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Comparing self-reported optometric dry eye clinical practices in Australia and the United Kingdom: is there scope for practice improvement?

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ABSTRACT

Purpose: The aim of this study was to compare the self-reported clinical practice behaviours of optometrists in Australia and the United Kingdom (UK) with respect to the diagnosis and management of dry eye disease (DED). We also sought to examine whether the reported practices of clinicians in each region were consistent with current evidence-based recommendations for DED.

Methods: An online survey was distributed to optometrists (Australia, n=654; UK, n=1,006). Respondents provided information about practice modality, years of optometric experience, preferred diagnostic and management strategies (stratified by DED severity) and the information/evidence base used to guide patient care.

Results: A total of 317 completed surveys were received (response rates, Australia: 21%, UK: 17%). Optometrists in both regions demonstrated similarly strong knowledge of tear film assessment and adopted both subjective and objective techniques to diagnose DED. Patient symptoms were considered the most important, valuable and commonly performed assessment by both Australian and UK respondents. UK practitioners valued and utilised conjunctival signs and tear meniscus height assessments more than Australian optometrists ($p<0.05$), who placed relatively greater emphasis on sodium fluorescein tear break-up time to diagnose DED ($p<0.05$). Clinicians in both locations tailored DED therapy to severity. While practitioners in both regions predominantly managed mild DED with eyelid hygiene and tear supplementation, Australian optometrists indicated prescribing topical corticosteroid therapy significantly more often than UK practitioners for moderate (14% versus 6%) and severe (52% versus 8%) disease ($p<0.05$). The major source of information used to guide practitioners' dry eye management practices was continuing education conferences.

Conclusions: This study highlights a range of parallels and divergences in dry eye clinical practice between Australian and UK optometrists. Our data identify both areas of strength in the adoption of evidence-based practice, as well as some potential to improve international translation of dry eye research evidence into practice.

INTRODUCTION

Dry eye disease (DED) is a highly prevalent, multifactorial disorder of the tears and ocular surface. The condition affects up to one in five adults and can have significant negative impact upon quality of life.[1] DED can be clinically challenging to diagnose[2] and to manage effectively.[3] At least a component of the complexity in providing high quality clinical care to dry eye patients is the relatively poor association between signs and symptoms.[4] In recognition of the potential challenges associated with navigating the evidence base regarding various approaches to dry eye clinical care, considerable international effort, substantially led by the Tear Film Ocular Surface Society, has been directed towards developing clinically-relevant systematic reviews to guide international DED care.

In 2007, the International Dry Eye Workshop (DEWS) Diagnostic Methodology Subcommittee published a detailed review on the clinical diagnosis of DED.[5] With advances in technology, other techniques have since become available and, accordingly, more recent reviews in the field have sought to summarise evidence relating to the utility of these methods.[2, 6-8] An algorithm to assist practitioners with adopting a standardised approach to diagnosing severe DED has recently been described.[9] An electronic 'dry eye tool box', incorporating a screening algorithm, has also become commercially available, but is yet to be validated.[10] However, it is still unclear whether practitioners utilise these resources and to what extent current international dry eye clinical practices are evidence based.

A number of previous studies have sought to evaluate the self-reported dry eye clinical practices of eye care providers. Together, these studies indicate for significant variations in clinical diagnostic approaches, with preferences for examination techniques being influenced by factors such as the health profession (optometrist versus ophthalmologist) and demographic (region of the world) of the survey population.[11-15] The majority of these studies were, however, undertaken prior to the DEWS systematic reviews, which were integral for achieving international consensus to both define the disease and outline protocols for clinical care. Some studies surveyed international experts in the field, and therefore may not represent the practice behaviours of the broader profession.[14, 15]

Our research group has recently published the first study to examine the self-reported dry eye clinical practice behaviours of Australian optometrists.[11] This work highlighted scope to improve the translation of dry eye research evidence into areas of clinical practice in Australia. Similar to Australia, optometrists in the United Kingdom are the major community providers of primary eye care and therefore assume a major role in diagnosing and providing care to people with DED. Despite this, there is a relative paucity of current literature regarding the dry eye practices of eye care practitioners in this region. Furthermore, the relative consistency of contemporary dry eye practices in different regions of the world has not been previously investigated.

The primary aim of this study was to compare the self-reported clinical practice behaviours of optometrists in Australia and the United Kingdom with respect to the diagnosis and management of DED, in order to gain insight into potential region-specific differences in diagnostic approaches and patient care. We also sought to examine whether the reported clinical practice patterns of clinicians in each region were consistent with current evidence-based practice recommendations for DED, as a basis for identifying potential areas for clinical practice improvement in both regions.

METHODS

i. Participants

A link to an Internet survey was distributed via e-mail to registered optometrists who were members of the Cornea and Contact Lens Society of Australia (CCLSA, n=654) and British Contact Lens Association (BCLA, n=1006). The survey, which had minor demographic-specific customisations for each region, was designed to assess the self-reported clinical practice behaviours of optometrists in relation to the diagnosis and management of dry eye disease (DED). The project was reviewed and approved by the University of Melbourne and University of Cardiff Human Research Ethics Committees. A written statement on the first page of the weblink informed potential participants that their electronic submission of the survey implied their consent to participate and that the survey should take up to 10 minutes. Participants were assured that all responses would remain anonymous and that confidentiality would be strictly maintained. Only completed surveys were used in analyses.

ii. Survey design

SurveyMonkey™ was used to host the survey, the content and design of which we have previously published.[11] Respondents were forced to progress through the questions within the survey without reviewing or altering responses on previous pages.

In brief, the areas of dry eye clinical practice that were investigated were:
(a) practitioner demographics: years of optometric practice experience, practice location, practice modality, clinical interest in DED, tear film knowledge and frequency of tear film assessment;
(b) diagnosis: clinical techniques used to identify DED, perceived diagnostic utility of clinical techniques (ranked on a five-step Likert scale) and method(s) used to grade DED severity;
(c) management: preferred therapies stratified by DED severity (mild, moderate and severe) and criteria for ophthalmologic referral (based upon eight patient scenarios);
(d) information and evidence base: sources used by respondents to inform patient care in relation to dry eye management practices.

iii. Data analysis

Statistical analyses were performed using the Statistical Package for the Social Sciences (IBM SPSS, http://www-01.ibm.com/software/analytics/spss/). Graphs were plotted using GraphPad Prism (Version 5.0 for Mac, http://www.graphpad.com/scientific-software/prism/). Descriptive statistics were used to analyse practitioner demographics, utilisation of dry eye diagnostic tests, dry eye management practices, ophthalmology referral patterns, tear film evaluation knowledge and the sources of information used to guide clinical decision-making. Chi-squared tests were used to compare data consisting of proportions. Data normality was tested using the Kolmogorov-Smirnov (K-S) test. Given a non-normal distribution of data, the Mann-Whitney test was used to compare quantitative, continuous data between groups. Unless otherwise stated, data are shown as median

[interquartile range, IQR]. Proportions are reported to full integers. An alpha value of 0.05 was adopted for statistical significance.

RESULTS

a. Practitioner demographics

Completed surveys were returned by 317 optometrists (overall response rate: 20%) over a two-week period; 144 responses (response rate: 21%) were from Australia and 173 (response rate: 17%) were from the United Kingdom (UK). Responses were received from practitioners in all Australian states, with 82% practicing in major cities and 18% in regional locations, as defined by the Australian Standard Geographical Classification – Remoteness Area system.[16] UK respondents practiced in England, Ireland, Scotland and Wales, with 41% in metropolitan and 59% in non-metropolitan counties, as classified using the Government Statistical Service coding and naming policy.[17] Australian and UK practitioners showed a similar distribution of optometric practice modality, with most in independent practice (Table 1). On average, UK respondents had practiced optometry for longer than Australian respondents (Table 1).

Table 1 – Summary of the demographic features of the survey respondents

Characteristic	Australia	United Kingdom
Responses (response rate, %)	144 (21%)	173 (17%)
Optometric practice experience (years)[a]	15.0 [8.0-27.5]	29.0 [19.0-35.0]**
Practice modality (%)		
- independent	71	80
- corporate	16	10
- academic (primarily research)	5	4
- other (e.g., hospital, refractive surgery)	8	6

[a]K-S testing indicated non-parametric distributions ($p < 0.0001$). Data are shown as median [inter-quartile range, IQR]. ** indicates statistically significant difference between groups ($U(304) = 6238$, $p < 0.0001$)

b. Dry eye clinical expertise

As summarised in Table 2, most Australian and UK respondents specified having a clinical or research interest in dry eye disease. Practitioners in both regions undertook a similar number of tear film assessments per week (approximately three per working day, U(304) = 9769, p=0.11) and demonstrated similar knowledge with respect to dry eye clinical examination procedures (p=0.37).

Table 2 – Summary of the dry eye clinical expertise of the survey respondents

Characteristic	**Australia** (n = 144)	**United Kingdom** (n = 173)
Self-reported clinical research or interest in dry eye disease (%)	51	58
Average number of tear film assessments per week	12.0 [6-20]	11.0 [5-20]
Correctly named techniques to assess both tear volume and stability (%)	71	64

[a]K-S testing indicated non-parametric distributions ($p < 0.0001$). Data are shown as median [inter-quartile range, IQR].

c. Diagnosis of dry eye disease

The self-reported number of clinical tests used by respondents to routinely diagnose DED is summarised in Figure 1. On average, UK practitioners indicated using more procedures to make a diagnosis than Australian practitioners (UK median: 7.4, IQR: 6.0-9.0 versus Australia median: 6.6, IQR: 5.0-8.0, U(304) = 9849, p=0.0006).

Figure 1 – Number of diagnostic tests reportedly used by survey participants for dry eye diagnosis

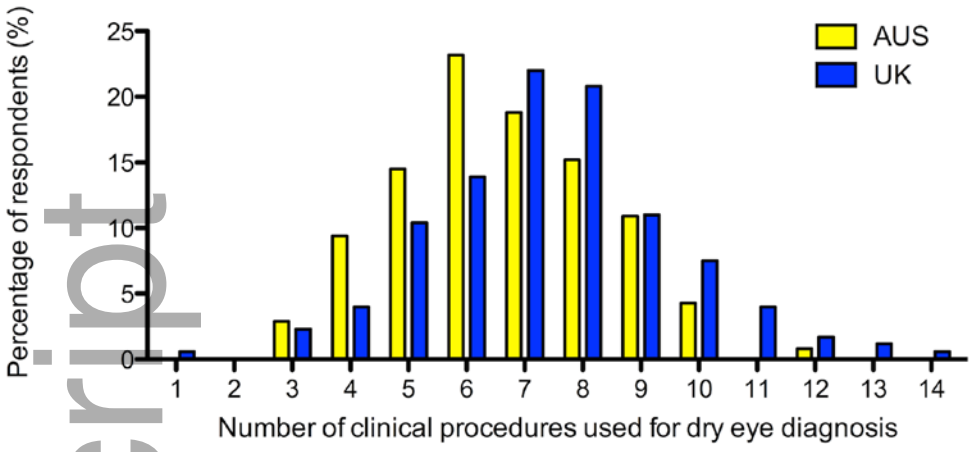
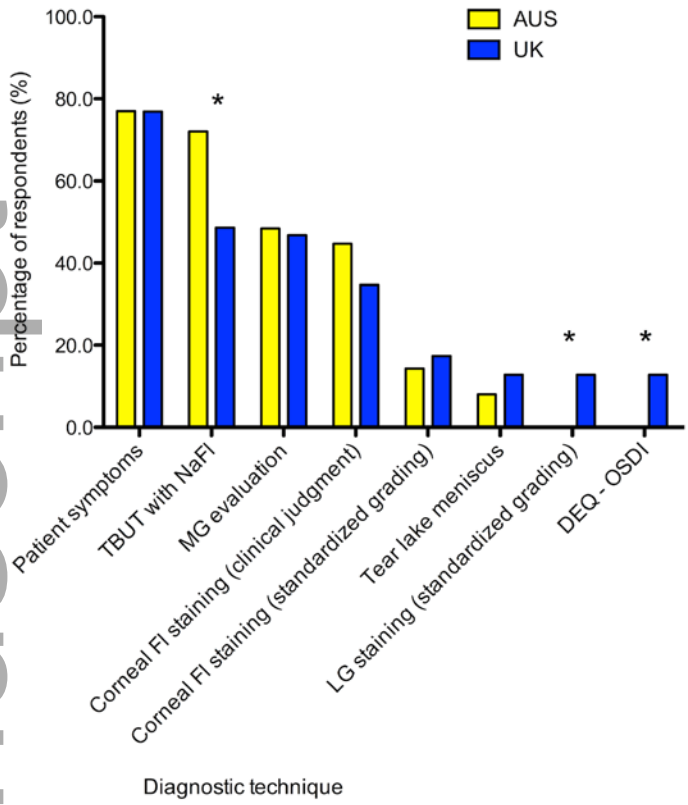


Figure 2 shows the percentage (%) of respondents who selected nominated clinical procedures as one of the three most important techniques for diagnosing DED. Patient symptoms were selected by about three-quarters of both Australian and UK respondents. Fluorescein-assisted tear-break-up-time ranked second in importance, with relatively more emphasis placed on this procedure by Australian practitioners (p=0.002). Meibomian gland evaluation was also considered of value by about half of respondents, with no significant difference between regions (p=0.89). UK practitioners placed relatively more importance on lissamine green conjunctival staining (p=0.001) and the Ocular Surface Disease Index (OSDI) standardised symptom questionnaire (p=0.001) when making a diagnosis of DED.

Figure 2 – Percentage (%) of respondents who selected each clinical procedure as one of their three most important assessments for dry eye diagnosis.



Legend: AUS, Australian practitioners; DEQ, dry eye questionnaire; LG, lissamine green; MG, meibomian gland; OSDI, ocular surface disease index; TBUT with NaFl, tear break-up time with fluorescein; UK, United kingdom practitioners. Note: only procedures with a response rate of ≥10 percent are shown . * indicates statistically significant difference between groups ($p < 0.05$)

Table 3 summarises the percentage of respondents from each region that indicated using specific clinical approaches for a routine dry eye assessment. For both Australian and UK optometrists, the four most popular approaches were patient symptoms ($p=0.72$), meibomian gland evaluation ($p=0.76$), sodium fluorescein tear break-up time ($p=0.26$) and conjunctival sodium fluorescein staining ($p=0.18$), with no significant difference in utilisation between practitioners in each region ($p > 0.05$). Tear osmolarity ($p=0.77$) and the Schirmer test ($p=0.80$) were equally least popular in each region with fewer than ten percent of respondents selecting these techniques.

Table 3 – Summary of the dry eye diagnostic approaches routinely used by survey respondents

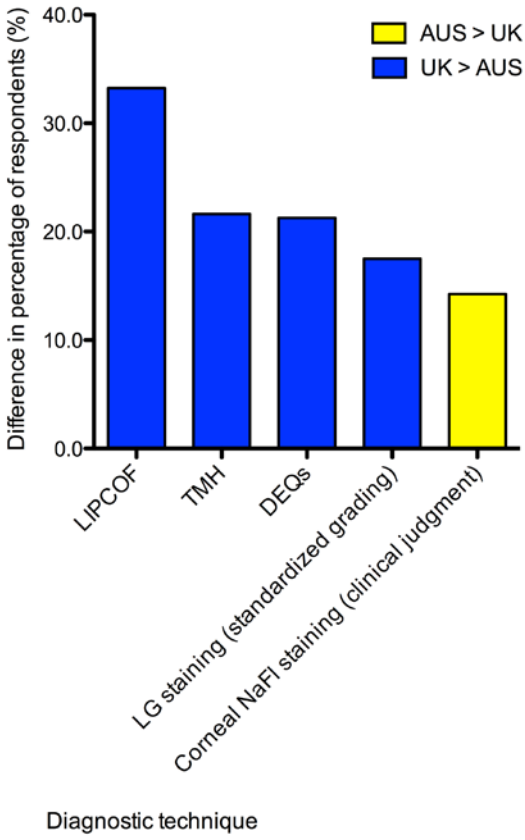
Diagnostic technique / assessment	Australia (n = 144)	United Kingdom (n = 173)
Patient symptoms	95	97
MG evaluation	94	95
NaFl TBUT	92	86
Conjunctival NaFl staining (clinical judgment)	82	73
Corneal NaFl staining (clinical judgment)	81*	67
Tear meniscus height (TMH)	55	76*
Examination of LIPCOF	40	73*
Corneal NaFl staining (standardised grading)	38	46
Tear film interference fringes	22	19
LG staining (clinical judgment)	14	25
Phenol red thread test	11	9
LG staining (standardised grading)	5	23*
DEQs	9	31*
Schirmer test	8	9
Tear osmolarity	7	5
Other	5	5

Numbers indicate the percentage (%) of respondents who selected routinely using each clinical procedure for dry eye diagnosis. Legend: DEQ, dry eye questionnaire; LG, lissamine green; LIPCOF, lid-parallel conjunctival folds; MG, meibomian gland; NaFl, sodium fluorescein; OSDI, Ocular Surface Disease Index; NaFl TBUT, tear break-up time with fluorescein; TMH, tear meniscus height; UK, United kingdom practitioners. * indicates statistically significant difference between practitioners in each region ($p < 0.05$)

Figure 3 shows the significant region-specific differences in adoption of diagnostic techniques for DED. Compared with UK respondents, a higher percentage of Australian practitioners nominated using a subjective assessment of corneal NaFl staining (p=0.04). A relatively greater proportion of UK practitioners indicated using

lid parallel conjunctival fold assessment (p=0.0001), tear meniscus height (p=0.003), standardised dry eye questionnaires (p=0.0002) and standardised grading of conjunctival lissamine green staining (p=0.0005).

Figure 3 – Difference (absolute %) in the percentage of respondents nominating a diagnostic technique, for procedures with a significant (p < 0.05) difference in utilisation between practitioners from Australia and the United Kingdom

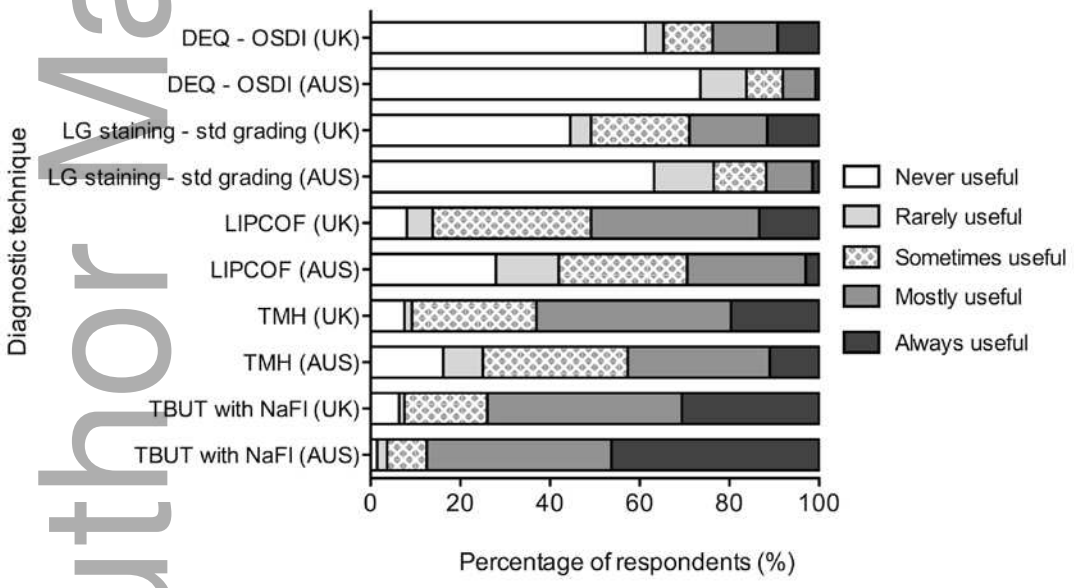


Legend: AUS, Australian practitioners; DEQ, dry eye questionnaire; LG, lissamine green; LIPCOF, lid-parallel conjunctival folds; NaFl, sodium fluorescein; TMH, tear meniscus height; UK, United kingdom practitioners.

Practitioners' perceptions of the relative value of clinical procedures for diagnosis of DED were also examined. Consistent with techniques categorised as most important and most frequently performed, clinical assessments regarded to be of highest utility by both Australian and UK practitioners were patient symptoms, meibomian gland evaluation and sodium fluorescein tear break-up time. In both regions, more than 80 percent of practitioners rated these approaches as either 'mostly useful' or 'always

useful' on the five-step Likert scale. Region-specific differences in the perceived value of clinical approaches for diagnosing dry eye are summarised in Figure 4. Consistent with greater self-reported utilisation of sodium fluorescein tear break-up time, Australian practitioners perceived this test to be of higher diagnostic value than UK optometrists (Australia: 87% versus UK: 74% 'mostly' or 'always' valuable, p=0.03). Also reflecting the reported differences in clinical test utilisation, UK practitioners placed more value on assessing tear meniscus height (UK: 63% versus Australia: 43% 'mostly' or 'always' valuable, p=0.007), lid parallel conjunctival folds (UK: 51% versus Australia: 29% 'mostly' or 'always' valuable, p=0.002), standardised grading of conjunctival lissamine green staining (UK: 29% versus Australia: 12% 'mostly' or 'always' valuable, p=0.005) and the OSDI symptom survey (UK: 24% versus Australia: 8% 'mostly' or 'always' valuable, p=0.004).

Figure 4 – Percentage of respondents (%) who rated the clinical value of dry eye diagnostic procedures, where differences were observed between practitioners from Australia and the United Kingdom.



Respondents ranked the clinical value of each diagnostic technique using a scale of: 1 = never useful, 2 = rarely useful, 3 = sometimes useful, 4 = mostly useful, 5 = always useful. Legend: AUS, Australian practitioners; DEQ, dry eye questionnaire; LG, lissamine green; LIPCOF, lid parallel conjunctival folds; NaFl, sodium fluorescein; OSDI, Ocular Surface Disease Index; MG, meibomian gland; std grading,

standardised grading; TBUT, tear breakup time; TMH, tear meniscus height; UK, United Kingdom practitioners.

For the preferred method used to grade DED severity, the most frequent response (from a forced choice list of options) from both practitioners in Australia and the UK was using their overall 'clinical judgment' (Table 4). Compared with Australian optometrists, those in the UK were relatively more likely to assess dry eye severity using patient symptoms (p=0.01).

Table 4 – Percentage (%) of respondents that selected each method as the primary technique for grading the severity of dry eye disease

Method (%)	**Australia** (n = 144)	**United Kingdom** (n = 173)
Overall 'clinical judgment'	45	35
Grading of corneal NaFl staining	26	16
Patient symptoms	15	31*
Standardised dry eye grading scale	6	6
Standardised DEQ	3	8
Other	6	6

Legend: DEQ, dry eye questionnaire; NaFl, sodium fluorescein. * indicates statistically significant difference between practitioners in each region ($p < 0.05$)

d. Management of dry eye disease

Table 5 summarises the self-reported management strategies used by Australian and UK practitioners for mild, moderate and severe DED. The management practices of optometrists in both regions were generally similar for mild DED, with most practitioners recommending eyelid hygiene (p=0.28) and lubricant eye drops (p=0.75). Compared with Australian respondents, a relatively higher proportion of UK practitioners indicated recommending patients to increase their dietary omega-3

intake (p=0.04) and fewer suggested preserved ocular lubricants (p=0.0001) for the management of mild dry eye. Compared with mild dry eye, higher proportions of practitioners in both regions indicated recommending patients to increase their dietary intake of omega-3s and/or to consume omega-3 supplements for moderate DED. Non-preserved gels were also recommended by almost two-thirds of optometrists in both regions for moderate disease. Compared with the self-reported prescribing for moderate disease, more practitioners in both regions recommended topical ointments and punctal plugs for severe DED. A major region-specific difference in dry eye treatment patterns was that Australian optometrists indicated prescribing significantly more topical corticosteroids than UK respondents for both moderate (p=0.001) and severe dry eye (p=0.0001).

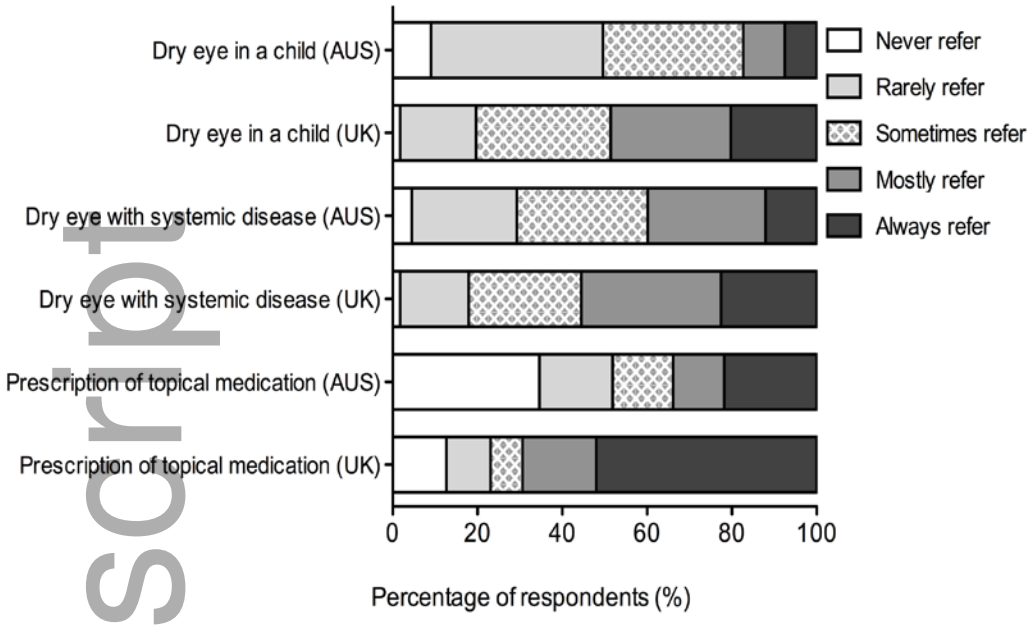
Table 5 – Percentage (%) of respondents that indicated using each dry eye treatment modality for managing mild, moderate and severe disease

	Severity of dry eye disease					
	Mild		**Moderate**		**Severe**	
Treatment modality	**AUS**	**UK**	**AUS**	**UK**	**AUS**	**UK**
Eyelid hygiene	66	74	85	93	86	93
Lubricant drops (NP)	73	76	80	80	77	86
Increased dietary intake of omega-3s	19	31*	40	47	59	59
Omega-3 supplements	13	14	52	45	70	63
Lubricant drops (P)	54*	24	28	19	17	8
Other	1	6	3	3	10	12
Gels (NP)	9	11	64	62	82	87
Gels (P)	7	4	25*	17	24*	12
No treatment	8	5	0	0	0	0
Ointment	1	2	12	16	45*	36
Topical NSAIDs	0	1	1	2	11	14
Punctal plugs	0	0	9	4	52	47
Systemic tetracyclines	1	0	0	1	21	20
Topical corticosteroids	0	0	14*	1	52*	8
Scleral contact lenses	1	0	0	0	5	2

Legend: AUS, Australia; DED, dry eye disease; NP, non-preserved; NSAID, non-steroidal anti-inflammatory drug; P, preserved; UK, United Kingdom. * indicates statistically significant difference between practitioner in each region for the indicated severity of DED ($p < 0.05$).

Criteria for ophthalmology referral were assessed using patient scenarios. Among optometrists in both regions, referral to an ophthalmologist was more likely if surgical intervention was potentially required, if the dry eye was unresponsive to treatment, for prescription of a systemic medication or for punctal occlusion. For each scenario more than 60 percent of Australian and UK respondents indicated that they would 'mostly' or 'always' refer in these situations. Optometrists in both regions were least likely to refer a patient on the basis of the dry eye being of mild severity. Figure 5 shows scenarios where differences in referral criteria were apparent between Australian and UK practitioners. Compared with Australian practitioners, UK optometrists were overall more likely to refer for ophthalmology care for prescription of a topical medication (UK: 69% versus Australia: 34% 'mostly' or 'always' refer, p=0.0001), if DED was evident in a child (UK: 49% versus Australia: 17% 'mostly' or 'always' refer, p=0.0001) and in the presence of systemic disease (UK: 55% versus Australia: 40% 'mostly' or 'always' refer, p=0.04).

Figure 5 – Percentage (%) of respondents who rated the frequency with which they would refer to an ophthalmologist for a given patient scenario, where a significant difference was observed between practitioners from Australia and the United Kingdom.

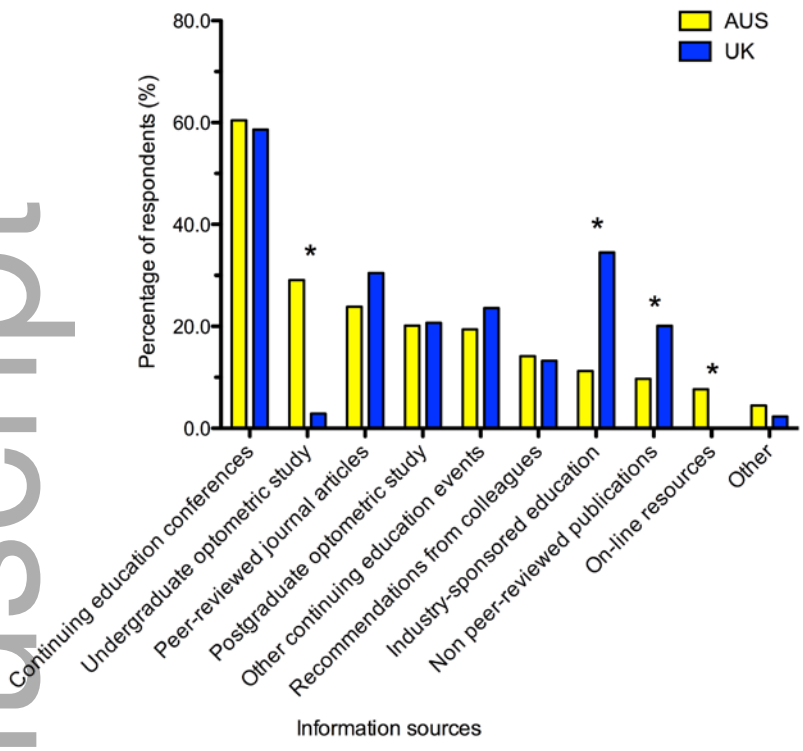


Respondents ranked their likelihood to refer using a scale of: 1 = never refer, 2 = rarely refer, 3 = sometimes refer, 4 = mostly refer, 5 = always refer. Legend: AUS, Australia; UK, United Kingdom.

e. Information and evidence base

Respondents were asked to select the two most important information sources used to guide their current management approach for DED from a list of 10 options (Figure 6). Both Australian and UK practitioners indicated that continuing education conferences were strongly influential in guiding their management approach. Compared with UK respondents, a higher percentage of Australian optometrists cited undergraduate optometric education (Australia: 29% versus UK: 3%, p=0.0001). A larger proportion of UK practitioners indicated deriving information to guide dry eye practices from industry-sponsored education (UK: 31% versus Australia: 11%, p=0.001) and non peer-reviewed optometric publications (UK: 20% versus Australia: 9%, p=0.04).

Figure 6 – Percentage (%) of respondents who selected each information or evidence source as one of the two most important influences on their current dry eye management approach



Legend: AUS, Australian practitioners; UK, United Kingdom practitioners.

Discussion

This study has compared the self-reported clinical practice behaviours of optometrists in Australia and the UK, as related to the diagnosis, classification and management of DED. This is the first study to have examined whether differences in contemporary optometric dry eye practices exist between practitioners in different geographic locations. Furthermore, we have analysed the reported practice patterns of practitioners in each region in the context of internationally recognised evidence-based guidelines for DED, so as to ascertain potential areas for clinical practice improvement in international dry eye care.

The survey achieved a favourable response rate (20% overall), with a similar level of engagement from optometrists in Australia and the UK. To avoid any potential effect of season on practitioners' responses, the surveys were administered during winter in both regions (Australia: July, UK: January). In both regions, most respondents indicated providing optometric care in a private practice setting, with diminishing percentages also in corporate, hospital and academic environments. Although UK

respondents reported, overall, to have practiced optometry for a longer period, in both regions the median period of practice was at least 15 years and therefore consistent with considerable clinical experience. We chose to survey the number of years of optometric practice, *in lieu* of practitioner age, as this was considered to more accurately reflect the level of post-graduation clinical experience. Tear film evaluation knowledge was similar between practitioners in each region, being higher than that reported for Spanish eye care practitioners.[18] This finding likely reflects the survey populations in both regions, with about half of Australian and UK practitioners self-nominating a clinical or research interest in DED, which involved professional organisations dedicated to corneal and contact lens practice.

Practitioners in both regions reported using several different techniques to diagnose DED; this is not surprising given the complexity of diagnosis and the diversity of available clinical techniques and approaches.[2, 6-8] We observed some noteworthy similarities in diagnostic practices amongst UK and Australian practitioners. Consistent with previous studies,[12-15] patient symptom assessment featured prominently, being considered both an important diagnostic, and commonly performed, test. Symptom assessment is recognised to be a key component of a comprehensive dry eye examination.[19]

While symptom assessment was highly valued and commonly adopted by practitioners in both regions, there was a region-dependent difference in the use of standardised dry eye questionnaires. While almost one-third of UK optometrists indicated routinely using dry eye questionnaires, less than ten percent of Australian optometrists reported using these tools. Various types of questionnaires exist,[20] including those specifically for dry eye screening[21] and others for longitudinally monitoring of treatment efficacy.[22, 23] Patient-reported outcomes correlate strongly with quality of life measures and are considered important endpoints in dry eye clinical trials.[24] Their additional value in clinical practice is for promoting consistency in the documentation of DED symptoms.[6] The DEWS Diagnostic Methodology sub-committee recommended for practitioners to use at least one standardised questionnaire for routine dry eye screening.[5] Furthermore, the Ocular Surface Disease Index (OSDI) has been specifically identified to be of value for monitoring patient symptomatology associated with meibomian gland dysfunction.[25] Our findings

suggest that while UK optometrists self-report the adoption of dry eye questionnaires more frequently than Australian practitioners, there is the potential to improve practitioner awareness regarding the value of such tools in both geographic regions.

Other prominent similarities in self-reported routine dry eye diagnostic practice patterns among Australian and UK practitioners were the high prevalence (≥85 percent of respondents) of assessments of meibomian gland integrity, sodium fluorescein tear break-up time and conjunctival fluorescein staining. These findings corroborate those of Graham and colleagues (2010), from a small survey (n=38) of UK optometrists, who found that more than 80 percent of practitioners self-reported undertaking these measures to diagnose DED.[13] Awareness of the importance of meibomian gland assessment, and to consider an evaporative-based aetiology, in dry eye diagnosis has been strongly emphasised in the recent ophthalmic literature.[25, 26] Our findings can be generalised to suggest that most Australian and UK optometrists possess knowledge of this need to carefully evaluate meibomian gland integrity as a component of routine evidence-based dry eye diagnostic protocols.

We also noted some interesting differences between the self-reported practice behaviours of clinicians in the two regions. Compared with Australian optometrists, a higher proportion of UK practitioners indicated routinely examining lid parallel conjunctival folds (LIPCOFs) and tear meniscus height. LIPCOFs, consisting of conjunctival folds at the temporal and nasal quadrants of the bulbar conjunctiva, are considered to be indicators of chronic mechanical conjunctival injury[2] and a useful screening tool for DED.[27] The combination of non-invasive tear break-up time and nasal LIPCOFs has been shown to be strongly predictive of symptoms in patients with mild to moderate DED.[28] That significantly more UK optometrists value and utilise LIPCOF assessment may, at least in part, reflect the demographic origin of the research evidence underpinning the value of this sign, which derives entirely from Europe and the UK. This finding argues strongly for the development of clear international guidelines to ensure best practice approaches despite regional preferences.

The relatively higher use of tear meniscus height as a diagnostic sign for DED among UK practitioners is likely to be indicative of its inclusion in the College of Optometrists clinical management guidelines.[29] However, research evidence to

support the value of tear meniscus in dry eye diagnosis remains controversial. The DEWS Diagnostic Methodology sub-committee (2007) identified a need for a standardised tear meniscus height quantification technique to be developed for general application[5] but the American Academy of Ophthalmology Preferred Practice Pattern places minimal emphasis on the method.[30] More recently, tear meniscus height has been proposed as a potential clinical biomarker for the aetiology-based classification of DED, to identify aqueous-deficient dry eye.[8] That a high percentage of UK optometrists indicated undertaking assessments that are conducive to differentiating both evaporative- and aqueous-based forms of DED argues towards comprehensive diagnostic protocols.

Few respondents (i.e., less than eight percent) from Australia or the UK indicated using tear osmolarity assessment. This is surprising given that tear hyperosmolarity occurs in all subtypes of DED and, using a threshold of 316 mOsmol/L, the test is highly specific for diagnosis.[31] Sullivan *et al*. have reported tear osmolarity to be informative for confirming disease severity,[32] although other studies have questioned its clinical utility.[33, 34] The assessment of DED severity by both Australian and UK respondents in this study was predominantly gauged using practitioners' 'own clinical judgment' rather than with objective measures. The relatively low uptake of tear osmolarity assessment by practitioners in both regions may reflect either a lack of understanding of its potential clinical value and/or be a sign of barriers to its implementation, including the cost of both the infrastructure and consumables and the noted requirement for controlled temperatures in the test environment.[34, 35] Many of the barriers and cost issues could be overcome by providing this service through regional "test" lab centres that optometrists could use on referral, similar to the pathology or imaging centres that are available for medical evaluations.

Consistent with the recommendations of the DEWS Management and Therapy sub-committee, both Australian and UK respondents stratified therapy based upon disease severity.[36] For mild DED, the most frequently recommended management strategies were ocular lubricants and eyelid hygiene, with about 70 percent of practitioners in each region nominating these options. While tear supplementation is the mainstay of supportive DED therapy,[37] there is a dearth of evidence relating to the relative superiority of specific products. It is therefore challenging for practitioners to apply an evidence-based approach in this area of care. The likely rationale for recommending eyelid hygiene is that meibomian gland dysfunction is highly

prevalent in individuals with DED[26] and there is therefore merit in undertaking therapies that concurrently address symptomatology related to both potential evaporative and aqueous components.[38]

A major difference in the self-reported management protocols of practitioners was the higher prevalence of topical corticosteroid prescribing by Australian optometrists for moderate and severe DED. As such, UK practitioners were more likely to refer a patient for ophthalmological care for the prescription of a topical medication. Inflammation is a key pathophysiological mechanism in DED.[39] Randomised controlled trial evidence supports the benefit of low potency topical corticosteroids for attenuating signs and symptoms in DED.[40, 41] As with all therapies, the potential benefits of treatment should be balanced against the risks and, as such, corticosteroid use in DED is generally limited to the control of acute inflammatory exacerbations, to reduce the likelihood of long-term side effects. The low rate of topical corticosteroid prescribing by UK optometrists is possibly due to fewer practitioners being endorsed to prescribe scheduled medicines, being approximately two percent of optometrists when conducting this survey and only 300 out of 14,000 in total. In contrast, about one third of the Australian optometric workforce held a registration endorsed by the Australian Health Practitioner Regulation Agency for prescribing scheduled ocular medicines.[42] Our findings highlight that appropriate utilisation of therapeutic intervention can be undertaken by suitably qualified optometrists and suggest Australian optometrists possess appropriate knowledge regarding the benefits of anti-inflammatory therapy in moderate and severe DED. It is interesting to note that UK optometrists reported that they were more likely, than their Australian counterparts, to recommend increased dietary intake of omega-3 essential fatty acids for their patients with mild or severe DED and that optometrists from both regions increasingly recommended omega-3 supplements in alignment with disease severity, given the relatively limited level of high-quality evidence to support such approaches.[43] Indeed, this treatment approach may be more frequently recommended by UK practitioners in the context of a lack of access to other anti-inflammatory therapies. Taken together, these data highlight how differences in scope of practice can create potential barriers to the adoption of evidence-based best modes of practice. It is logical given the continuum from mild to more severe dry eye that if an optometrist is interested in dry eye management and it is possible to enhance scope through training in therapeutics it would make sense to undertake this.

It should be borne in mind that both cohorts of practitioners were drawn from the membership of organisations for optometrists with an interest in anterior eye disease and/or contact lenses, which may differ from optometrists without such interests. We specifically chose to survey this population of clinicians, rather than the broader profession, to maximise the likelihood of achieving a favourable response rate. In addition, we considered this group of practitioners to be most likely to be adhering to best-practice clinical protocols for the diagnosis and management of dry eye; any identified areas for practice improvement in this population would therefore be expected to apply more generally to the profession. It should be noted that our findings relate to the self-reported practice behaviours of clinicians, as a proxy measure for clinical practice. The validity of self-reporting as a measure of optometric practice may overestimate the actual testing undertake in practice, particularly for discretionary tests.[44] Another relevant consideration is that most survey participants, from both regions, reported substantial clinical experience and contemporary practice within a private optometric setting. As a relatively low proportions of practitioners (Australia: 16 percent, UK: 10 percent) indicated practicing in a corporate setting, there is a possibility that clinical practices may differ among this sub-group of practitioners. Whether such differences exist could be addressed in a future study of clinical practice behaviours targeting the optometric profession in each country more broadly.

With regard to the information and evidence base used by respondents to guide dry eye management, most practitioners from Australia and the UK selected continuing education conferences. Only about one quarter of respondents in both regions nominated peer-reviewed journal articles. UK practitioners ranked industry-sponsored education more highly than Australian optometrists. This finding is interesting in view of the bias against preserved artificial lubricant eye drops for managing the spectrum of DED in the UK compared with Australia; it is possible that this region-specific difference in practitioner behaviour is underwritten, at least in part, by the strong promotion of non-preserved topical products for DED by industry. Undergraduate optometric training also ranked relatively highly among Australian respondents; this is likely explained by these clinicians having a relatively shorter length of optometric experience compared with UK practitioners (median: 15 versus 29 years, Table 1). It is becoming increasingly well recognised that evidence-based practice is an essential component of optometric training and practice.[45-47] That practitioners in both regions

relied heavily on conference education to guide dry eye management highlights that there is scope to improve the utilisation of primary refereed sources, in particular systematic reviews and meta-analyses, to guide patient care. Only about one in four respondents in both regions indicated using peer-reviewed papers to guide their clinical practice. These findings emphasise how the implementation of evidence-based practice not only requires the availability of evidence-based publications, such as those of the DEWS sub-committees, but also for a range of other external barriers to be overcome. Such barriers are likely to include practitioner awareness regarding the availability of the resource(s), the accessibility of the resources, practitioner confidence in accurately interpreting the refereed literature and the opportunity to implement the recommendations in clinical practice. Achieving recognition of the value and importance of adopting evidence-based guidelines by the relevant local professional bodies would also likely assist with encouraging their adoption. Our findings suggest that there is a need for sophisticated, multi-faceted approaches to post-registration clinician education to improve the implementation of evidence-based practice. In Table 6, we propose a potential framework for evidence-based clinical education that considers these factors so as to overcome some of the challenges faced by modern health professionals in translating research evidence into practice.

Table 6 – Proposed potential framework for multi-faceted evidence-based education for clinicians

1. Develop evidence-based clinical guidelines that are promoted by local professional bodies and updated with periodic review (e.g., every two to five years, depending upon changes in the highest quality research evidence)
2. Develop and promote education programs that are highly accessible to clinicians, including: - face-to-face lectures from educators that focus on evidence-based care; such resources may be developed into webinars to be readily viewed by practitioners in regional areas - practical workshops to upskill practitioners on core competencies and specialist clinical procedures - web-based clinical case scenarios to supplement the didactic components of the education program in terms of simulated patient scenarios

3. Develop pathways for referral of patients for specialised testing and evaluation by clinicians with recognised equipment and expertise (e.g., tear osmolarity, meibography)
4. Consider industry support for education in relation to relevant new products; such education would need to be broad in scope to ensure objectivity in promotion and involvement would need to avoid brand promotion.
5. Promote non-punitive clinical practice audit of optometric patient records and open discussion to promote behavioural change.

This study provides valuable insight into the current, self-reported dry eye practice behaviours of Australian and UK optometrists with an interest in DED. Practitioners in both regions demonstrated equivalently strong knowledge of clinical tear film assessment procedures, adopting a range of subjective and objective techniques to diagnose DED. As discussed, both parallels and divergences in the diagnosis and management of DED were apparent between contemporary optometric dry eye practice in Australia and UK. Furthermore, these data identify both areas of strength in the adoption of evidence-based practice, as well as the potential to improve international translation of dry eye research evidence into practice, particularly with regard to sourcing information, educational programs and evidence to guide clinical decision-making.

DISCLOSURES

LED and AJV are investigators for industry-sponsored clinical trials in dry eye disease (Allergan Pty Ltd, USA., Alcon Pty Ltd, USA) and recipients of an unrestricted research grant (CooperVision Pty Ltd, USA). CP is Head of Medical Affairs for Thea Pharmaceuticals Ltd (UK), whose product range includes treatments for dry eye disease (e.g., lubricant eye drops, nutraceuticals, eyelid hygiene products), as well as for glaucoma and ocular infection, inflammation and allergy. Neither the funding organisation nor any industry entity had any role in the design or conduct of this research.

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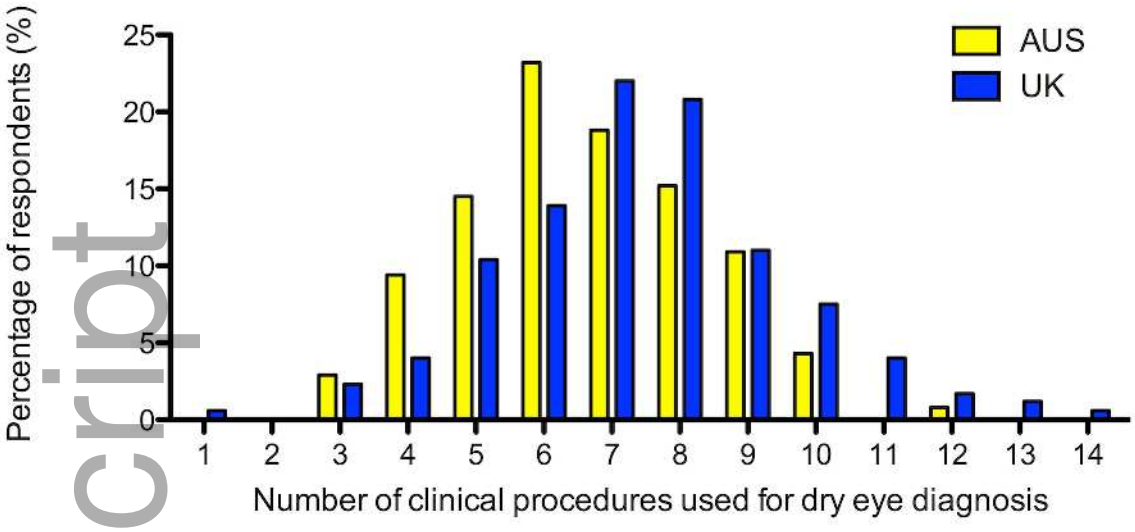

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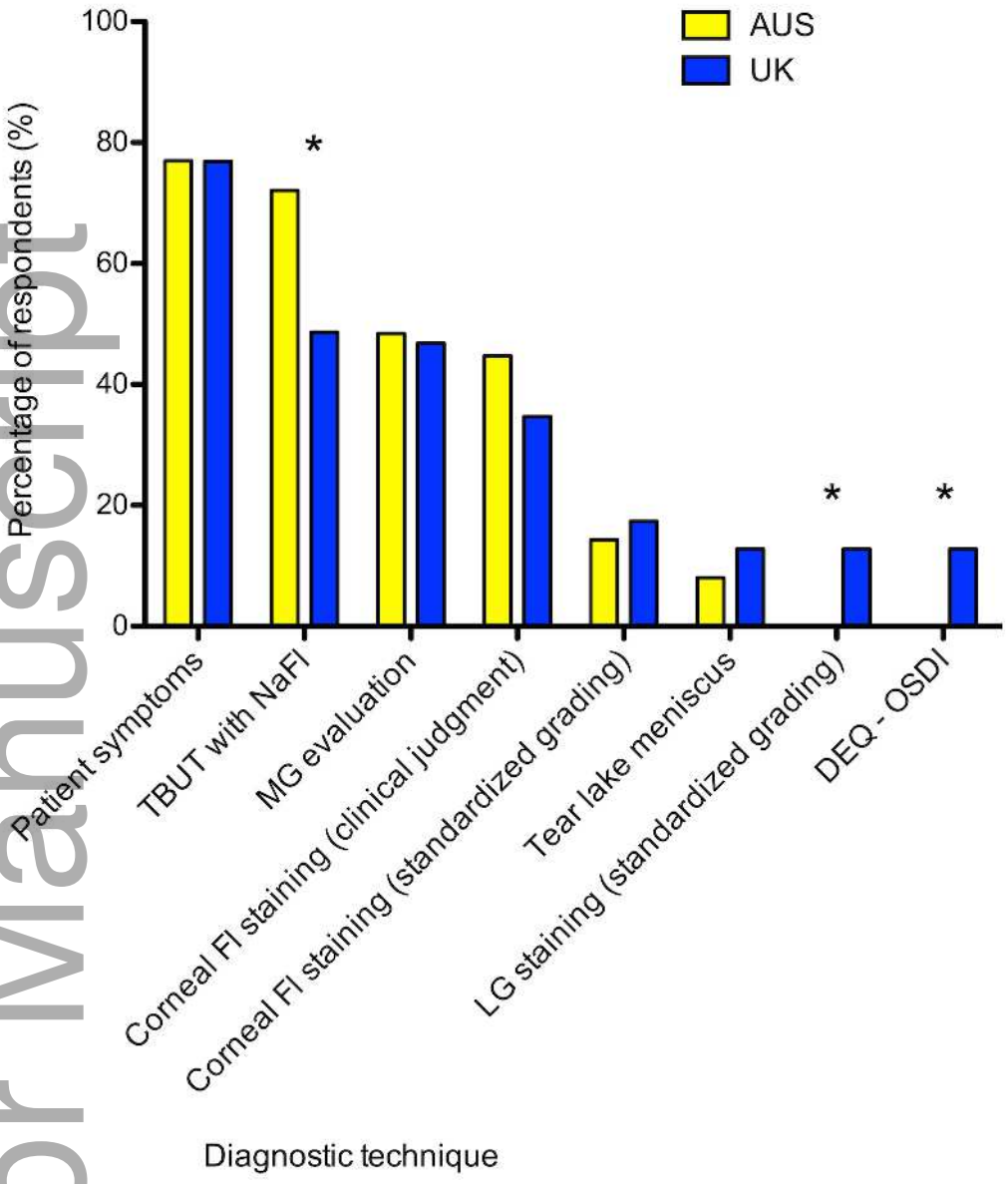

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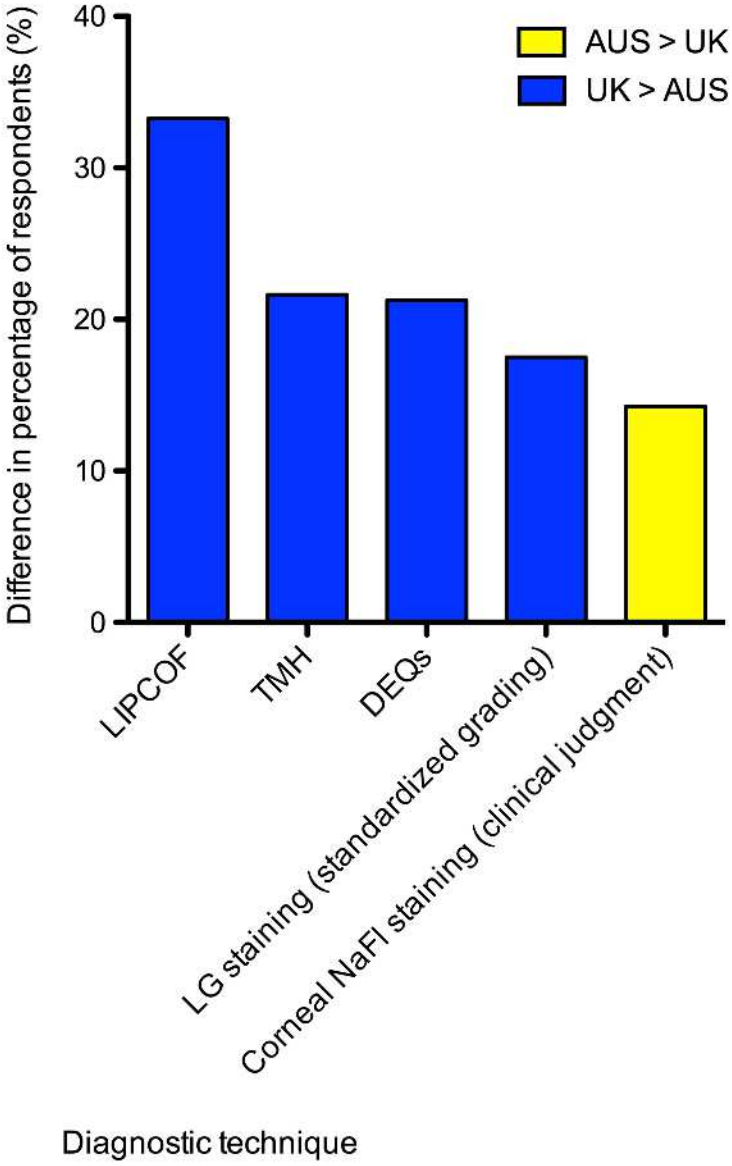

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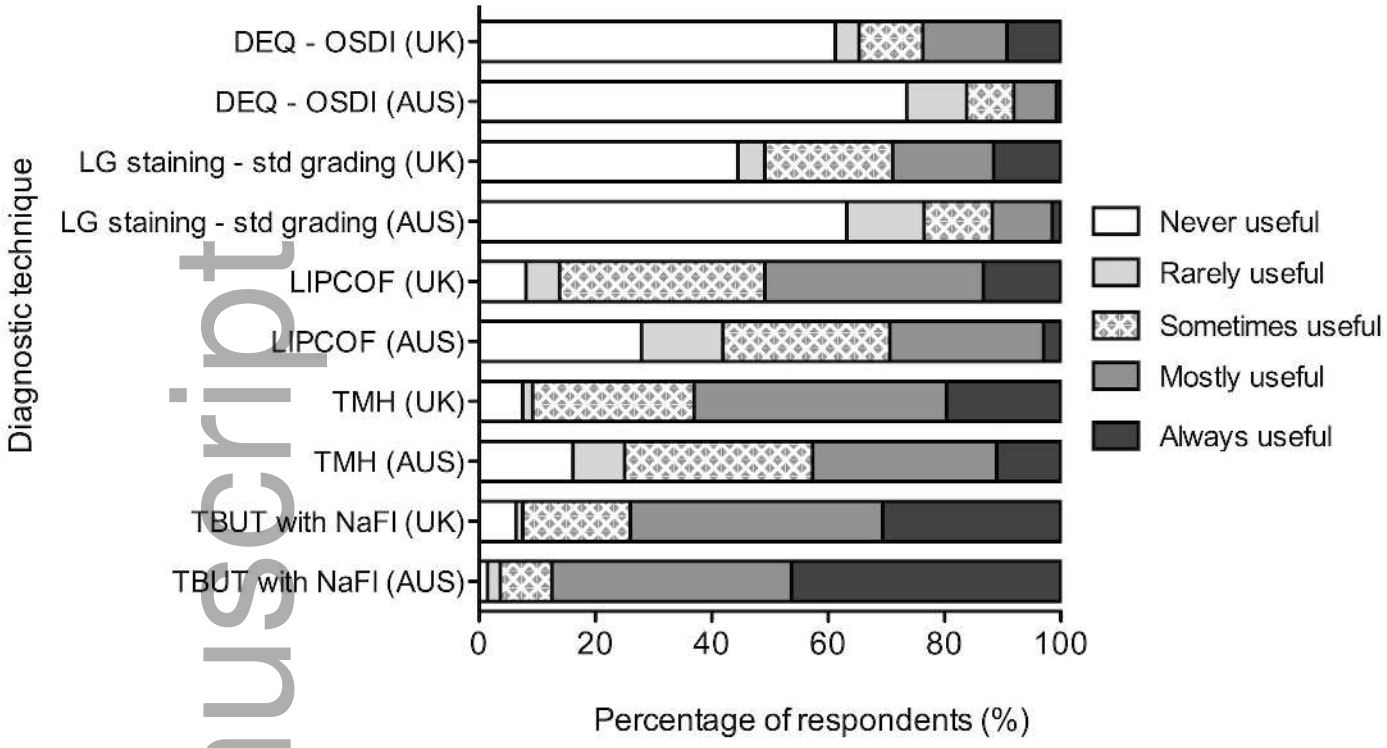

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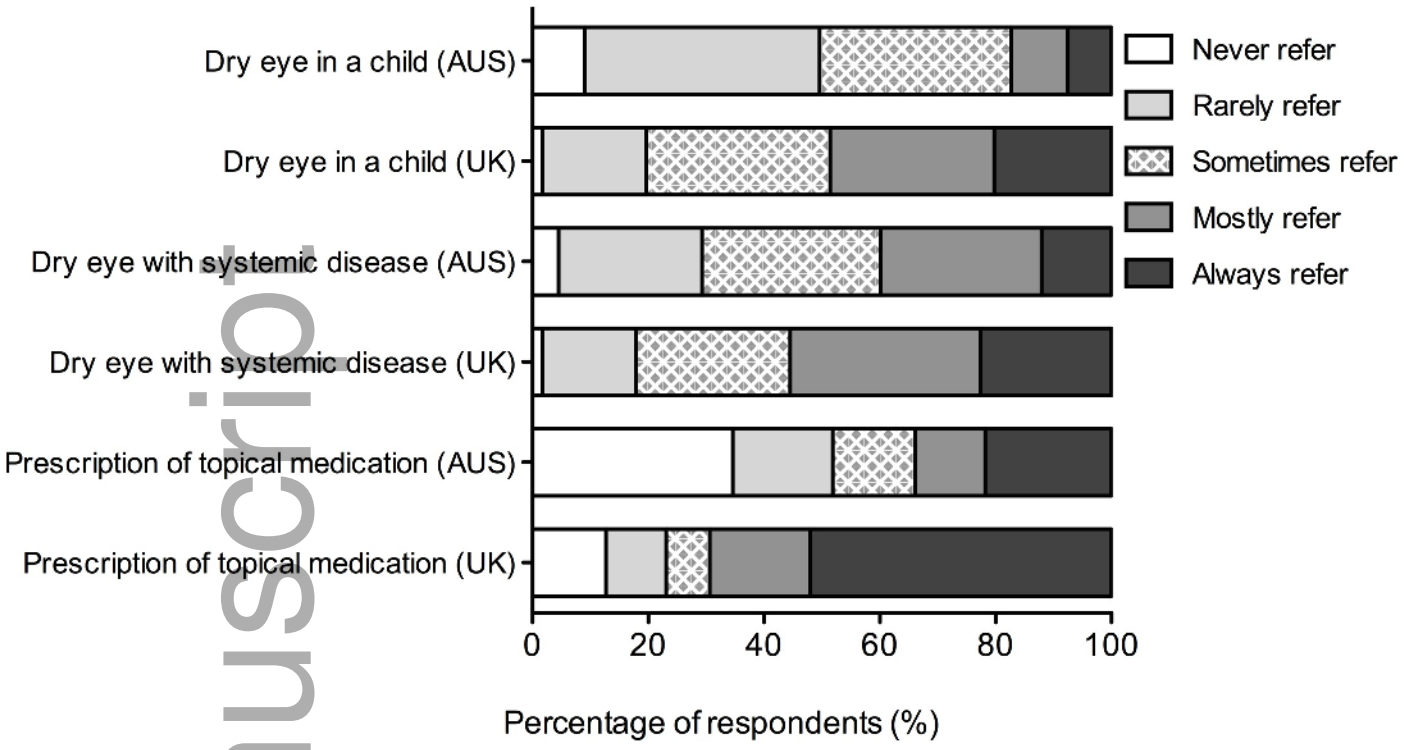

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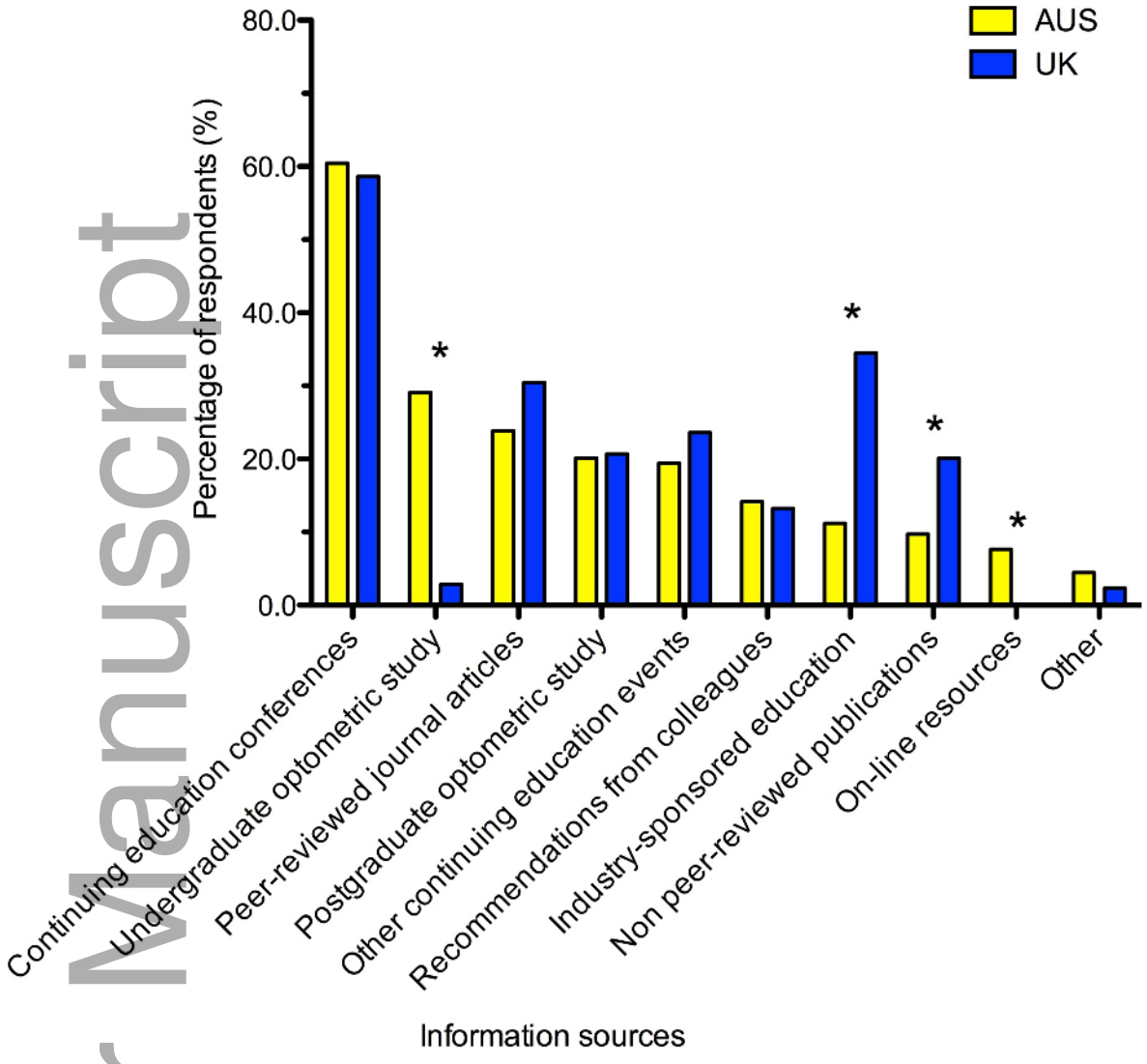

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