
Articles

2018

Expanding the Traditional Role of Optometry: Current Practice Patterns and Attitudes to Enhanced Glaucoma Services in Ireland

Catriona Barrett

Technological University Dublin, catriona.barrett@tudublin.ie

James Loughman

Technological University Dublin, james.loughman@tudublin.ie

Follow this and additional works at: <https://arrow.tudublin.ie/optomart>



Part of the [Optometry Commons](#)

Recommended Citation

Barrett, C. & Loughman J. (2018) Expanding the Traditional Role of Optometry: Current Practice Patterns and Attitudes to Enhanced Glaucoma Services in Ireland *J Optom.* (2018), <https://doi.org/10.1016/j.optom.2018.02.004>

This Article is brought to you for free and open access by ARROW@TU Dublin. It has been accepted for inclusion in Articles by an authorized administrator of ARROW@TU Dublin. For more information, please contact arrow.admin@tudublin.ie, aisling.coyne@tudublin.ie.



This work is licensed under a [Creative Commons Attribution-NonCommercial-Share Alike 4.0 License](#)



Journal of Optometry

www.journalofoptometry.org



ORIGINAL ARTICLE

Expanding the traditional role of optometry: Current practice patterns and attitudes to enhanced glaucoma services in Ireland

Catriona Barrett^{a,b,*}, James Loughman^{a,b,c}

^a Dublin Institute of Technology, 19A Lower Kevin Street, Dublin 8, Ireland

^b DIT Centre for Eye Research Ireland, Environmental Sustainability and Health Institute, Dublin, Ireland

^c African Vision Research Institute, University of KwaZulu Natal, South Africa

Received 4 November 2017; accepted 11 February 2018

KEYWORDS

Case-finding;
Glaucoma;
Optometrist;
Survey

Abstract

Purpose: To investigate current diagnostic equipment availability and usage for glaucoma case-finding within community optometric practice, and to explore optometrists' attitudes towards an enhanced scope of clinical practice.

Methods: An anonymous survey was developed, validated, and distributed to all optometrists in Ireland.

Results: 199 optometrists (27% of registrants) responded to the survey. 87% had access to the traditional triad of tests necessary to conduct adequate glaucoma case finding. Standard automated perimetry was the most commonly absent (13%) of the three essential screening tests. 64% of respondents indicated that monocular direct ophthalmoscopy was their first choice technique for fundus examination. 47% of respondents had access to contact applanation tonometry, though just 14% used it as first choice during routine eye examinations. Among the 73 participants with access to both contact and non-contact tonometry (NCT), 80.8% used NCT preferentially. The significant majority (98%) indicated an interest in enhanced glaucoma services with 57% agreeing that postgraduate training was an essential prerequisite to any increase in scope of practice.

Conclusion: Irish optometrists are well equipped with the traditional tests used in glaucoma detection. However, implementation of enhanced referral schemes or glaucoma monitoring or management services would require equipment upgrades and associated training in at least half of the surveyed practices. There is strong interest in furthering optometric professional development and expanding the traditional role boundaries of optometrists, incorporating further education as an essential prerequisite to an enhanced scope of practice.

© 2018 Spanish General Council of Optometry. Published by Elsevier España, S.L.U. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

* Corresponding author.

E-mail address: catriona.barrett@dit.ie (C. Barrett).

<https://doi.org/10.1016/j.optom.2018.02.004>

1888-4296/© 2018 Spanish General Council of Optometry. Published by Elsevier España, S.L.U. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Please cite this article in press as: Barrett C, Loughman J. Expanding the traditional role of optometry: Current practice patterns and attitudes to enhanced glaucoma services in Ireland. *J Optom.* (2018), <https://doi.org/10.1016/j.optom.2018.02.004>

PALABRAS CLAVE

Detección de casos;
 Glaucoma;
 Optometrista;
 Encuesta

Ampliar el rol tradicional de la optometría: patrones actuales de práctica y actitudes hacia la mejora de los servicios para glaucoma en Irlanda

Resumen

Objetivo: Estudiar la disponibilidad actual y el uso del equipo diagnóstico para la detección de casos de glaucoma dentro de la práctica optométrica comunitaria, y explorar las actitudes de los optometristas hacia la mejora del alcance de la práctica clínica.

Métodos: Se desarrolló, validó y distribuyó una encuesta anónima a todos los optometristas de Irlanda.

Resultados: 199 optometristas (el 27% de los registrados) respondieron a la encuesta. El 87% tenía acceso a la triada tradicional de pruebas necesarias para realizar una detección adecuada de casos de glaucoma. La perimetría automatizada estándar fue la más comúnmente ausente (13%) de las tres pruebas de cribado esenciales. El 64% de los que respondieron al test indicó que la oftalmoscopia directa monocular era su técnica de primera elección para el examen del fondo del ojo. El 47% de los que respondieron a la encuesta tenía acceso a la tonometría de aplanación de contacto, aunque únicamente el 14% la utilizaba como primera elección durante los exámenes oculares rutinarios. Entre los 73 participantes con acceso tanto a la tonometría de contacto como a la de no contacto (NCT), el 80,8% utilizaban NCT preferentemente. Una mayoría significativa (98%) indicó su interés por mejorar los servicios de glaucoma, el 57% de los cuales afirmó que la formación post-grado era un requisito previo esencial para cualquier incremento del alcance de la práctica.

Conclusión: Los optometristas irlandeses están bien equipados de las pruebas tradicionales utilizadas para la detección del glaucoma. Sin embargo, la introducción de programas de mejora de la derivación, o supervisión del glaucoma, o servicios de gestión, requeriría la modernización de los equipos y la formación asociada en al menos el 50% de los encuestados. Existe un fuerte interés por ampliar el desarrollo profesional de la optometría y expandir los límites de la función tradicional de los optometristas, incorporando mayor formación como requisito previo esencial para mejorar el alcance de la práctica.

© 2018 Spanish General Council of Optometry. Publicado por Elsevier España, S.L.U. Este es un artículo Open Access bajo la licencia CC BY-NC-ND (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Introduction

Optometrists play a vital role in detecting glaucoma, the world's leading cause of irreversible blindness.¹ Primary open angle glaucoma (POAG), the most common glaucoma subtype,² is insidious, progressive and irreversible, presenting a significant public health challenge.² As population screening for POAG is neither cost effective³ nor viable,⁴ it is primarily detected through opportunistic case-finding during routine eye examinations. Evidence from the UK⁵ has shown that the vast majority of glaucoma and ocular hypertension cases are detected through opportunistic case-finding by community based optometrists.

In Ireland, as with many jurisdictions, there are no specific guidelines relating to glaucoma detection in optometric practice. In 2009, the Association of Optometrists Ireland (AOI) issued guidelines for optometrists outlining the procedures that might be carried out during a routine eye exam,⁶ and this document does refer to the examination of patients at risk of glaucoma, stating that intraocular pressure measurement and visual field assessment should be carried out on all patients deemed to be at risk of glaucoma. The choice of equipment used for these tests and the protocol for determining those at risk from glaucoma are not defined, leaving considerable room for variation between practitioners.

Optometric practices wishing to provide state funded eye examinations in Ireland must sign an agreement that outlines the scope and content of the eye exam to be provided. This document states that the contracted optometrist agrees to 'provide eye examinations and advice to the best of his/her knowledge and ability for eligible persons...using suitable instruments and equipment in a suitable manner' and to 'carry out all tests judged to be necessary to determine the patient's need for vision care as in both sight and health provided that the exact format and content will be determined by the optometrist's professional judgement.'⁷ It can be inferred, that the scope of the eye exam is quite broad and gives responsibility to optometrists to determine the patients' refractive correction and to rule out any form of ocular pathology including glaucoma, though the accepted standards for examination strategies are not clearly defined.

Clinical practice norms in optometry have evolved significantly over the past few decades, with optometric training in Ireland moving from a once part-time, evening course diploma, to a now full-time, four-year honours degree programme,⁸ and optometrists are now highly trained health care professionals. The range of equipment and examinations in use within optometry practices has also grown, and optometrists are expected to make pragmatic judgements as to which investigations can feasibly

be carried out within an eye examination based on an individual's presenting complaints and risk factor profile. Anecdotal evidence suggests a large variation in equipment and practice boundaries between optometry practices and practitioners, though no accurate data exists as to Irish optometrists' typical glaucoma case-finding procedures. This research was designed to assess current practice patterns among optometrists in Ireland with a particular emphasis on the tests used in case-finding for glaucoma. This benchmark of current practice standards will be useful in determining equipment and training needs for future enhanced services schemes. Optometrists' level of interest in enhancing their scope of practice was also explored, as a means to provide an insight into the ways the profession might evolve in the coming years.

Methods

A survey to investigate community optometrists' current practice for glaucoma detection was developed. A review of similar international studies was conducted in order to inform the design and content of the survey.^{9,10} Once developed, the survey went through a validation process: it was first reviewed by an expert on question construction, to ensure that it did not contain leading, confusing or double-barrelled questions and a pilot survey was then sent to 20 community optometrists. The pilot group was selected at random from a group of 70 optometrists who had taken part in a Dublin based glaucoma referral refinement scheme. Feedback from the pilot was incorporated into the final survey design which consisted of 4 sections, covering different aspects of optometric practice (Appendix A).

Section A: Demographic information

This section sought information on the year that participants first qualified into the profession, their current mode of practice, their academic qualifications, and the time given for routine eye examinations in their practice.

Section B: Diagnostic examinations

The second section was designed to establish the range of equipment available within practices and to explore optometrists' level of confidence in performing a range of pertinent examination techniques.

Respondents were asked which tonometers were available to them in practice, whether they carried out tonometry themselves or if it was delegated to support staff, and to indicate their first choice technique for intraocular pressure (IOP) screening during routine eye examinations.

Respondents indicated their usual method of examining the fundus. Options were: 'direct ophthalmoscopy', 'binocular indirect ophthalmoscopy (BIO) using a slit lamp and condensing lens', 'BIO using a headset and condensing lens', or 'other please specify'. A supplementary question asked optometrists to indicate their level of competence at slit lamp BIO. They were asked to respond on a five-point scale, from 1 (unable to carry out slit lamp BIO) to 5 (expert).

Participants were also asked to identify the types of investigative equipment they had available within their workplace, specifically the exact model of perimeter if known, as well as other more specialist equipment such as optical coherence tomography, gonioscopy, and pachymetry.

Section C: Attitudes to enhanced scope practice

This section sought qualitative information on optometrists' attitudes towards enhanced scope optometry, exploring the level of interest in glaucoma shared care schemes as well as other forms of enhanced scope practice. Participant opinion on the need for postgraduate training as a pre-requisite for enhanced scope practice was also assessed.

Section D: Perceived barriers to glaucoma detection

The findings from this section are explored in detail in a separate paper.¹¹

A multi-mode method of distribution was used to maximise survey responses and minimise sampling bias. 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 were analysed on the statistical package for social sciences (IBM SPSS Statistics for Windows, Version 22.0 Armonk, NY: IBM Corp.). The results were analysed using descriptive and inferential statistics: a frequency analysis was carried out and logistic regression was used to further analyse the results.

Results

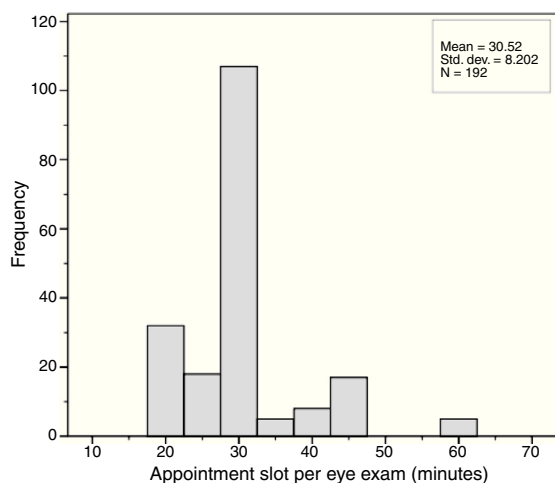
199 optometrists responded to the survey, equating to 27% of optometrists registered in Ireland. The study represents a large proportion of the optometrists registered to practice in Ireland, and has a margin of error of 6% at the 95% confidence level. This falls within an acceptable range for margin of error, allowing a reasonably high degree of confidence in the accuracy of the survey findings.

Demographic information

Respondents had varied levels of experience within optometry, the time since qualification into the profession ranged from 1 to 64 years (mean 20.17 years, ± 12.46). 14.9%

Table 1 Participating optometrists' modes of practice.

Mode of practice	n (%)
Employee in an independent practice	37 (18.6%)
Owner of an independent practice	92 (46.2%)
Employee in a franchise or large multiple	34 (17.1%)
Franchise director or owner of a large multiple	3 (1.5%)
Locum optometrist	26 (13.1%)
Academic	3 (1.5%)
Employee in a private ophthalmology practice	1 (0.5%)
Not specified	3 (1.5%)

**Figure 1** Reported times per appointment slot.

of participants had acquired postgraduate qualifications within optometry, ranging from certificate level courses right through to PhD. The reported modes of practice are shown in Table 1.

The median time per appointment was 30 min, range 20–60 min (Fig. 1).

Diagnostic equipment and examinations

Tonometry

To measure intra-ocular pressure, 53% of respondents had access to non-contact tonometry (NCT) only, 8% had access to contact tonometry only, and 39% had both NCT and contact tonometry available in their practice. Optometrists working in independent practices appeared more likely to have access to contact tonometry (51.2%) relative to those working in franchises or large multiples (33.3%), though the difference did not quite reach statistical significance (Table 2).

Respondents were asked to identify the tonometry technique they used as first choice during routine eye examinations, the responses are represented in Fig. 2, which shows that NCT was by far the most popular technique.

There were 73 study participants across all modes of practice who had access to both contact and non-contact tonometry techniques. Among this group, 81%, used NCTs preferentially despite having access to contact techniques. This finding was not related to the practice of delegating tonometry measures to ancillary staff, where

NCT would be the expected technique of choice. Among practitioners with access to both techniques and who always carried out tonometry themselves (54 of 73 participants), the proportion using NCT routinely was even higher (83%).

Fundus examination

The majority of respondents (64%) indicated that monocular direct ophthalmoscopy was their first choice technique for fundus examination. Slit lamp binocular indirect ophthalmoscopy (SLBIO) was the second most popular technique (32%). Head set BIO was used by 1% of respondents. A small minority (3%) indicated that they used fundus photography in isolation as their method of choice for ocular examination. 79% had a fundus camera in practice which they used in addition to ophthalmoscopy.

Of 197 responses to the Likert item relating to competence on SLBIO, 33% considered themselves 'expert' at the technique, representing the 33% of optometrists who reported using SLBIO as their first choice for fundus examination. 13% were unable to carry out SLBIO (Fig. 3).

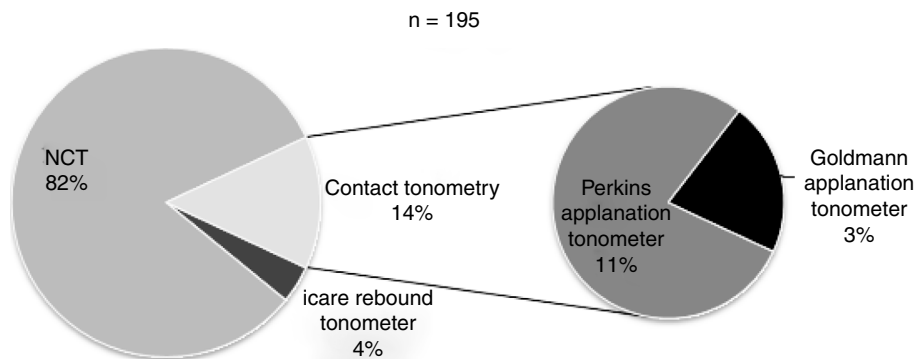
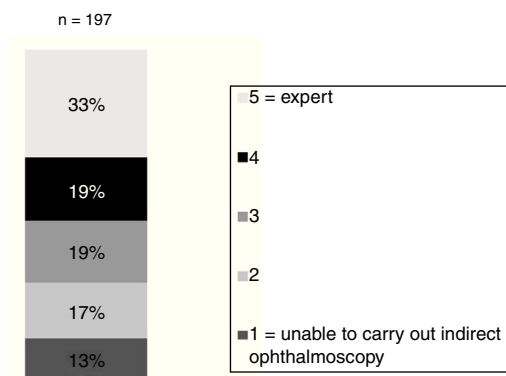
While the majority of optometrists surveyed had some level of competence on SLBIO, direct ophthalmoscopy was the more popular technique for fundus examination. A binomial logistic regression was performed to explore potential determinant factors that might explain fundus examination technique preference. Specifically, the effects of years since registration, time per appointment, country of training [Ireland ($n=126$) vs. UK ($n=27$)], mode of practice [independent practice ($n=120$) vs. franchise or large multiple ($n=33$)], and postgraduate qualifications [yes ($n=19$) vs. no ($n=134$)], on the likelihood that participants use direct ophthalmoscopy or SLBIO. The total n for this model was 153: in this analysis, those using headset BIO or fundus cameras only were excluded: in some of the variables, mode of practice especially, some data was excluded as roles such as locum optometry could not be accurately categorised into a specific practice type. Linearity of the continuous variables with respect to the logit of the dependent variable was assessed via the Box-Tidwell (1962) procedure. A Bonferroni correction was applied using all eight terms in the model resulting in statistical significance being accepted when $p < .00625$. Based on this assessment, both continuous independent variables were found to be linearly related to the logit of the dependent variable. There were three studentised residuals with values of 2.212, 4.628, and -2.965 standard deviations, which were kept in the analysis.¹

The logistic regression model was statistically significant, $\chi^2(5) = 48.577$, $p < .0005$. The model explained 37.8% (Nagelkerke R^2) of the variance in ophthalmoscopy techniques and correctly classified 77.1% of cases. Of the five predictor variables, years since qualification and postgraduate education were statistically significant (Table 3). More time since qualification was associated with an increased

¹ The regression was repeated after these three outliers were removed from the analysis. The same independent variables, years since registration and postgraduate qualifications, remained significant and there was no change to the significance of the other three variables in the model.

Table 2 Tonometry availability according to optometrists' mode of practice.

	NCT only <i>n</i> (%)	Contact applanation tonometry only <i>n</i> (%)	Both <i>n</i> (%)	χ^2 <i>p</i> NCT vs contact applanation or both
Independent practice (<i>n</i> = 129)	63 (48.8%)	14 (10.9%)	52 (40.3%)	<i>p</i> = 0.058
Franchised practice or large multiple (<i>n</i> = 36)	24 (66.7%)	0 (0%)	12 (33.3%)	

**Figure 2** First choice tonometer for routine intraocular pressure screening in community optometry.**Figure 3** Optometrists' reported competence in slit lamp BIO ranked on a scale of 1–5.

likelihood of using direct ophthalmoscopy. Notably, those with postgraduate qualifications were close to 12 times more likely to use SLBIO relative to those without.

Some of the cases in the 'mode of practice' category were excluded from the model as some roles, such as locum optometry could not be adequately categorised to a practice type and others, such as academic optometry, had very small numbers which is not ideal for regression modelling. Removing this variable, which was not a significant predictor of ophthalmoscopy technique choice, gave us 27 extra cases that could be included in the regression model bringing the total number of cases to *n* = 180. The logistic regression was then repeated to see if the extra cases changed the significance level of any of the other independent variables: years since registration, time per appointment, country of training [Ireland (*n* = 150) vs. UK (*n* = 30)], and postgraduate qualifications [yes (*n* = 27) vs. no (*n* = 153)]. This showed that years since registration and postgraduate qualifications were both

still significant at the *p* < 0.0005 level and the remaining variables were not significant predictors of ophthalmoscopy technique.

Investigative equipment

87% of respondents had an automated perimeter in practice. Various models of the Henson perimeter (ranging from the 2000 to 8000 model) were the most popular make (48%). 1.4% of those with perimeters used a Humphrey Visual Field Analyser. Most respondents listed just the brand name of the perimeter they had available in practice, omitting the exact model details so it is unclear exactly which instruments are most commonly used but it appears that the majority of the perimeters listed are capable of carrying out full threshold test strategies which are required for appropriate glaucoma diagnosis or monitoring.

The availability of other more specialist investigative equipment is given in Table 4.

Attitudes to an enhanced scope of practice

Just 4 participants (2.1%) indicated that they 'have no interest in changing the scope of the traditional eye examination', the remainder indicated varied levels of interest in expanding their scope of practice for glaucoma detection and/or monitoring ranging from a simple repeat measures service to independent medical management of glaucoma (Fig. 4).

A follow up question asked optometrists if they considered postgraduate education an essential pre-requisite to providing these enhanced scope services. Of the 196 respondents who completed this question, 57% considered postgraduate education an essential prerequisite to providing a repeat measures service or for monitoring glaucoma suspects, 60% deemed postgraduate education an essential

Table 3 Logistic regression predicting the likelihood of direct ophthalmoscopy use vs. indirect ophthalmoscopy use based on years since qualification as an optometrist (years), postgraduate qualifications within optometry, country of undergraduate training (Ireland compared to the UK), mode of practice (independent practice vs. franchise or large multiple), and appointment slot in minutes. Statistically significant variables are highlighted in grey.

	B	SE	Wald	df	p	Odds ratio	95% CI for odds ratio	
							Lower	Upper
Years	−0.114	.025	20.742	1	<0.0005	1.12	1.07	1.18
Postgraduate qualification	−2.456	0.662	13.785	1	<0.0005	11.63	3.19	43.48
Country of training	−0.234	0.514	0.207	1	0.649	1.26	0.47	3.46
Mode of practice	0.512	0.593	0.746	1	0.388	1.67	0.52	5.34
Appointment slot	0.057	1.230	1.616	1	0.116	1.06	0.99	1.14
Constant	1.564	1.230	1.616	1	0.204	4.78		

Table 4 Relative frequency of the availability of specialist equipment in community optometric practice.

	n = 199
Fundus camera	79%
Digital slit lamp camera	12%
Optical coherence tomography	11%
Gonioscopy lens	7%
Pachymeter	5%

prerequisite to optometric monitoring of stable glaucoma patients, and 92% considered postgraduate education an essential prerequisite to optometric management of the medical treatment for patients with glaucoma.

There was also a high level of interest in other forms of enhanced scope practice. This included 68% of respondents who indicated an interest in shared care schemes for diabetic retinopathy patients, while 67% were interested in providing pre/post-operative cataract services, 61% were willing to become involved in shared care schemes for age related macular degeneration (AMD) patients, 47% indicated interest in expanding their role in paediatric services, 45% were interested in taking up hospital optometry

positions, and 42% indicated an interest in independent prescribing by optometrists. Just 6% of respondents filled in a free text box allowing for other suggestions for enhanced optometry services. Suggestions included; low vision services, red eye triage and foreign body removal, sports vision assessment, keratoconus management, colorimetry, binocular vision therapy, hospital based advanced contact lens clinics, and clinical management of dry eye.

Discussion

The results show that Irish optometrists are well equipped to perform the traditional triad of tests necessary to detect glaucoma, with 87% of practitioners reporting access to all three clinical techniques (tonometry, optic nerve assessment, and standard automated perimetry), and a large proportion of optometrists reporting access to contact tonometry equipment (47%). This demonstrates that optometrists are well equipped for glaucoma case finding services but implementation of enhanced referral services, such as a repeat measures scheme, would require equipment upgrades and associated training in at least half of the surveyed practices.

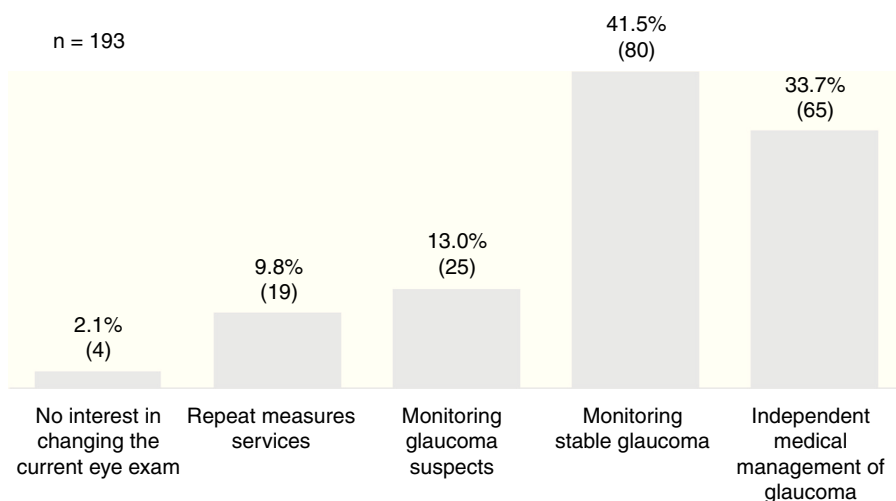


Figure 4 Optometrists' interest in new, enhanced practice roles for glaucoma detection and management, % (n).

Tonometry

NCT is, by far, the current first choice for IOP measurement during routine eye examinations, a finding consistent with previous clinical practice surveys carried out in Great Britain^{9,12} and Northern Ireland.¹³ There has been speculation that the ability to delegate non-contact tonometry to non-professional staff may contribute to its popularity relative to contact techniques.⁹ Our survey has found that NCT use is high even among those optometrists that do not delegate IOP measurement, and have ready access to contact tonometry, the accepted reference standard. Other potential barriers to performing contact tonometry, such as a need for training, the recurring cost of topical anaesthetic, a perception that contact tonometry is more time consuming than NCT, or that NCT is a lower risk procedure, may be at play.

In 2006, a new General Ophthalmic Services (GOS) contract was introduced in Scotland. The new contract required optometrists to demonstrate competence in Goldmann applanation tonometry (GAT) before they could be accredited to practice in Scotland, and paid a supplementary fee to perform the test.¹⁴ The inclusion of contact tonometry results went from 11.8% prior to the new contract to 50% following the introduction of the new contract and funding, demonstrating that training and finance barriers can be overcome, though it is notable that GAT was still the most common examination missing from optometric glaucoma referrals.¹⁴

Achieving a culture shift in IOP measurement in optometry practices might require a combination of strategies, including policy and funding changes, as seen in Scotland, as well as changes in education and training of optometrists. There might be a perception among optometrists that NCT is equivalent to GAT in terms of accuracy of IOP measurement: while non-contact tonometers have been shown to have high levels of agreement with GAT,¹⁵ users should be aware that the calibration of most NCTs is not based on absolute (manometric) measures of IOP but against the established reference standard, i.e. Goldmann applanation tonometry. Thus, NCTs calibrated in this way cannot exceed the accuracy attainable with the reference standard. It has been shown in fact, that there is an overestimation of IOP by NCT relative to GAT at higher IOP levels,¹⁶ and that NCT is significantly more susceptible to the effects of central corneal thickness than GAT,¹⁷ factors that are particularly relevant in glaucoma diagnosis and management. This evidence shows that contact techniques have clear advantages over NCTs, that optometrists should be encouraged to use contact techniques preferentially, especially when IOP or central corneal thickness are high, and that any practitioners wishing to progress from glaucoma case finding towards diagnostic services such as monitoring glaucoma suspects or patients with ocular hypertension, should be required to use contact tonometry.

Fundus examination

The majority of those surveyed reported some level of proficiency with SLBIO though monocular direct ophthalmoscopy remains the most popular technique for fundus examination during routine eye exams. Indirect ophthalmoscopy has a

number of advantages over direct techniques, two of which are particularly relevant to glaucoma detection: it provides a stereoscopic view of the optic nerve head, allowing for more accurate interpretation of cupping of the nerve, and the magnification of the image is not significantly affected by the patient's refractive error, allowing the size of the optic nerve head to be measured with a simple calculation. In a separate review of Irish optometrists' referral letters for suspect glaucoma (unpublished data set), there was an almost complete lack of disc size measurements, an essential factor in discerning the relevance of cup-disc ratio values, which may be due to reliance on direct ophthalmoscopy.

Binomial logistic regression showed that those with postgraduate qualifications were much more likely to use indirect rather than direct ophthalmoscopy and that more recently qualified optometrists were also more likely to use SLBIO as their first choice technique (Table 3).

This shows that more recent participation in education is relevant in terms of likelihood of SLBIO use. However, more recently qualified optometrists have also been shown to be more likely to refer false positively,¹⁸ indicating that ophthalmoscopy technique alone does not predict accuracy in glaucoma detection.

Perhaps the more accurate appreciation of the optic nerve contour that is facilitated by SLBIO creates a more sensitive screening test. This sensitive screening could produce a high volume of false positive referrals when applied to the population attending optometric practices where the proportion of true glaucoma is typically low.¹⁹ As SLBIO is now a core competency required of undergraduate optometry students in Ireland, it is likely that its use will become more commonplace over time. Future work could assess the impact this may have on false positive referrals to ophthalmology services.

Perimetry

Automated perimeters were shown to be widely available (87%) though this still lags behind UK estimates which have shown that virtually all optometrists (>95%)⁹ have access to automated perimetry. The reasons for this difference are unclear. The Association of Optometrists Ireland (AOI) recommend a visual field examination is conducted on any patient deemed to be at risk of glaucoma,⁷ but some Irish optometrists might consider automated perimetry to be beyond their traditional screening role, preferring to refer any glaucoma suspect findings rather than investigating for visual field loss.

One could argue that referring patients on the basis of inadequate screening tests such as isolated tonometry or ophthalmoscopy findings represents poor professional performance, potentially causing unnecessary psychological stress to patients²⁰ as well as wasting time and resources in secondary care. However, at the time of this survey, State funding for optometric eye examinations was limited to a once off payment per exam. Therefore, some practitioners may have felt that performing automated perimetry, a relatively time consuming diagnostic investigation, was outside the scope of a traditional optometric eye exam.

Recent contract negotiations in Ireland have resulted in increased funding for supplementary diagnostic testing within optometric practice. This could impact the use of perimetry by Irish optometrists. Future work should look to assess the use of perimetry within this new funding structure.

Development of a standardised approach to visual field testing could also become important in relation to the new fitness to practice complaints procedures²¹ being implemented by optometry's regulatory body in Ireland, where professional performance is assessed in relation to the perceived practice norms and failure to conduct a visual field examination in a glaucoma suspect could be considered sub-standard practice.

Advanced diagnostics

The availability of specialist equipment broadly follows trends which have been reported in the UK.^{9,22} It is notable that some Irish optometry practices are willing to invest in advanced diagnostic equipment despite the lack of state funding for enhanced services, and restrictive legislation which, until recently, tightly controlled optometrists' scope of practice, requiring that any patient found suspect for pathology should be informed and referred to a medical practitioner.²³ This legislation was abolished in October 2015 and replaced with a broader definition of scope of practice, indicating that optometrists can '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'.²⁴ Within this framework, there is clear scope for optometrists, with the appropriate skills and equipment, to become more involved in the diagnosis, monitoring and management of ocular pathology. It appears that enhanced case-finding could be easily implemented in those few practices with ready access to contact tonometry, pachymetry and gonioscopy for example, but the majority of optometrists would require equipment upgrades and corresponding training to carry out more detailed diagnostic testing for glaucoma.

Enhanced scope of practice

The overwhelming majority of participants indicated some interest in broadening their scope of practice in glaucoma care. With an established base of practices dispersed across the country, optometrists are well placed to redirect some eye care services away from acute hospitals, though there was also a high level of interest in hospital optometry positions. Under the UK's National Health Service (NHS), a number of innovative care pathways have emerged such as repeat measures,²⁵ referral refinement,²⁶ and optometry-led hospital-based glaucoma assessment clinics²⁷ for example, which involve optometrists in the co-management of glaucoma and have proven an effective strategy in dealing with increasing patient numbers.

The majority of respondents considered postgraduate education an essential prerequisite to enhanced scope of practice. Current professional development opportunities in Ireland are mainly in the form of short lectures or workshops, often sponsored by companies or private

ophthalmology clinics as a means to generate business rather than target specific training needs within the profession. The Dublin Institute of Technology (DIT), the only optometry programme within the Republic of Ireland, offer various postgraduate research opportunities for optometrists but just one level 9 clinical module which was launched in January 2017. It is clear that new, more targeted training opportunities will be an important facilitator of enhanced optometric services.

Irish optometrists can partake in distance learning opportunities offered in many universities across the UK, but clinical experience in these modules is necessarily limited. A number of studies have shown that didactic teaching alone is unlikely to lead to significant improvements in clinical competence²⁸ and that longer term training, including ophthalmology feedback on referred patients, may be essential to improving the positive predictive values (PPV) of optometric glaucoma referrals.²⁹ Involving ophthalmologists in training and appraising optometrists in enhanced scope roles would provide expert feedback on performance and referrals which would serve to better align practice patterns between hospital and community. In order to provide this form of training, optometrists could be included in multidisciplinary ophthalmology teams, where apprenticeship style training can be integrated into work practices and optometrists will be exposed to a range and volume of pathology that is not seen in most traditional optometric practices, further developing the depth of expertise within the optometry profession.

Limitations

The results reflect the current trends in Irish optometry practices, so the findings may not be generalisable across other jurisdictions. However, information on the development of Irish optometry is of interest in a European context where demographic change owing to an ageing population is prompting a re-evaluation of primary eye care delivery models.³⁰ Optometric practice patterns across Europe vary widely, though it appears that a decline in the numbers of ophthalmologists³¹ is resulting in a transfer of many primary care responsibilities to optometrists and opticians.³²

This survey may have underestimated optometrists' use of contact tonometry techniques as the questions regarding tonometry use related to first choice screening technique during routine eye exams. It is possible that some optometrists use contact tonometry to repeat IOP measurements when individuals are found suspect for glaucoma or NCT readings are high, though evidence from a further analysis of optometric referrals for suspect glaucoma (unpublished dataset) found a very low rate of contact tonometry use: just 5% of the IOP measures recorded on the referral letters ($n=215$) were taken using contact tonometry.

The survey also failed to assess the use of pupillary dilation in glaucoma detection. For accurate evidence regarding the use of discretionary, supplemental diagnostic investigations such a pupillary dilation, a standardised patient (SP) methodology might be appropriate. A study by Theodossiadis *et al.* found that self-reported clinical practice questionnaires overestimate routine tests undertaken by

optometrists in practice, and while a survey of optometrists showed good correspondence to the SP reports for mandatory tests such as ophthalmoscopy, correspondence was poor for discretionary tests.³³ These findings indicate that accurate assessment of the use of more advanced clinical investigative techniques might not be possible with surveys alone.

It is also possible that survey bias impacted the results, particularly in relation to attitudes towards enhanced scope of practice as those with most interest in glaucoma detection were most likely to respond to a survey titled 'detecting glaucoma in optometric practice'. Nonetheless, it is notable that at least a quarter of all optometrists in Ireland are expressing interest in enhanced optometric services for glaucoma detection and management.

Furthermore, this survey appears to underrepresent optometrists working in large multiples or franchised practices. Future work should seek to engage more directly with this cohort of optometrists.

Conclusion

Irish optometrists are well equipped with the traditional tests used in glaucoma detection. However, implementation of enhanced referral schemes or glaucoma monitoring or management services would require equipment upgrades and associated training in at least half of the surveyed practices. There is strong interest in furthering optometric professional development and expanding the traditional role boundaries of optometrists, incorporating further education as an essential prerequisite to an enhanced scope of practice.

Conflicts of interest

The authors report no conflicts of interest and have no proprietary interest in any of the materials mentioned in this article.

Acknowledgements

This work was supported by research funding from the Association of Optometrists Ireland. Special thanks to Claire McDonnell for lending her expertise on question construction.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.optom.2018.02.004>.

References

1. Resnikoff S, Pascolini D, Etya'ale D, Kocur I, Pararajasegaram R, Pokharel GP, et al. Policy and practice. *Bull World Health Organ*. 2004;82:844–851.
2. Quigley HA, Broman AT. The number of people with glaucoma worldwide in 2010 and 2020. *Br J Ophthalmol*. 2006;90:262–267.
3. Burr JM, Mowatt G, Hernández R, Siddiqui MAR, Cook J, Lourenco T, et al. The clinical effectiveness and cost-effectiveness of screening for open angle glaucoma: a systematic review and economic evaluation. *Health Technol Assess (Rockv)*. 2007;11, iii–iv, ix–x, 1–190.
4. Mowatt G, Burr JM, Cook JA, Rehman Siddiqui MA, Ramsay C, Fraser C, et al. Screening tests for detecting open-angle glaucoma: systematic review and meta-analysis. *Investig Ophthalmol Vis Sci*. 2008;49:5373–5385.
5. Bowling B, Chen SDM, Salmon JF. Outcomes of referrals by community optometrists to a hospital glaucoma service. *Br J Ophthalmol*. 2005;89:1102–1104.
6. Association of Optometrists Ireland. *Guidelines for Members regarding performance of eye examinations*; 2009 <http://www.aoi.ie/system/files/attachments/EyeExaminationGuidelinesAug09.pdf> [accessed 04.11.17].
7. Agreement between Health Boards. *Optometrists and dispensing opticians for the provision of spectacles and contact lenses*; 1999 <http://www.aoi.ie/system/files/attachments/HSEContract.pdf> [accessed 04.11.17].
8. *History of the Association of Optometrists Ireland*; 2017 <http://www.optometrists.ie/about-the-aoi/history-of-the-aoi> [accessed 04.11.17].
9. Myint J, Edgar DF, Kotecha A, Murdoch IE, Lawrenson JG. A national survey of diagnostic tests reported by UK community optometrists for the detection of chronic open angle glaucoma. *Ophthalmic Physiol Opt*. 2011;31:353–359.
10. Myint J, Edgar DF, Kotecha A, Murdoch IE, Lawrenson JG. Barriers perceived by UK-based community optometrists to the detection of primary open angle glaucoma. *Ophthalmic Physiol Opt*. 2010;30:847–853.
11. Barrett C, O'Brien C, Butler JS, Loughman J. Barriers to glaucoma case finding as perceived by optometrists in Ireland. *Clin Exp Optom*. 2018;101:90–99.
12. Tuck MW. Referrals for suspected glaucoma: an International Glaucoma Association survey. *Ophthalmic Physiol Opt*. 1991;11:22–26.
13. Willis CE, Rankin SJA, Jackson AJ. Clinical survey glaucoma in optometric practice: a survey of optometrists. *Ophthalmic Physiol Opt*. 2000;20:70–75.
14. Ang GS, Ng WS, Azuara-Blanco A. The influence of the new general ophthalmic services (GOS) contract in optometrist referrals for glaucoma in Scotland. *Eye (Lond)*. 2009;23:351–355.
15. Cook JA, Botello AP, Elders A, Fathi Ali A, Azuara-Blanco A, Fraser C, et al. Systematic review of the agreement of tonometers with Goldmann applanation tonometry. *Ophthalmology*. 2012;119:1552–1557.
16. Tonnu P, Ho T, Newson T, El Sheikh A, Sharma K, White E, et al. The influence of central corneal thickness and age on intraocular pressure measured by pneumotometry, non-contact tonometry, the Tono-Pen XL, and Goldmann applanation tonometry. *Br J Ophthalmol*. 2005;89:851–854.
17. Matsumoto T, Makino H, Uozato H, Saishin M, Miyamoto S. The influence of corneal thickness and curvature on the difference between intraocular pressure measurements obtained with a non-contact tonometer and those with a goldmann applanation tonometer. *Jpn J Ophthalmol*. 2000;44:691.
18. Davey CJ, Scally AJ, Green C, Mitchell ES, Elliott DB. Factors influencing accuracy of referral and the likelihood of false positive referral by optometrists in Bradford, United Kingdom. *J Optom*. 2016;9:158–165.
19. Harper R, Henson D, Reeves BC. Appraising evaluations of screening/diagnostic tests: the importance of the study populations. *Br J Ophthalmol*. 2000;84:1198–1202.
20. Davey CJ, Harley C, Elliott DB. Levels of state and trait anxiety in patients referred to ophthalmology by primary care clinicians: a cross sectional study. *PLoS ONE*. 2013;8.

21. CORU. *Guide to fitness to practise*; 2017 http://www.coru.ie/en/public/guide_to_fitness_to_practise [accessed 03.08.17].
22. Dabasia PL, Edgar DF, Murdoch IE, Lawrenson JG. Noncontact screening methods for the detection of narrow anterior chamber angles. *Investig Ophthalmol Vis Sci*. 2015;56:3929–3935.
23. *Opticians Amendment Act 2003*; 2016 <http://www.irishstatutebook.ie/eli/2003/act/22/section/12/enacted/en/html#sec12> [accessed 27.07.16].
24. *Health (Miscellaneous Provisions) Act 2015*; 2017 <http://www.irishstatutebook.ie/eli/2014/act/33/enacted/en/html> [accessed 04.11.17].
25. Parkins DJ, Edgar DF. Comparison of the effectiveness of two enhanced glaucoma referral schemes. *Ophthalmic Physiol Opt*. 2011;31:343–352.
26. Ratnarajan G, Newsom W, Vernon SA, Fenerty C, Henson D, Spencer F, et al. The effectiveness of schemes that refine referrals between primary and secondary care – the UK experience with glaucoma referrals: the Health Innovation & Education Cluster (HIEC) Glaucoma Pathways Project. *BMJ Open*. 2013;3:1–8.
27. Chawla A, Patel I, Yuen C, Fenerty C. Patterns of adherence to NICE Glaucoma Guidance in two different service delivery models. *Eye*. 2012;26:1412–1417.
28. Myint J, Edgar DF, Murdoch IE, Lawrenson JG. The impact of postgraduate training on UK optometrists' clinical decision-making in glaucoma. *Ophthalmic Physiol Opt*. 2014;34:376–384.
29. Roberts HW, Rughani K, Syam P, Dhingra S, Ramirez-Florez S. The Peterborough Scheme for community specialist optometrists in glaucoma: results of 4 years of a two-tiered community-based assessment and follow-up service. *Curr Eye Res*. 2015;40:690–696.
30. Thomas D, Weegan L, Walendzik A, Wasem J, Jahn R. *Comparative analysis of delivery of primary eye care in three European countries*; 2011 <http://www.ecoo.info/archive/studies-and-reports/> [accessed 04.11.17].
31. Resnikoff S, Felch W, Gauthier T, Spivey B. The number of ophthalmologists in practice and training worldwide: a growing gap despite more than 200 000 practitioners. *Br J Ophthalmol*. 2012;96:783–788.
32. The European Council of Optometry and Optics. *ECOO Blue Book Data on optometry and optics in Europe*; 2017 <http://www.ecoo.info/wp-content/uploads/2017/05/ECOO-Blue-Book-2017.pdf> [accessed 01.11.17].
33. Theodossiades J, Myint J, Murdoch IE, Edgar DF, Lawrenson JG. Does optometrists' self-reported practice in glaucoma detection predict actual practice as determined by standardised patients? *Ophthalmic Physiol Opt*. 2012;32:234–241.