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Full title: A comparison of the self-reported dry eye practices of New Zealand optometrists and ophthalmologists

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Abstract

Purpose: The aim of this cross-sectional survey was to evaluate the self-reported clinical practices of New Zealand optometrists and ophthalmologists with respect to the diagnosis and management of dry eye disease. It also sought to compare these behaviours with the current research evidence base.

Methods: An anonymous survey was distributed electronically to New Zealand eye care clinicians (optometrists n=614, ophthalmologists n=113) to determine practitioner interest in dry eye disease, practice experience, practice modality, preferred diagnostic and management strategies, and information used to guide patient care.

Results: Respondents from both professions (response rates, optometrists: 26%, ophthalmologists: 26%) demonstrated similarly strong knowledge of tear film assessment. Ninety percent of respondents ranked patient symptoms and meibomian gland evaluation as the most valuable and common diagnostic approaches. Conversely, standardised grading scales and validated dry eye questionnaires were infrequently adopted. Both professions tailored dry eye management according to severity, indicating eyelid hygiene and non-preserved lubricants as mainstay therapies. Ophthalmologists prescribed systemic tetracyclines significantly more than optometrists for moderate (48% vs. 11%) and severe (72% vs. 32%) dry eye (p<0.05). Continuing education conferences were acknowledged as the primary information source used to guide dry eye management practices by both professions.

Conclusions: Consistent with evidence-based guidelines, New Zealand eye care professionals combine subjective and objective techniques to diagnose and stratify dry eye management according to disease severity. There is potential to improve dissemination of research evidence into clinical practice, with continuing education via professional conferences the favoured mode of delivery.

Introduction

Dry eye disease (DED) is defined by the International Dry Eye Workshop as “a multifactorial disease of the tears and the ocular surface that results in symptoms of discomfort, visual disturbance, and tear film instability with potential damage to the ocular surface.”[1] The condition affects up to 35% of the population in some regions,[2]

and symptoms, such as fluctuating vision and ocular surface pain, can severely impact quality of life.[3,4]

The challenge faced by eye care providers is that DED diagnosis and management is complicated by variability in the signs and symptoms of the disease, as well as the often poor association between clinical manifestations and patient symptomology.[5,6] Without universal consensus for a "gold standard" diagnostic test,[7] there is considerable variation in self-reported clinical care strategies among optometrists and ophthalmologists.[8-13] Previous studies have demonstrated that many practitioners rank patient symptoms as their primary diagnostic and management indicator for DED, however this is typically undertaken without standardised questioning.[8,9,11-14] Preferences for specific clinical procedures are anecdotally recognised to differ depending on practitioners' profession and demographics. Only one published study has reviewed optometric practices relating to the stratification of treatment according to DED severity, as well as considering the source or quality of scientific evidence that drives respondents' clinical judgments.[13]

The primary objective of this study was to evaluate the self-reported diagnostic and management protocols of New Zealand (NZ) optometrists and ophthalmologists for DED. The adherence of respondents' clinical behaviour was compared with current evidence-based guidelines, as informed by the International Dry Eye Workshop [7,15,16] and the International Workshop on Meibomian Gland Dysfunction (MGD).[3,17] A secondary aim of the study was to explore the potential influence of practice demographics, clinical experience and self-perceived interest in DED and, for optometrists, the influence of therapeutic endorsement status, on diagnostic and management practices.

Methods

Participants and survey design

This project followed the tenets of the Declaration of Helsinki and was approved by the University of Auckland Human Research Ethics Committee (Ref. 9648). Only completed surveys were included in analyses.

An anonymous online survey, hosted by Qualtrics, was emailed to 614 registered optometrists, via the New Zealand Association of Optometrists, the Cornea and

Contact Lens Society of New Zealand, and Specsavers Optometrists (NZ); and to 113 ophthalmologists, via the Royal Australian New Zealand College of Ophthalmologists (RANZCO), Auckland District Health Board, and Counties Manukau District Health Board. A total of 20 questions was presented, in sequence, without the option to review or alter preceding answers. The survey, which was adapted from that described by Downie *et al.*[13] and pilot-tested by the authors, surveyed four primary aspects of DED practice: 1) practitioner demographics, practice modality, specialisation, tear film knowledge and frequency of undertaking tear film evaluations; 2) diagnostic procedures; 3) treatment strategies, patient review frequency and perceived management success; 4) information and evidence sources underlying these self-reported clinical behaviours. Table 1 summarises the questions surveyed. Participants were classified as knowledgeable of tear film evaluation concepts if they provided a correct response to two questions relating to diagnostic tests for tear volume and tear film quality/stability assessment.

Data analyses

Statistical analyses were performed using IBM SPSS Statistics (Version 23, SPSS, USA, http://www-01.ibm.com/software/analytics/spss/) and GraphPad Prism (Version 6.0 for Windows, GraphPad Software Inc., USA, http://www.graphpad.com/scientific-software/prism/). Data were tested for normality with the Kolmogorov-Smirnov test. Non-parametric distributions were compared with the Mann-Whitney test and parametric distributions with unpaired *t* tests. Descriptive statistics were employed to analyse the conduct frequency of preferred diagnostic procedures, basic knowledge of tear film evaluation, treatment and referral patterns and demographic information. The Fisher's exact test allowed comparison of data consisting of proportions of respondents. The association between the number of diagnostic procedures performed and both years of practice experience and the presence or absence of a self-declared interest in DED were explored with Spearman's rho test of correlation. A *p* value of 0.05 or less was considered significant. For multiple comparisons, Bonferroni correction was applied to the *p* value as appropriate.

Results

In total, 174 optometrists (response rate: 26%) and 29 ophthalmologists (response rate: 26%) submitted completed surveys, over a two-week period beginning in May 2015.

Practitioner demographics

A range of optometric experience was evident (*Table 2*), with the period since initial registration ranging from six months to 47 years. Optometrist respondents practised in all regions of NZ, except Marlborough, with most in urban areas (86%) and the remainder in independent or satellite urban areas, as defined by the NZ Census Urban/Rural Classification System (2001, 2006).[18] Approximately two-thirds of optometrist respondents worked in group practices, with 68% in independent optometry, 21% in corporate practice, 6% as locums and the remainder in academia, hospital or other settings. The majority (71%) were qualified to prescribe scheduled ocular therapeutic medicines.

Similarly, ophthalmologist respondents reported varying degrees of clinical experience (*Table 2*), but overall had significantly greater years of clinical experience relative to optometrist counterparts (p=0.028). Most ophthalmologists (96%) indicated practicing in major urban areas and the remainder in independent urban communities. The majority (86%) worked in group practices, and on average the respondents devoted 65% of their time to independent practice, 32% to hospital, and 3% to academic practice. Ophthalmic field subspecialisation was specified by 76% of respondents, with the remainder reporting practice as a general ophthalmologist; 34% of respondents considered themselves subspecialists in cornea and external eye diseases, 17% in oculoplastics, and 28% in refractive surgery.

Patient demographics

Table 3 summarises the percentage estimates, for both professions, of patients presenting with aqueous deficient dry eye, anterior blepharitis and meibomian gland dysfunction (MGD). MGD was deemed the most frequent dry eye subtype, while aqueous deficient dry eye was considered least common. Overlap in estimation was allowed to account for patients diagnosed with multiple dry eye subtypes.

Practitioner clinical expertise and knowledge in DED

Self-declared interest in DED was indicated by 67% of optometrists and 59% of ophthalmologists. Most respondents (83% optometrists and 83% ophthalmologists) correctly listed techniques that could be used clinically to assess tear volume and stability. For tear volume, the procedures considered appropriate were Schirmer test

(47% optometrists and 77% ophthalmologists), tear meniscus height (37% optometrists and 4% ophthalmologists) and phenol red thread test (16% optometrists and 19% ophthalmologists). For tear stability, accepted techniques were tear break-up time (TBUT) (89% optometrists and 92% ophthalmologists), the Tearscope™ (Keeler, UK) (4% optometrists and 4% ophthalmologists), quality of Placido-disc corneal topography mires (3% optometrists), interferometry (3% optometrists) and Keratograph (Oculus, Germany) (1% optometrists and 4% ophthalmologists). A self-declared interest in DED was not found to correlate with tear film knowledge, tear film assessment frequency or years of clinical experience (p>0.05 for all comparisons).

Dry eye diagnosis

Table 4 summarises the clinical procedures that practitioners ranked from first to third most important for diagnosing DED. Overall, responses from optometrists and ophthalmologists were similar; both professions considered patient symptoms to be highly valuable. However, more optometrists (28%) rated meibomian gland evaluation as second most important than did ophthalmologists (7%), and more ophthalmologists (31%) ranked clinical impression of corneal fluorescein staining as second most important compared to optometrists (13%).

The quantity of clinical tests practitioners reported using for routine DED diagnosis is presented in *Figure 1*. Most practitioners (79% of optometrists and 69% ophthalmologists) selected six or more techniques within any single DED assessment; the minimum number of procedures nominated by any practitioner was three. There was no statistically significant difference in the number of tests performed between the professions (p=0.47). A positive correlation was found between the use of more diagnostic techniques and a self-reported clinical interest in DED for ophthalmologists (r=0.47, p=0.01 0).

Figure 2 highlights the variety of procedures practitioners indicated using routinely for DED diagnosis. Almost all practitioners selected patient symptoms, meibomian gland evaluation and fluorescein-assisted TBUT. However standardised symptom assessment was not consistently employed, with less than 5% of optometrists and only 7% of ophthalmologists using validated Dry Eye Questionnaires (DEQs). In addition, over 70% of practitioners evaluated corneal fluorescein staining based on clinical impression but only 40% of optometrists and 7% of ophthalmologists specified using a

standardised grading scale. Optometrists reported using lid parallel conjunctival fold assessment more frequently than ophthalmologists, while the converse was evident for the Schirmer II test. Tear meniscus height (TMH) was the most frequently selected method for assessing tear volume. Optometrists with a self-declared interest in DED were more likely to use the phenol red thread test (15% versus 5%, p=0.047) and the McMonnies DEQ (6% versus 0%, p=0.048) than those without a specific interest.

Perceived value of dry eye diagnostic techniques was consistent with the procedures most commonly performed (*Figure 3*). Both groups of clinicians deemed patient symptoms, meibomian gland evaluation, corneal and conjunctival fluorescein staining, and fluorescein assisted TBUT as the most valuable. The least useful procedures, as rated by optometrists, were tear film pH, Schirmer II test, non-validated DEQs and tear osmolarity. Ophthalmologists showed similar preferences except for the Schirmer II test, which was rated much more positively compared to optometrists (p<0.0010). Respondents from both groups typically assessed dry eye severity according to "clinical impression" (46% optometrists and 53% ophthalmologists), while others reported reliance on corneal fluorescein staining (23% optometrists and 18% ophthalmologists) and symptom assessment (18% optometrists and 24% ophthalmologists) in judging severity.

Dry eye management

The self-reported management strategies used by practitioners for mild, moderate and severe DED are summarised in *Figure 4*. The Bonferroni correction was applied when the selection of management strategies for mild, moderate and severe dry eye was compared due to there being three possible comparison combinations (mild vs. moderate, moderate vs. severe, severe vs. mild). The adjusted alpha was thus set at 0.0167 (0.05 / 3) for statistical significance during these specific analyses.

For mild DED, the most frequently recommended treatments were non-preserved lubricant eye drops (74% optometrists and 72% ophthalmologists), preserved lubricant eye drops (62% optometrists and 69% ophthalmologists) and eyelid hygiene (74% optometrists and 62% ophthalmologists). No treatment for mild disease was recommended by 12% of optometrists and 7% of ophthalmologists. Ophthalmologists with a self-declared interest in DED more frequently recommended non-preserved lubricant drops than those without (88% versus 50%, p=0.038).

For moderate DED, there was a reduction in the recommendation for preserved lubricant formulations from both professions. Optometrist recommendations shifted towards non-preserved lubricant drops (p=0.0047) and gels (p<0.0010), rather than preserved products. Relative to mild disease, there was increased recommendation of topical ointments (p<0.0010), topical corticosteroids (p<0.0010), topical NSAIDs (p=0.015), oral tetracyclines (p<0.0010), omega-3 fatty acid supplementation (p<0.0010), punctal plugs (p<0.0010), eyelid hygiene (p<0.0010) and "other" management strategies (e.g., referral, p=0.0083). Ophthalmologist responses showed more frequent recommendation of non-preserved gels (p=0.0070), topical ointments (p<0.0010), topical corticosteroids (p<0.0010), and systemic tetracyclines (p=0.0096) for moderate DED. Overall, the most common treatments for moderate dry eye were eyelid hygiene (90% optometrists and 76% ophthalmologists), increased dietary omega-3 fatty acid intake (70% optometrists and 48% ophthalmologists), non-preserved lubricant drops (86% optometrists and 86% ophthalmologists) and gels (71% optometrists and 45% ophthalmologists). Recommendation of topical corticosteroid use was more common in optometrists with a self-declared interest in DED, than in those without (16% versus 2%, p=0.0020), as it was for systemic tetracycline use (16% versus 3%, p=0.011).

For severe DED, mainstay treatments, such as eyelid hygiene, non-preserved lubricant drops and gels were maintained. There was also a decrease in the frequency of recommending preserved lubricant drops and gels. Compared with moderate disease, more practitioners from both professions recommended non-preserved gels, topical ointment, cyclosporine-A, topical corticosteroids, systemic tetracyclines, punctal plugs and autologous serum. Optometrists with a self-declared interest in DED indicated using fewer preserved gels (12% versus 22%, p=0.016), more topical corticosteroids (46% versus 27%, p=0.016) and more systemic tetracyclines (39% versus 20%, p=0.012) than non-specialists. Ophthalmologists with a self-declared dry eye interest routinely prescribed more topical corticosteroids (88% versus 42%, p=0.014), cyclosporine-A (59% versus 8%, p=0.0080), systemic azithromycin (47% versus 8%, p=0.043) and autologous serum (59% versus 8%, p=0.0080) than their non-specialist colleagues. The management protocols reported by ophthalmologists tended to be more focussed upon prescription therapeutics than those reported by optometrists. This is notable in moderate and severe DED, where topical corticosteroids, systemic

tetracyclines and systemic azithromycin were prescribed with significantly higher frequency ($p<0.05$ in all cases).

Patient review practices varied according to disease severity. For mild DED, most respondents indicated that they would undertake a review consultation only upon patient request (55% optometrists and 76% ophthalmologists). For moderate DED, 56% of optometrists would review within four weeks, while about one-third of ophthalmologists would still review only upon patient request. Pre-arranged follow-up became more frequent with severe DED, with 57% of optometrist respondents indicating that they would review after one or two weeks and 46% of ophthalmologists after three to four weeks of the initial consultation.

Both professions were asked to rate the perceived success of their dry eye management on a scale from one to ten, for mild, moderate and severe DED. Of the surveyed ophthalmologists, the majority (65%) considered their management of mild DED as at least 'mostly successful' (score of 7 or above); this proportion reduced to 58% and 48% respectively for moderate and severe DED. Most optometrists scored their treatment as at least 'mostly successful' for mild (58%) and moderate (52%) DED. However, for severe disease about half of optometrists rated their management as only 'sometimes successful' or worse (i.e. score of 5 or below).

Theoretical patient scenarios, which were used to assess optometric criteria for tertiary referral (*Figure 5*), indicated that the most commonly referred cases were when surgical intervention might be required, when the dry eye was unresponsive to treatment, or for the prescription of systemic medication. Thirty percent of TPA-accredited optometrists indicated they would never refer for the prescription of a topical medication for dry eye management, while 52% of non-TPA respondents indicated they would always institute tertiary referral.

Sources of educational information and evidence

Figure 6 shows the sources of information selected by practitioners as influential for guiding their current dry eye management approaches. Continuing education conferences were the major information source used by both optometrists (62%) and ophthalmologists (86%). Peer-reviewed journal articles were more often a chosen source of further education for ophthalmologists (50%) than for optometrists (25%).

Discussion

This is the first study to analyse the self-reported clinical practice behaviours of NZ eye care professionals, as related to the diagnosis, quantification and management of DED. The survey achieved a response rate (26%) from both professions, which was considered favourable. The potential for selection bias, is acknowledged, however, whereby survey responders may be more likely to reflect clinicians with a stronger interest in anterior ocular disease and/or continuing education. Overall, respondents demonstrated strong knowledge of tear film evaluation, with 83% of both optometrists and ophthalmologists correctly listing techniques for evaluating tear volume and stability. This level of knowledge is similar to that reported in a recent survey of optometrists in Australia and the United Kingdom,[19] and likely reflects the level of interest in DED further to publication of the Tear Film Ocular Surface Society clinical guidance documents, developed as part of the International Dry Eye Workshop,[7,15] International Workshop on MGD,[20] and International Workshop on Contact Lens Discomfort.[21]

Reflecting the complexity of diagnosis,[7] multiple clinical subjective and objective tests were typically employed by clinicians. Respondents with a self-declared dry eye interest from both professions reported performing a greater number of diagnostic tests and comparatively modern techniques. For example, lid parallel conjunctival fold assessment, which is a valuable screening tool for DED,[22] was performed by 41% of ophthalmologists with a declared dry eye interest compared with only 8% that indicated no such interest. Remarkably, a self-declared interest in DED did not correlate with tear film knowledge, tear film assessment frequency or years of clinical experience ($p>0.05$ for all comparisons). Patient symptom assessment was described as the major diagnostic approach by both professions (*Table 4*), consistent with previous studies,[8,11-14,19] however few respondents indicated using a validated Dry Eye Questionnaire (DEQ) to score symptoms. Possible explanations for this include a concern that DEQs are time-consuming to perform in routine practice, naivety of their advantages over traditional history taking, or lack of awareness of their availability. According to the Dry Eye Workshop Diagnostic Methodology Subcommittee, practitioners should adopt at least one validated DEQ for routine dry eye screening.[7] With regard to ocular surface staining, most practitioners in both professions relied on their “clinical impression” to

assess severity rather than scoring against a standardised grading scale. Validated scales, such as the Oxford scheme,[15,23] are of value for maintaining consistency in recording clinical findings, both longitudinally and between clinicians.[24]

Objective diagnostic techniques favoured by both professions were fluorescein-assisted TBUT and MG evaluation (*Table 4*). Whilst easily and commonly performed, fluorescein TBUT is known to disrupt the tear film.[25,26] Consequently, non-invasive procedures, to examine tear performance in a natural state, are considered preferable.[27,28] Ensuring direct comparability with the previously work of Downie et al.[13] precluded inclusion of diagnostic options such as non-invasive TBUT (NITBUT) and lid wiper epitheliopathy in the current questionnaire. Nevertheless, respondents had the opportunity to state such methods in the 'Other' box, which only a few optometrists (NITBUT: 2%; lid wiper epitheliopathy: 2%; corneal topography mire quality: 2%) and no ophthalmologists indicated in their response. Therefore our findings suggest there is the potential to educate practitioners about the relative merit of such methods. Increased emphasis on MG assessment contrasts with findings from previous studies.[10-12,14] This change in practice may be due to the relatively recent availability of lipid-based artificial tears and/or increased awareness of the outcomes from the Tear Film Ocular Surface Society International Workshop on MGD publication, which recommends assessment of MG function in all patients with a low tear break-up time.[17]

Our results also reveal that few NZ eye care practitioners are adopting tear osmolarity technology. Tear osmolarity has a reported sensitivity of 90% and a specificity of 95% for diagnosing DED.[29] As such, it is currently deemed to be the single best objective measure for DED and can also assist with stratifying disease severity.[30] The poor uptake of osmolarity assessment may be a consequence of equipment and consumables cost, and/or ignorance of its clinical value as an objective diagnostic technique. Instead, approximately half of surveyed practitioners graded dry eye severity using their "clinical intuition". This subjective assessment creates the potential for clinical bias, and may confound detection of clinical improvement when an individual patient's care is shared between multiple clinicians.

One notable difference in diagnostic preference between the professions was the more frequent use of the Schirmer II test by ophthalmologists relative to optometrists (34% versus 1%, $p<0.0010$). Limitations in the utility of the Schirmer test are well

recognised,[31] although it remains useful as a provocative test in confirming lacrimal gland insufficiency. The association of severe aqueous deficiency with systemic autoimmune diseases such as Sjögren's syndrome, which can require complex medical management, might, at least in part, explain the increased tendency for Schirmer test's continued use by ophthalmologist respondents.

In relation to management approaches for mild DED, artificial lubricants and eyelid hygiene were the most frequently prescribed therapies by both professions. Differentiating the ocular consequences of aqueous deficiency from MGD can be challenging in patients with symptomatic dry eye, and can often require simultaneous treatment of both conditions.[3] Although eyelid hygiene is considered a potentially effective therapy, it requires clear instructions from the clinician and ideally a follow-up examination to ensure patient compliance. However, over half of all optometrists and three-quarters of ophthalmologists indicated that they would review a patient with mild DED only upon patient request. This may be due to DED, except in severe expression of the condition, being considered non-sight threatening and management being driven predominantly by patient symptomatology. For moderate and severe DED, non-preserved preparations were increasingly recommended by respondents from both professions. These findings suggest that practitioners recognise the relative importance of prescribing non-preserved ocular formulations for patients with more advanced disease.[15] The prescribing of topical corticosteroids also increased for moderate to severe cases, likely signifying practitioner recognition of inflammation as a key feature of DED.[16] There is evidence to support the application of topical corticosteroids for managing surface inflammation in DED. [3,15,32] However, risks from long-term usage such as intra-ocular pressure elevation and the potentiation of ocular infection limit this therapy to controlling acute inflammatory exacerbations.

At the time of this survey, 63% of current practicing optometrists held a registration that was endorsed by the Optometrist and Dispensing Opticians Board to prescribe scheduled ocular medicines, including topical corticosteroids and non-steroidal anti-inflammatory agents, as well as prescribing rights for oral doxycycline and azithromycin.[33] The percentage of TPA-accredited optometrists was even higher in the sampled population (71%), yet less than 40% of surveyed optometrists indicated that they would prescribe a topical corticosteroid for managing severe DED. In this respect, the practice behaviours of NZ optometrists can be considered more conservative than

Australian optometrists, where data indicate that more than 60% of optometrists would independently prescribe this ocular medication for dry eye.[13] A potential explanation for this apparent difference in practice behaviours might relate to the survey sampling method. Downie *et al.* (2013) specifically surveyed optometrists who were members of the Cornea and Contact Lens Society of Australia, while the present study cast a wider net through New Zealand Association of Optometrists, reaching 92% of the profession. The latter method likely captured a greater diversity of respondents. Reflecting their more established and broader scope of practice, ophthalmologists indicated prescribing systemic tetracycline-derivatives and azithromycin more frequently than optometrists, particularly for severe DED. Their greater years of 'eye-specific' clinical experience (*Table 2*) may have influenced their predisposition to prescribe these antibiotics, which provide anti-inflammatory effects that may attenuate the signs and symptoms of MGD-related DED.[3,34,35] However, it should be noted that while a third of the optometrist respondents had been registered for less than ten years, this group would have qualified with ocular therapeutics as an integral component of their undergraduate degree. Furthermore, oral medicines prescribing rights for optometrists had only recently (July 2014) come into force,[1] and a future study might be expected to show increasing confidence in oral medicine prescribing. A similar trend was evident for increasing recommendations of omega-3 essential fatty acid intake with increasing severity, with almost four out of five practitioners indicating they would recommend this treatment for severe dry eye. Traditionally, enhancing omega-3 essential fatty acid intake has been considered beneficial for improving cardiovascular health and reducing inflammation in rheumatoid arthritis; however, recent epidemiological studies and clinical trials have also reported promising findings in relation to treating DED.[36-38] Further research is required to clarify specific factors such as treatment duration, optimum dosage, and/or possible benefits of adjunct omega-6 essential fatty acid intake,[39] which suggests the potential to improve practitioners' understanding of the evidence base in this area of practice.

Both professions selected continuing education conferences as the main source of information used to guide their management approach. One-quarter of optometrists considered peer-reviewed journal articles as one of their top two influences, compared

[1] It is acknowledged that prescribing rights for optometrists vary widely across the world with the use of topical medications for diagnostic purposes outside the scope of practice in some countries. This latest extension in scope of practice is a significant advancement for NZ optometry, bringing it into line with prescribing rights observed across many States in America.

with nearly half of sampled ophthalmologists. This tendency of NZ optometrists to prefer conference education over primary information sources has been described in other areas of optometric practice,[40,41] and may reflect limited journal access without significant subscription costs for the majority of optometrists in private practice. To ensure that optimum clinical practice standards are maintained, it is therefore essential for the content of continuing education to be consistent with the best available research evidence. A framework for achieving international consistency in the evidence-based education of clinicians for dry eye practice has recently been proposed.[19] As implied by our findings, this model includes the potential to disseminate information relating to current best practice through informative workshop-based delivery, which reviews the fundamental clinical skills that are critical for implementing evidence-based dry eye care.

The present study demonstrates that NZ eye care professionals possess a strong knowledge of tear film assessment. This finding likely mirrors significant, recent international research efforts that have sought to improve the clinical diagnosis and management of DED, with the intention of improving patient outcomes. Eye care practitioners employ both subjective and objective diagnostic tests, and identify the need to stratify their treatment according to disease severity. A lack of uniformity in the use of specific diagnostic and clinical care procedures between the professions was evident from the study. The need for global consensus in relation to dry eye diagnosis and management is being addressed by the Tear Film Ocular Surface Society International Dry Eye Workshop II, which is currently underway and will result in the publication of evidence based, contemporary clinical guidance documents for dry eye. Implementation of the Dry Eye Workshop II outcomes by eye care clinicians, to ensure the appropriate translation of research evidence into practice, will be integral to achieving further gains in the provision of clinical care to dry eye sufferers.

DISCLOSURE

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

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Table Titles:

Table 1. Summary of questions presented in the survey

Table 2. Years of clinical practice experience reported by survey respondents

Table 3. Estimated percentage of patients diagnosed with aqueous deficient dry eye (ADDE), anterior blepharitis and meibomian gland dysfunction (MGD) by respondent optometrists and ophthalmologists

Table 4. Frequency with which optometrists and ophthalmologists rank specific dry eye diagnostic procedures as one of the top three most important tests.

Figure Legends:

Figure 1. Range in number of clinical tests routinely used by optometrists and ophthalmologists for diagnosing DED.

Figure 2. Percentage of respondents (yellow bars - optometrists; blue bars – ophthalmologists) indicating use of specific diagnostic tests in their routine clinical assessment for DED. Asterisks (*) denote statistically significant differences ($p<0.05$) between responses from optometrist and ophthalmologist survey participants.
Key: Clin impress, clinical impression; Conj, conjunctival; DEQ, dry eye questionnaire; Fl, sodium fluorescein; LG, lissamine green; MG, meibomian gland; NaFl, sodium fluorescein; OSDI, ocular surface disease; TBUT, tear breakup time; TMH, tear meniscus height.

Figure 3: Diagnostic tests ranked according to perceived clinical utility by respondents (A: optometrists; B: ophthalmologists) according to the following scale: 1 = never useful or not applicable, 3 = rarely useful, 5 = sometimes useful, 7 = mostly useful, 10 = always useful.

Figure 4. Comparison of dry eye treatment recommendations for A: mild; B: moderate; and C: severe dry eye disease, by optometrists and ophthalmologists
Asterisks (*) indicate statistically significant differences ($p<0.05$) between optometrists and ophthalmologists.
Key: NP, non-preserved; NSAIDs, non-steroidal anti-inflammatory drugs; P, preserved.

Figure 5. Rates of tertiary referral from optometrists for each of the listed patient scenarios according to the following scale: 1 = never refer, 3 = rarely refer, 5 = sometimes refer, 7 = mostly refer, 10 = always refer.

Figure 6. Relative preference of the various information sources used to guide dry eye management for the optometrists and ophthalmologists surveyed. N.B. only sources of information with a response rate ≥ 5% are displayed.

OPO-OA-2039 R2 Table 1

Table 1. Summary of questions presented in the survey

Question category	Question surveyed
1) Practitioner demographics and tear film knowledge	a. Year optometry registration or ophthalmology training was commenced b. †Forced choice selection of therapeutic accreditation status c. †Mode of optometry practice (i.e., corporate, independent, academic, hospital, locum, other, solo, group) d. ‡Mode of ophthalmology practice (i.e., general or subspecialist) and percentage of time spent in the following modes of practice: independent practice (single or multiple owners), academic institution, hospital, other e. ‡Self-reported subspecialty/ies (i.e., cataract, cornea and external eye disease, glaucoma, medical retina, neuro-ophthalmology, ocular oncology, oculoplastics, paediatrics, refractive surgery, strabismus, uveitis, vitreo-retinal) f. Postcode of primary place of practice g. Forced-choice selection (yes/no) of self-declared clinical or research interest in DED h. Average number of tear film evaluations performed per week i. Average number of patient examinations conduced per week j. Estimation of approximate percentage of patients who exhibit aqueous deficiency, anterior blepharitis and meibomian gland dysfunction k. Open answer response for specifying one test for assessing each of tear volume and tear stability
2) Diagnostic techniques	a. Forced choice selection of the three most important clinical procedures for diagnosing DED from 20 options b. Selection of an unrestricted number of responses from 20 options for which diagnostic techniques are routinely used c. Ranking the clinical value of each of the 20 diagnostic techniques, where 1 = never useful or not applicable, 3 =

		rarely useful, 5 = sometimes useful, 7 = mostly useful, 10 = always useful d. A forced choice selection of the preferred method used to routinely grade dry eye severity from six options
3)	Management strategies, review frequency and treatment success	a. Unrestricted number of selections from 17 options of therapies that would be recommended for each of mild, moderate and severe symptomatic DED b. Open answer response to specify how long after commencing treatment follow-up would be scheduled for mild, moderate, and severe symptomatic DED c. Ranking perceived success of management for mild, moderate and severe symptomatic DED, where 1 = never successful, 3 = rarely successful, 5 = sometimes successful, 7 = mostly successful, 10 = always successful d. †Selecting the frequency of ophthalmologic referral for eight patient scenarios, where 1 = never refer, 3 = rarely refer, 5 = sometimes refer, 7 = mostly refer, 10 = always refer
4)	Information and evidence base	a. Forced choice selection of the two most important influences on the practitioner's current management approach for DED (from 11 options for optometrists and nine options for ophthalmologists; the variation in option choices is due to tailoring the selection to what is available for the profession)

†indicates questions displayed only to optometrists, ‡ indicates questions displayed only to ophthalmologists

OPO-OA-2039 R2 Table 2

Table 2. Years of clinical practice experience reported by survey respondents

Years of clinical experience	≤ 10	11-20	21-30	31+
Optometrists: % of respondents	34	23	22	21
Ophthalmologists: % of respondents	3	45	24	28

OPO-OA-2039 R2 Table 3

Table 3. Estimated percentage of patients diagnosed with aqueous deficient dry eye (ADDE), anterior blepharitis and meibomian gland dysfunction (MGD) by respondent optometrists and ophthalmologists

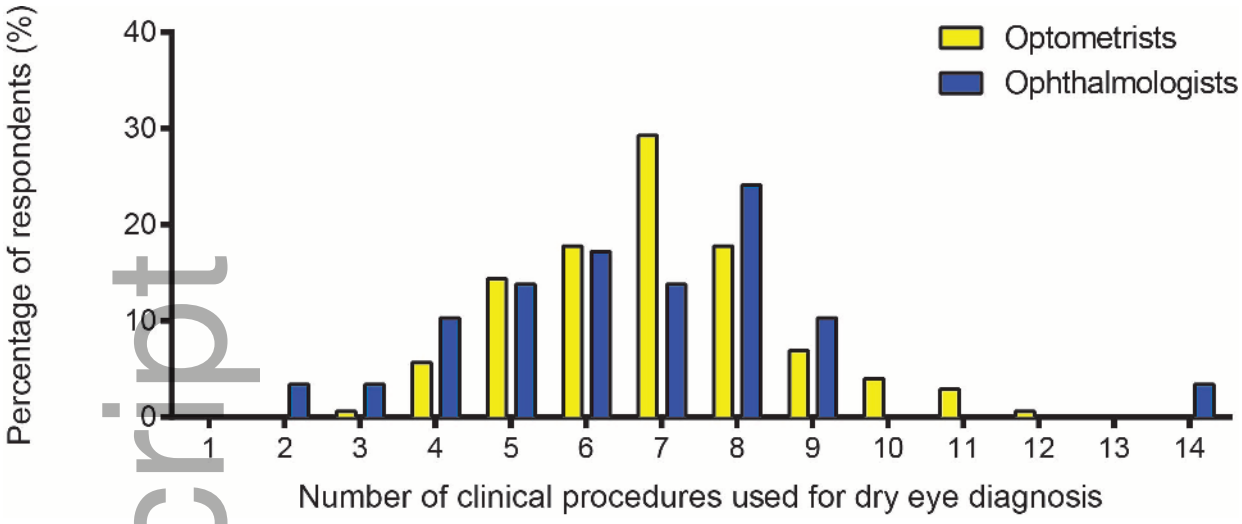
Legend: Ophth, ophthalmologist; Optom, optometrist.

	ADDE		Anterior blepharitis		MGD	
Profession	Optom	Ophth	Optom	Ophth	Optom	Ophth
Median (interquartile range) (%)	10 (5-20)	5 (2-14)	15 (10-30)	10 (5-30)	35 (20-60)	28 (10-44)

OPO-OA-2039 R2 Table 4

Table 4. Frequency with which optometrists and ophthalmologists rank specific dry eye diagnostic procedures as one of the top three most important tests. Legend: Only procedures with a response rate ≥ five percent are shown. Key: Ophth, ophthalmologist; Optom, optometrist; TBUT, tear breakup time.

Diagnostic procedure	Ranking					
	First		Second		Third	
	Optom	Ophth	Optom	Ophth	Optom	Ophth
Patient symptoms	37	28	11	3	14	14
Corneal fluorescein staining (clinical impression)	18	21	13	31	10	10
Meibomian gland evaluation	14	7	28	7	26	24
TBUT with fluorescein	12	7	20	21	21	7
Corneal fluorescein staining (standardised grading)	11	3	10	3	6	0
Tear meniscus height	1	3	6	7	9	17



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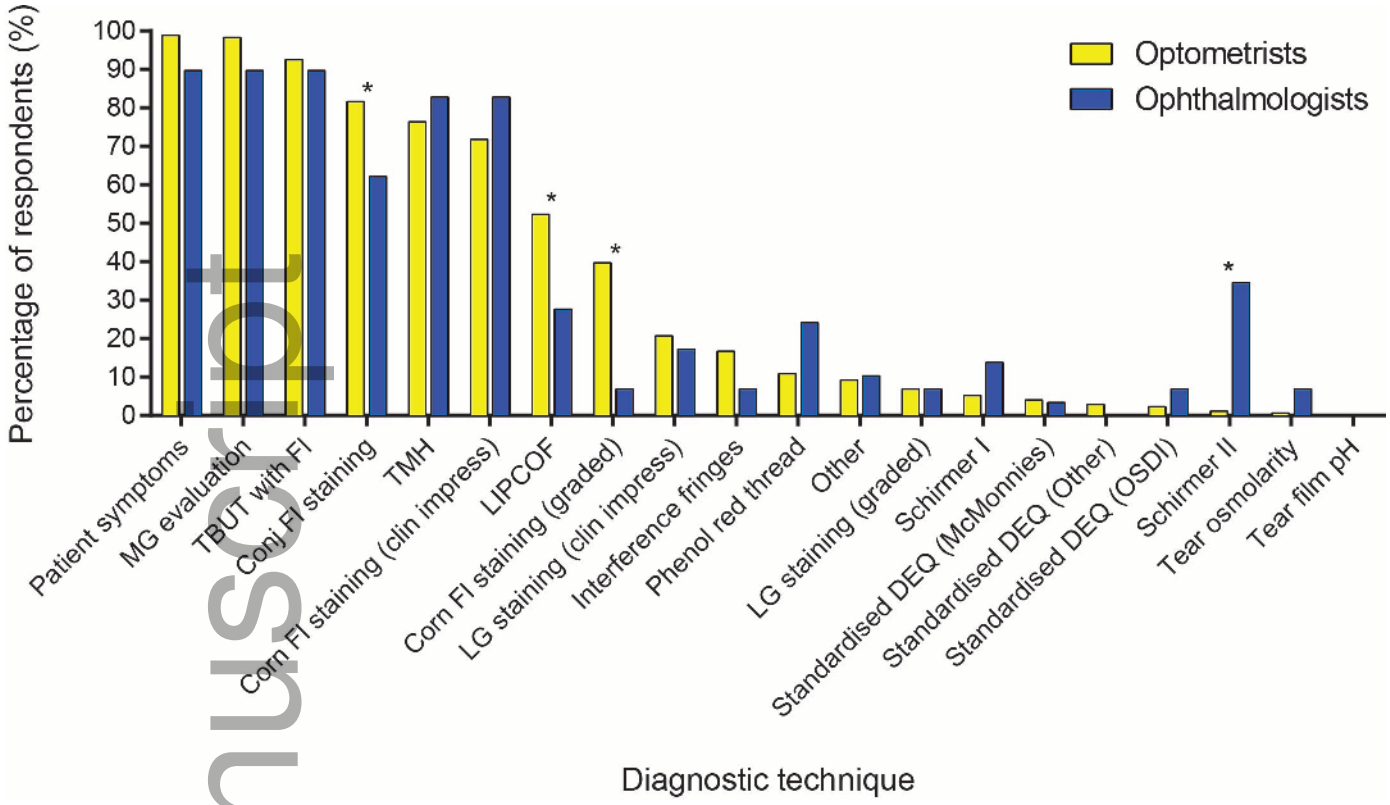

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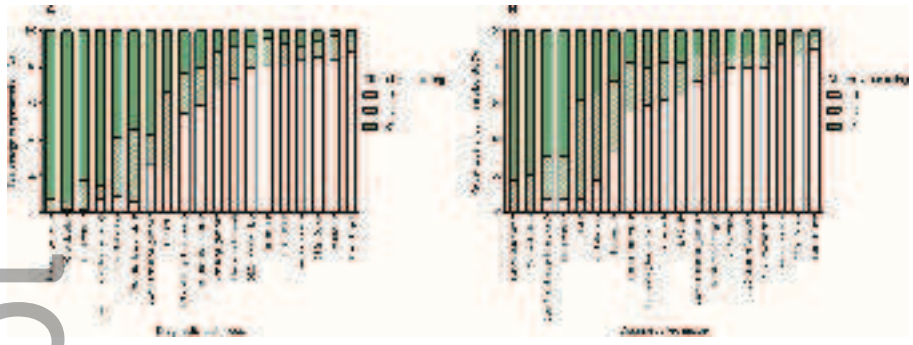

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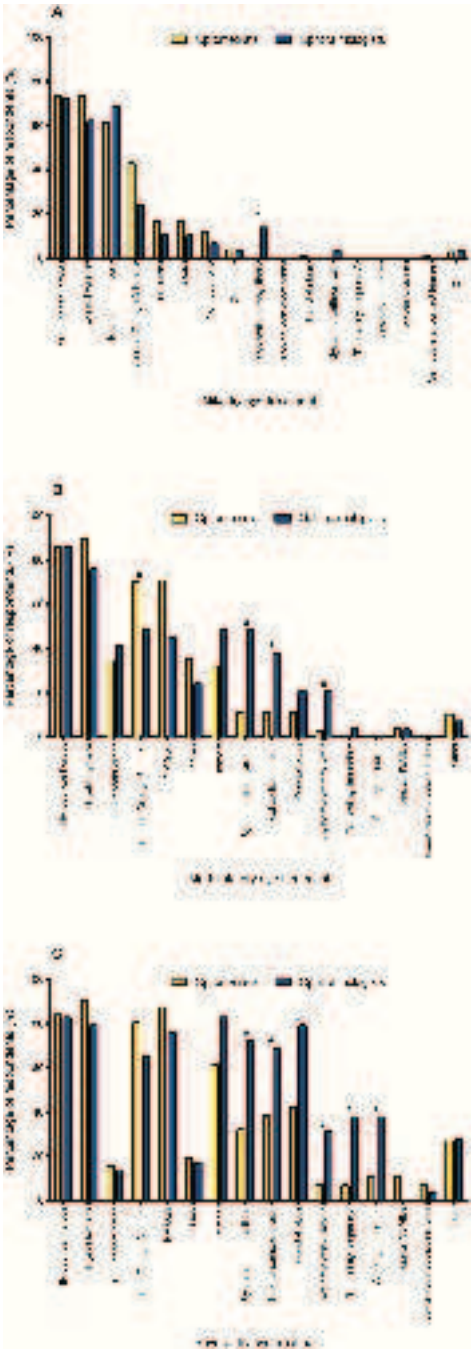

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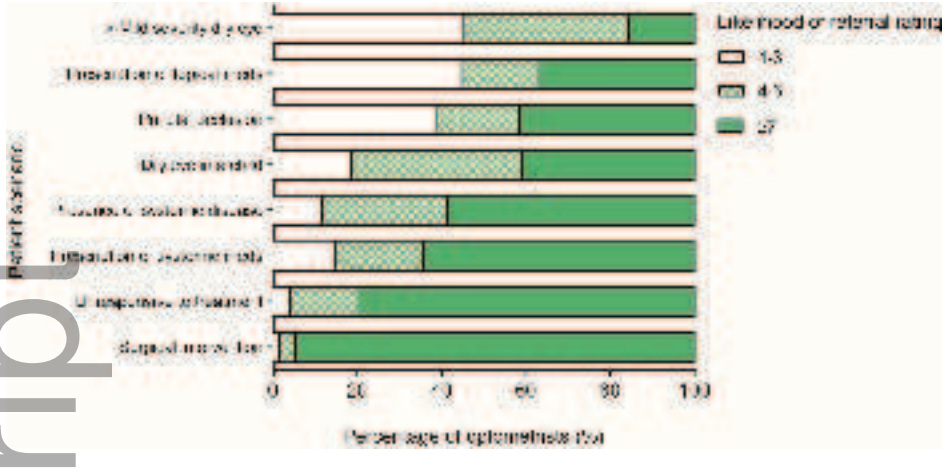

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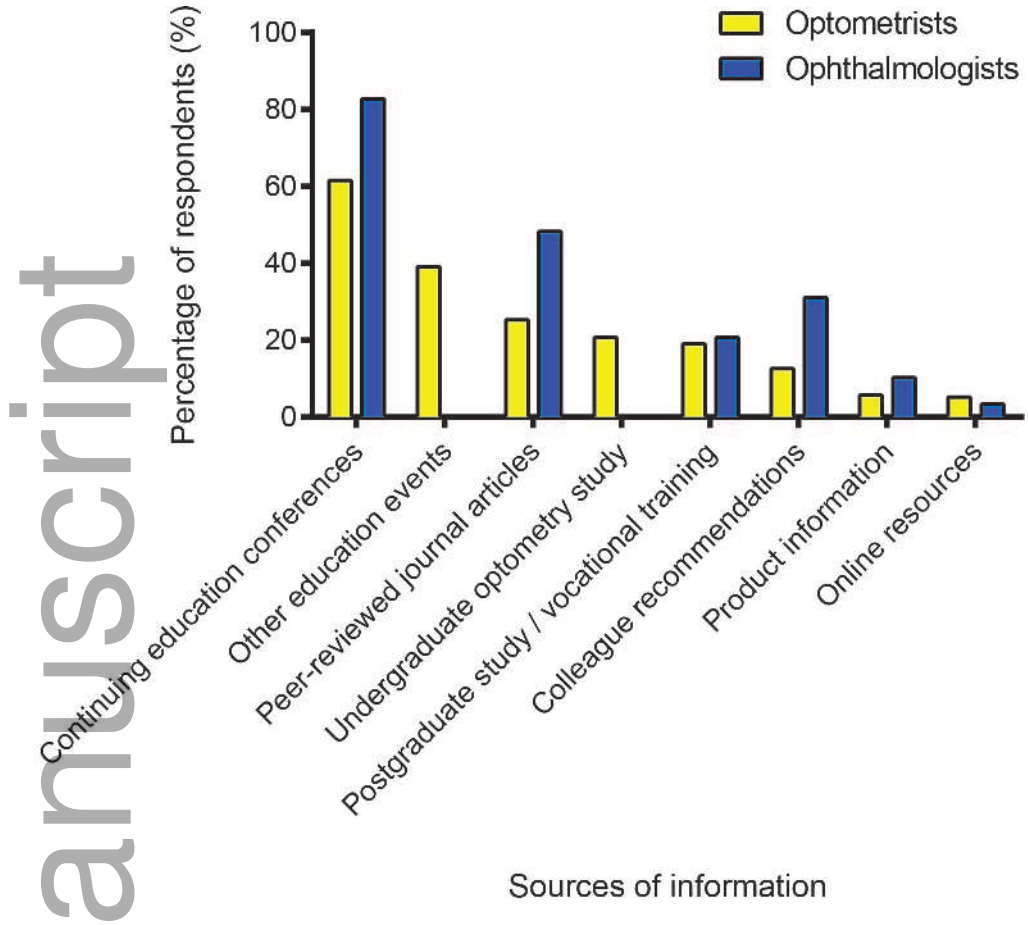

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