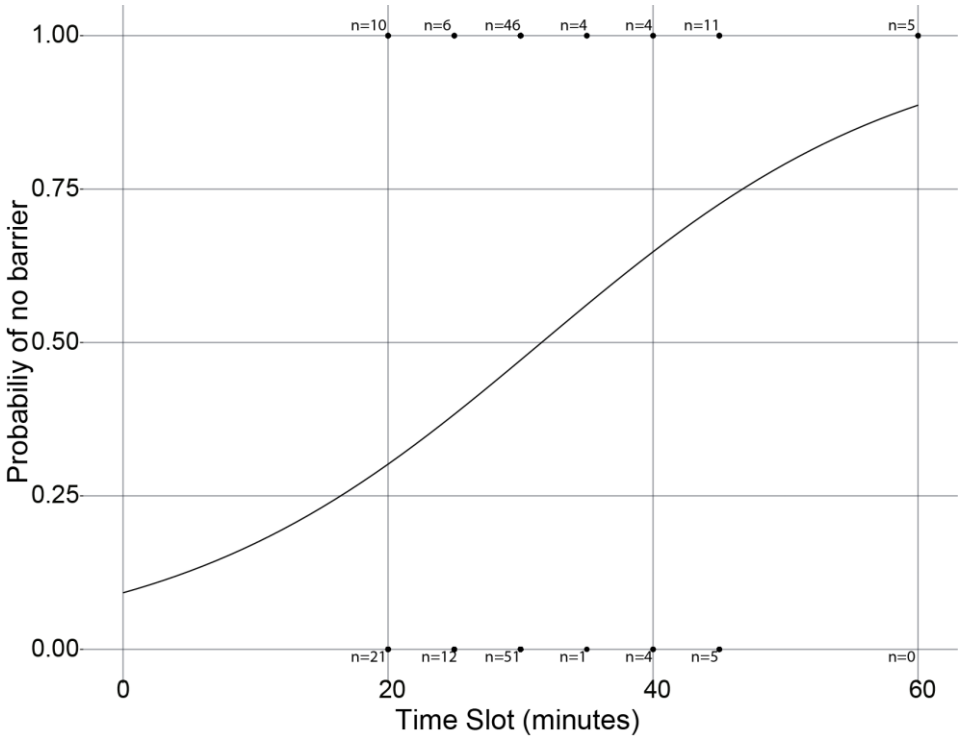

Figure 2: Time slot logistic regression analysis graph, the dots and n depicts the number of optometrists who indicated no barrier (1) or that there is a time barrier (0) as a function of time slot (minutes)

A multiple linear regression was conducted to identify those optometrists most likely to be affected by short appointment times. Fees charged per eye examination, years since qualification and mode of practice (independent private practice vs. large multiples or franchises) all proved to be

significant predictors of the amount of time available to optometrists per eye examination. R^2 for the overall model was 42.2% with an adjusted R^2 of 41.1%, a large size effect. The multiple regression model statistically significantly predicted the time per appointment slot, F (3, 158) = 38.412, $p <$ .0001. All three variables added statistically significantly to the prediction, $p < .05$. Regression coefficients, standard errors, and exact p values are shown in Table 6.

The model shows that optometrists with less experience, charging lower fees, and working in large multiples or franchised practices have the shortest appointment times. Using the regression model to predict appointment times illustrates the effects of each independent variable, showing that years of experience had a small, though statistically significant, effect on the appointment time, while mode of practice had a large effect: optometrists working in independent practice, charging 30 euro for a sight test with ten, twenty and thirty years' experience are predicted to have an appointment slot of 30.80 (95% CI 29.30 – 26.30), 31.97 (95% CI 30.75 – 33.19) and 33.1 (95% CI 31.63 – 34.65) minutes respectively. For optometrists working in a franchise or multiple, charging 30 euro for a sight test with ten, twenty and thirty years' experience, the predicted test time is substantially shorter, at 22.92 (95% CI 20.73 – 25.11), 24.09 (95% CI 21.84 – 26.33) and 25.26 (95% CI 22.64 – 27.87) minutes respectively.

Table 6: Multiple linear regression analysis summary

B = unstandardised regression coefficient; SE_B = standard error of coefficient; β = standardised coefficient; t = t-value.

Variable	B	SE_B	β	t	p
Intercept	30.26	2.88		10.49	*< 0.001*
Fee per eye exam	0.24	0.055	0.29	4.39	*< 0.001*
Years since qualification	0.12	0.045	0.17	2.63	*0.010*
Mode of practice	-7.88	1.33	-0.39	-5.92	*< 0.001*

The final element in the survey was a free text box, where respondents could elaborate on their responses, or suggest other barriers to glaucoma detection. 9% of respondents completed the free text box. The most commonly cited barrier was a lack of finance or time for diagnostic tests (41%). Specific mentions included shortfalls of state funding and patients' unwillingness to pay supplementary fees as a restriction to buying equipment and giving extra chair time for enhanced or repeated diagnostic tests. 31% of respondents cited poor care pathways including lack of structured referral pathways and absence of multidisciplinary cooperation as a barrier.

Discussion

The key findings to emerge from our study include; (i) the perceived need for extra training in glaucoma detection and the clear link between a perceived need for training and a lack of postgraduate education; (ii) a lack of funding for supplementary diagnostic tests, where optometrists agreed that patients were unwilling to pay an extra fee for diagnostic investigations that could not reasonably be provided for a standard eye examination fee; (iii) a strong link between shorter appointment times and increasing barriers to glaucoma detection.

Training needs

The high frequency of agreement (71%) with the need for extra training in examination techniques relating to glaucoma detection contrasts with UK data where optometrists' level of training was an infrequently cited barrier.[26] This difference might be partly explained by the difference in survey methodologies used in the two studies: Myint et al. assessed barriers to glaucoma detection through qualitative analysis of a free-text question and found that time and financial constraints were the most commonly stated barriers.[26] The use of Likert items in our survey may have influenced responses, where conscientious practitioners were inclined to agree that further training would

improve their ability to detect glaucoma. It's possible they would have been less likely to raise this issue independently. The response to our free-text question regarding barriers to glaucoma detection was low (9%), though it's notable that lack of finance and time were the key barriers raised, showing very close alignment with the barriers identified by optometrists in the UK.

While this methodological influence should be acknowledged, the high level of agreement with the need for extra training, and differences identified between optometrists' perceived need for training in the UK and Ireland, cannot be completely ignored. Higher uptake of postgraduate education among optometrists practicing in the UK could have generated higher levels of confidence. 15% of respondents to our survey indicated that they have already obtained postgraduate qualifications, whereas uptake of postgraduate education among optometrists working the UK is higher at 24%.[29] Only 15% of our participants agreed that access to training was a barrier (Table 2), implying that training is perceived as available but is not being availed of, so the difference in uptake of postgraduate education is unlikely to be accounted for by lack of access alone. In the UK, optometrists can participate in a variety of enhanced service schemes,[30] examples of which include; glaucoma repeat measures;[31] referral refinement;[32] and co-management,[33] many of which require postgraduate training. It's possible that the lack of extended scope roles in Ireland has resulted in a relatively lower level of uptake of postgraduate training. Within our free text response spaces, two optometrists noted that they would only consider structured postgraduate training if shared care, or enhanced scope schemes became a reality in Ireland.

At the time of the survey, optometrists in Ireland were constrained in their scope of practice by a restrictive and arguably archaic legislation, which obliged optometrists to refer patients to a medical practitioner once the minimum index of suspicion for pathology was met and stated that: '(a) registered optician who is not a registered medical practitioner shall not suggest by any written or oral statement or by any action that the registered optician has made or is capable of making a

medical diagnosis of a disease of the eye or that, in relation to the treatment of the eyes, the registered optician has done or is capable of doing anything other than-
(a) in the case of a registered optometrist, the prescribing or provision of spectacles, or
(b) in the case of a registered dispensing optician, the provision of spectacles. '

Optometrists practicing within this context may have felt discouraged from expanding their clinical skill and expertise, and may have considered themselves 'over-trained' for the role defined by the 1956 legislation.

This legislation was repealed on October 31st 2015, being replaced by the Health (Miscellaneous Provisions) Act 2015, and regulation of optometry was transferred to a new multi-profession health regulator called CORU. Under the new legislation, scope of practice has been defined quite loosely, stating that professionals must 'act within the limits of (their) knowledge, skills, competence and experience' and 'practice only in areas in which (they) have relevant competence, education, training and experience'.[34] Within this framework, there is clear scope for optometrists, with the appropriate skills, to become more involved in the diagnosis, monitoring and management of ocular pathology. In this new environment, Irish optometrists might feel more motivated to engage in further education and training, as any new skills can now be put to use in areas of personal interest. A UK survey found that 42.7% of optometrists identified a special interest in a particular area of optometry, and 69% of these respondents wished to undertake further training in the field of interest.[29] The top area of special interest was glaucoma.[29]

Even those optometrists who may not feel inclined to partake in structured postgraduate education will need to meet a new statutory requirement for CPD. Optometry's new regulatory body CORU, require 30 hours of CPD in a 12 month period, with the first cycle beginning on April 1st, 2017. Educators should consider this potential extra demand for postgraduate education in Ireland, and

further analysis into the types of training that can develop real improvements in clinical competence[23,35,36] should be prioritised. Any new educational opportunities should be developed in consultation with the profession, to ensure that the identified need for extra training is appropriately addressed. Consideration should also be given to design and content the undergraduate degree programme, to ensure that newly qualified optometrists are appropriately trained in glaucoma detection and also equipped the with the skills to engage in, and take responsibility for, their own continuing professional development.

Very few of the optometrists surveyed had glaucoma specific qualifications, just 6 of the 30 respondents with completed postgraduate education had completed a glaucoma module or certificate though only 14 of the 30 gave enough detail in their answer that the exact type of postgraduate qualification could be could be discerned. Respondents were considered to have completed postgraduate education if they had completed a level 9 or 10 postgraduate course in any area relating to optometric practice, including modules, certificates, diplomas, clinical masters, or PhDs. Interestingly, any form of postgraduate education (as defined above) appeared to increase optometrists' confidence in their ability to detect glaucoma (they were less likely to agree with the Likert item 'I need extra training'). Perhaps this indicates that those optometrists who have sought out postgraduate education are more independent, life-long learners, and even if they have not completed a course specifically relating to glaucoma detection, they are confident in their own ability to keep their training up to date.

Financial constraints

Patient unwillingness to self-fund supplementary diagnostic tests within optometry practices was the second most frequently perceived limitation to optometrists' case finding for glaucoma. A similar theme emerged in free text responses, where shortfalls of state funding as well as patients'

unwillingness to pay supplementary fees, were identified as barriers to buying equipment and giving extra 'chair time' for enhanced diagnostic tests. Optometrists could potentially improve patient uptake of supplementary testing by improving patient education, putting emphasis on the importance of detecting insidious disease and emphasising the clinical rather than the commercial aspects of their service. Shah et al. found that only a minority of optometrists discussed glaucoma risk factors with a patient of African racial decent, even when the standardised patient asked the optometrist if she was at greater risk of any eye conditions,[37] showing that patient education by optometrists is likely underutilised and inconsistent. Even if patient education was significantly improved however, the funding structures within the healthcare system may incentivise patients to seek referral to secondary care, where appointments are free, rather than self-fund diagnostic testing within an optometry practice.

In Ireland, the State is the largest single purchaser of optometry services, subsidising eye examinations and optical appliances through a variety of schemes.[38] When the survey was carried out, the contracts did not allow or pay for repeat appointments to refine clinical decision making, so patients found suspect for glaucoma had to pay for follow up appointments (for example repeated visual fields or tonometry measurements), or the practice provided these services with no additional remuneration. Public hospital services, including ophthalmology outpatient departments, are free to all (subject to small co-payments). This financial incentive, coupled with the considerable pressure optometrists are under to detect every case of sight threatening disease, naturally leads to false positive referrals to secondary care. Low risk patients, who might suitably undergo further investigations and monitoring within community optometry, may be added to the long waiting list for public ophthalmology outpatient appointments. This circumstance has been studied by Tuck,[39] who found that 74% of the patients referred by an optometrist with 'almost definite' glaucoma were confirmed as having the condition, compared with only 21% of those with

'possible' glaucoma. Recent contract negotiations have led to significant modernisation of the contractual agreements between the Department of Social Protection and those optometrists agreeing to provide State funded eye examinations. On April 4th, 2017, a notification was issued declaring that the primary eye examination fee was to be increased from €22.42 to €30.00, and a further €20 (€30 if dilation is required) would be paid for a follow-up or repeat appointment. This represents an important change in the current funding of optometry practices, which could have a significant impact on optometric glaucoma case findings procedures, potentially facilitating more accurate diagnostic testing within community-based optometry practices. The significant increases in funding may affect both the time and equipment available to optometrists in community practice. Our chi square analysis (Table 3) shows that optometrists charging less than €30 for a private eye examination were significantly more likely to agree with the Likert item 'the equipment available where I work is inadequate; this limits the accuracy of my glaucoma exam'. The new fee structures demonstrate a recognition of the primary eye care services provided by optometrists, and they may represent a watershed moment in clinical practice patterns. Future work should look to map the changes in practice norms that emerge from the increased funding of optometry services in Ireland.

It stands to reason that optometrists with shorter appointment times would feel that time constraints limit their ability to detect glaucoma and the logistic regression (Table 5, Figure 2) confirmed that time per appointment was a significant predictor of agreement with this barrier. It's also important to note that this same group identified many more barriers, which highlights the importance of time as a facilitator of comprehensive and effective clinical practice.

Time since registration was found to be a significant predictor of sight test time, where optometrists with less experience are more likely to have a shorter appointment times. It's possible that younger or more junior optometrists are more susceptible to pressure from management to deliver faster eye examinations. Senior or more experienced clinicians may have more confidence in dictating

suitable appointment times, or may be in the position of setting their own appointment diaries. Although there was a much higher proportion of less experienced optometrists working in large retail groups or franchises, which tended to have shorter appointment times compared to independent private practices, the regression shows that time since registration is a significant predictor of test time even when this confounding factor is adjusted for (Table 6). Davey et al.[15] examined the factors influencing false positive referrals from optometrists, and found that clinician experience had the greatest effect on referral accuracy, where inexperienced optometrists were more likely to generate false positive referrals to ophthalmology. Shorter appointment times for inexperienced optometrists might contribute to this effect, where less experienced optometrists, who might be more uncertain of a diagnosis, also have less time to refine their clinical decision-making, making them more likely to make unnecessary referrals.

The factor which had most effect on the time per appointment was mode of practice, where optometrists working in large multiples or franchises were predicted to have significantly shorter test times than those in independent private practice. The assumption one could draw from this, is that franchised practices and large retail groups have a higher volume of patients and optometrists are under pressure to produce faster eye exams, but other factors might also be at play. Multiples often have more ancillary staff who can carry out preliminary testing prior to the patient's eye exam. This can shorten examination times significantly, and is arguably a better use of optometrists' time. There may also be a significant difference in the patient populations of the different types of practices, representing a type of causality dilemma. It's possible that more 'straightforward' patients tend to present to multiples or franchises, whereas patients who perceive their issues as more complex, tend to present to independent optometry practices that may be perceived as more competent or clinically experienced given that there is a much higher proportion of more experienced optometrists working in independently owned businesses. Therefore, the shorter

appointment times reported by those in multiples or franchised practices may result from their less complex patient base, or vice versa. The fact remains, however, that shorter appointment slots appear to influence optometrists' perceptions of the barriers that exist to glaucoma detection. Though the Association of Optometrists Ireland advise that eye examinations should not take less than 20 minutes,[40] our findings suggest that a sight test time of 30 minutes or longer is more appropriate, which falls in line with recommendations from the Scottish General Ophthalmic Services.[41]

State financing of extra time for diagnostic testing within community optometry could facilitate more accuracy in referrals to secondary care, which would likely result in a net saving for the state32 while also relieving the significant psychological burden[42] created by unnecessary referrals. The recent renegotiation of the State's eye examination fees may serve to address the time and finance issues identified; similar repeat measures schemes have proven to be a cost effective[43] intervention in the glaucoma care pathway. It will be interesting to observe how the increased funds are implemented across various practice settings, whether increased fees will result in improved equipment levels, increased appointment times, or perhaps just become assimilated into the business without any discernible change to service provision.

Limitations

Surveys are vulnerable to both sampling and response bias, and a healthy degree of scepticism toward survey data is often appropriate. The methodology used within our survey aimed to minimise bias, and the demographics of the respondents do appear representative in terms of geographic location and time since qualification. Being aware of the potential for bias, particularly voluntary response bias where the survey can over represent individuals with strong opinions, we have conducted a conscientious and judicious analysis of the survey responses.

Conclusions

This paper is the first in depth exploration of optometrists' perceptions of the barriers to glaucoma detection in community practice in Ireland. The research took place at a critical time for Irish optometry, taking stock of practice norms prior to the enactment of landmark legislation, which may usher in significant developments in the scope of practice over the coming years.

Any change in scope of practice, will need to be underpinned by appropriate training, education and experience, and optometrists' responses to the survey show a clear acknowledgement of the link between further education and improving clinical practice. To deliver real improvements in clinical competence, the type of training made available should be carefully considered by educators and legislators in Ireland.

The responses also identified financial constraints on clinical practice that may be addressed by the recent renegotiation of the State's eye examination fees. Increased fees and repeat measures allowances, may serve to provide more equitable access to refined clinical decision making. Increases in the standard eye examination fee might be best used to facilitate longer appointment times, so that optometrists, including younger graduates and those working in multiples, are not burdened with examination times that limit their perceived ability to detect glaucoma. Future research should build on the findings presented in this paper, to analyse the impact of funding increases and legislative changes on optometric clinical practice patterns in Ireland.

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