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Dry eye clinical practice patterns of UK optometrists

Rachel K. Casemore, James S. Wolffsohn, Debarun Dutta *

Optometry and Vision Science Research Group, Optometry School, Aston University, UK

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ABSTRACT

Purpose: In light of the increased roles of optometrists working in primary care in the UK, this research study aimed to gain an insight into perceptions of dry eye disease (DED), knowledge and confidence in diagnosis and management, and satisfaction with currently available treatment options.

Methods: Links to an online survey were distributed to optometrists across the UK via optometry websites newsletters, conferences, and local optical committee data bases, between October 2021 and July 2022. The anonymous questionnaire contained a variety of question types including multiple choice, likert-type scale, and free text questions.

Results: The survey was completed by 131 optometrists, with a broad range of experience, who reported examining 33.3 ± 31.0 dry eye patients per month. Forty-eight percent of respondents were involved in the provision of an extended service. Fluorescein tear breakup time, corneal fluorescein staining, and anterior lid assessment were the most used clinical procedures, both for diagnosis and monitoring purposes. Sixty percent of respondents reported that they believed their patients were satisfied/managed with artificial tear alone, with the availability of a preservative free option being the top consideration, particularly with increasing severity. Of the 18.7% of respondents who held Independent prescriber status, 68% felt this had widened their ability to diagnose and treat DED. This was evidenced by an increase in steroid recommendation for moderate and severe disease. **Conclusions:** Although dry eye disease was perceived to be an important condition, opinions varied widely regarding knowledge and confidence in diagnosis and management. Involvement in an extended service did not alter patient management. However, an increase in therapeutic management and the employment of a stepwise approach to management has been identified.

1. Introduction

The increasing prevalence of DED poses a significant economic burden, both in time and resources [1]. Due to its multifactorial nature and the poor correlation between signs and symptoms, accurate diagnosis and management of DED can prove challenging [2]. In recent years, the role of optometrists in the UK has extended, with many pursuing further qualifications to develop their interest in specialist areas of practice, such as independent prescribing and DED management. In the primary care sector, DED may be managed during a routine eye examination, fall into the remit of an enhanced commissioned service, or may be managed during a specialist dry eye appointment.

Of the approximately 17,000 UK optometrists registered with the General Optical Council, around 1441 were registered as Independent Prescribers, as of February 2023; an increase of approximately 400 over the last two years [3]. The specialty-registration of independent prescribing (IP) was first introduced for optometrists in 2008. This

permitted qualified optometrists to clinically assess a patient, establish a diagnosis, determine the clinical management needed and prescribe where necessary. Following on from this, extended General Ophthalmic Services (GOS) were implemented, initially by the Scottish Government in 2010, with the aim of reducing the burden on general practitioners and the hospital eye service. This shifted the contact point for primary eye care toward community optometrists across the UK, who became the designated first port of call for primary and supplementary or unplanned eye care provision. The clinical decision-making ability of experienced and trained IP optometrists working in acute ophthalmic services has been shown to be concordant with consultant ophthalmologists [4].

Many optometrists are also becoming involved in Clinical Commissioning Group (CCGs) minor eye condition service (MECS) provision. The Local Optical Committee Support Unit (LOCSU) reported that in April 2020, 84 out of 135 CCGs had a MEC-type service commissioned for delivery by optical practices [5]. Between the start of the COVID-19 pandemic and November 2020, there was a reported increase of 24% in

* Corresponding author at: Optometry School, Aston University, Birmingham B4 7ET, UK.

E-mail address: d.dutta@aston.ac.uk (D. Dutta).

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Table 1

Summary table of practitioner demographics.

Characteristic	Respondents, n (%)		
Years of practice			
<5 years	23 (18.5)		
6–10 years	20 (16.1)		
11–15 years	18 (14.5)		
16–25 years	35 (28.2)		
More than 25 years	28 (22.6)		
Area of UK in which practice			
England	82 (63.6)		
Wales	17 (13.2)		
England and Wales	3 (2.3)		
Scotland	22 (17.1)		
Northern Ireland	3 (2.3)		
Preferred not to say	2 (1.6)		
Type of practice where dry eye patients examined			
High Street Multiple	52 (41.9)		
Small chain	3 (2.4)		
Independent	57 (46.0)		
Academic institution	3 (2.4)		
Other (not specified)	9 (7.3)		
IP qualified			
No	100 (81.3)		
Yes	23 (18.7)	England Wales Scotland Northern Ireland Not specified	10 (43.5) 5 (21.7) 6 (26.0) 1(4.4) 1 (4.4)
Involved in a MECs-type scheme			
No	65 (52.4)		
Yes	59 (47.6)	England Wales England and Wales Scotland Northern Ireland	35 (59.3) 16 (27.1) 3 (5.1) 3 (5.1) 2 (3.4)

the number of CCGs commissioning urgent and MEC-type services.

A recent literature review found 12 articles published in the previous two decades containing the results of surveys investigating trends in diagnosis and treatment of DED by community eye care practitioners (ECPs) [6]. The first qualitative study of UK practitioners attitudes towards DED in 2005 reported an overall poor satisfaction with diagnostic and therapeutic options for DED management [7]. Recently, a survey of Australasian ophthalmologists (7.6%) and optometrists (92.4%) reported similar attitudes towards DED diagnostic tests and therapies. However higher rates of satisfaction with available tests and therapeutic options were found [8]. In 2021, TFOS reported the results of an international survey examining the management patterns of eye care professionals in the context of severity and subtype of DED [9]. The survey included ophthalmologists (37%) and optometrists (58%) from 51 countries (142 from the UK) and found that management at each severity level and between subtypes differed across continents and countries. Although the survey included 93 UK optometrists [10] their specific responses were not reported.

The only other survey to include UK optometrists was in 2016, which compared self-reported optometric DED practices between Australian and UK optometrists [11]. However, this survey was conducted in 2015 or before, and was only administered to practitioners who were members of a contact lens association, which may not reflect the true wider picture of optometric practice. Since that time considerable evidence-based guidance regarding diagnosis and management of DED, in the form of the TFOS DEWS II reports [12,13], has been widely promoted to ECPs in the UK.

Therefore, in view of the increased roles of UK optometrists working

in the primary care sector, the primary aim of this study was to gain a current insight into their perceptions of dry eye as a disease, knowledge and confidence in diagnosis and management, and satisfaction with currently available first-line treatment options. A further aim of the survey was to gain an insight into whether dry eye research is being translated into practice.

2. Methods

2.1. Participants and design

The survey was aimed at UK optometrists who diagnose and manage DED specifically in a primary care setting. The study was approved by Aston University's College of Health and Life Sciences Ethics Committee (#1795). Optometrists who worked only in a hospital or secondary care setting were requested not to complete the survey.

An anonymous, web-based questionnaire was designed (<https://www.onlinesurveys.ac.uk>), containing a variety of question types including multiple choice (single or multiple answer), Likert-type scale questions, grid questions, selection list questions and single-line free text questions (Supplementary material 1). The survey was conducted between October 2021 and June 2022 and was estimated to take approximately 15 min to complete. The landing page for the online survey included participant information and links to the full Participant Information Sheet, followed by the survey. Printed copies of the participant information and consent form were also used at in-person conferences. In order to get a true picture of optometrists' interest and level of involvement, all respondents were encouraged to complete the questionnaire regardless of their level of engagement in DED management.

The survey consisted of 16 questions (including several sub-questions) that collected information primarily on the following areas:

- Practice patterns and demographics of the practitioner's experience, current knowledge, practice location and understanding of DED
- Preferred diagnostic techniques used for DED
- Preferred treatment and patterns of intervention based on severity of DED
- Therapeutic qualification and MECs involvement

2.2. Inclusion and exclusion criteria

The survey was administered to UK optometrists only. Given that practice patterns of hospital-based optometrists are significantly different, and the majority of UK optometrists are employed in a high-street practice setting, hospital-based optometrists were excluded in this survey.

2.3. Distribution

A web link and QR code were made available on the research pages of the LOCSU and the Optometry Today websites. Links were also distributed through colleagues and via several Local Optical Committees by email to their databases. In an attempt to cover all regions of the UK, the links were also distributed via Optometry Scotland, Optometry Wales and the Northern Ireland Optometric Committee. Links were also included at a couple seminars on DED at optometric conferences (Optometry Tomorrow, Telford 2022, and 100% Optical, London 2022).

2.4. Data analysis

Data analysis was performed using Microsoft® Office Excel®, GraphPad InStat version 3.00 for Windows 95, GraphPad Software, San Diego, California, USA, and IBM SPSS Statistics for Windows, Version 26 for Decision Tree Analysis. As the questionnaire data cannot be considered to be continuous, the Mann-Whitney non-parametric test was

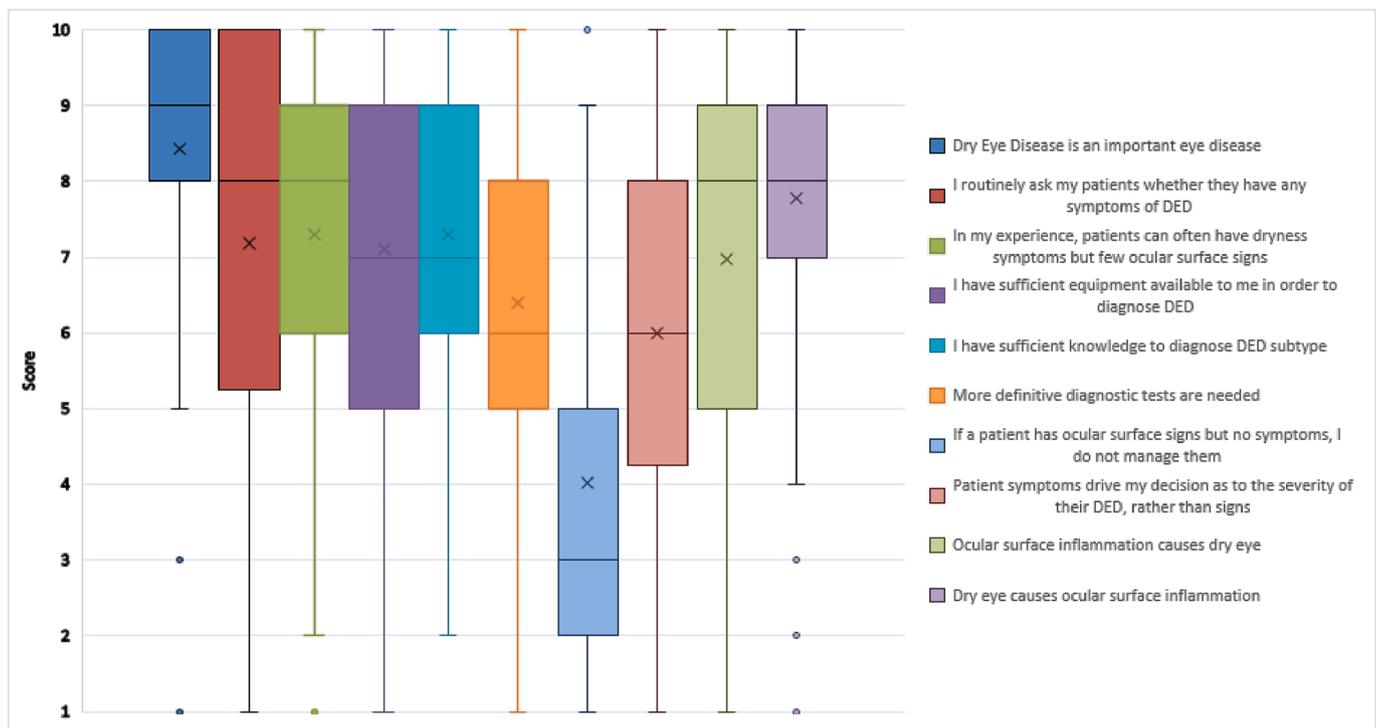


Fig. 1. Box Whisker plots showing the results of question 1, illustrating the minimum, lower quartile, median, mean (represented by a x), upper quartile and maximum scores, where a score of 1 = strongly disagree to 10 = strongly agree. Outliers are represented by a dot (identified as 1.5 multiplied by the IQR value of the data).

used to compare practitioner opinions between groups. Descriptive statistics such as median, mode and interquartile range, were used to analyse practitioner demographics. Practitioners' opinions were reported as a mean rank and standard deviation. Fisher's exact test was used to compare categorical data for the therapeutic approach of practitioners to different DED severities. Where any data was missing, responses were calculated on the total number of responses to the question. For all tests an alpha value of 0.05 was adopted for statistical significance.

3. Results

3.1. Practitioner demographics

In total, 131 optometrists responded to the survey. Response rates to some of the demographic questions varied (from 123 to 129) and therefore percentages of the responses are also given. The practitioner demographics are summarised in Table 1. Responses were gathered from all four constituent countries of the UK, the majority from England (63.6%). Eighty-eight percent of responses were obtained from practitioners working in either a multiple or independent practice primary care setting. Although the highest number of responses came from optometrists with 16–25 years of experience, a good range of experience was represented. Of the optometrists who had been qualified for <5 years, 71.4% of them reported working for a multiple practice. Twenty-three respondents (18.7% of the responses) were IP-qualified and just under a half-reported involvement in MECS provision.

Practitioners' estimation of the percentage of their adult patients who they believed to have DED varied widely, with a mean of $47.1 \pm 21.2\%$. They reported seeing an average of 33.3 ± 31.0 patients with DED per month.

3.2. Practitioner's opinions about DED

Overall, optometrists were aware of the importance of DED and felt

they have adequate knowledge and equipment to diagnose DED (Figs. 1 and 2). They regularly included questions related to DED in their work up and thought that signs and symptoms in DED may not always correlate. Optometrists generally agreed with the statement that ocular surface inflammation causes DED, however there was a stronger perception that DED is likely to induce ocular surface disease. While optometrists are generally confident in diagnosis of DED there was no specific pattern found in responses in terms of requirement of more specific diagnostic tests. Optometrists may not have adequate time to manage dry eye patients during a routine eye examination but were still likely to treat a patient with signs, but no symptoms of dryness.

Most optometrists believed they are confident and have adequate knowledge in managing DED. However, IP qualified optometrists were significantly more confident in managing patients with DED ($p = 0.031$) and felt more knowledgeable about available treatment options ($p = 0.049$) when compared to their non-IP colleagues. Mixed responses were received regarding confidence in patient specific targeted treatment, although IP optometrists were again significantly more confident ($p = 0.081$).

3.3. Diagnostic clinical procedures recorded or performed

Fig. 3 details the preferred diagnostic clinical procedures performed by optometrists for: (1) a routine eye examination with no dry eye symptoms, (2) a routine eye examination with dryness symptoms reported, (3) a specific appointment for a dry eye assessment (including a MECS-type appointment). Respondents were asked only to complete the survey for the type of appointments that they provide for patients. Fewer responses were obtained from practitioners seeing patients for a specific dry eye appointment ($n = 66$), which may reflect the fact that less than half of the total respondents ($n = 59$) reported involvement in MECS-type provision.

Assessment of screen use (81%), history of occupation (89%), contact lens wear (89%), and blepharitis (77%) were popular tests during routine eye examination. Sixty-six percent of optometrists reported also

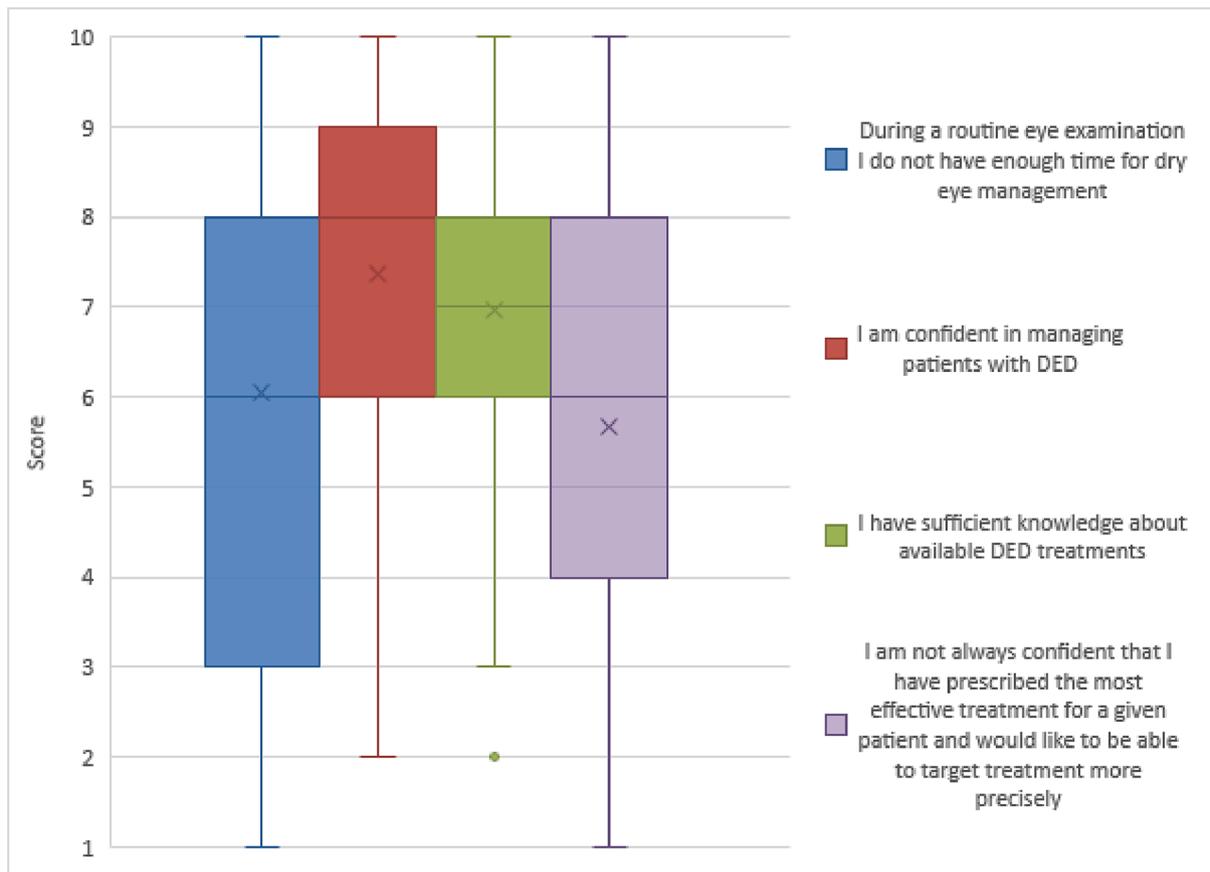


Fig. 2. Box Whisker plots showing the results of question 7, illustrating the minimum, lower quartile, median, mean (represented by a x), upper quartile and maximum scores, where a score of 1 = strongly disagree to 10 = strongly agree. Outliers are represented by a dot (identified as 1.5 multiplied by the IQR value of the data).

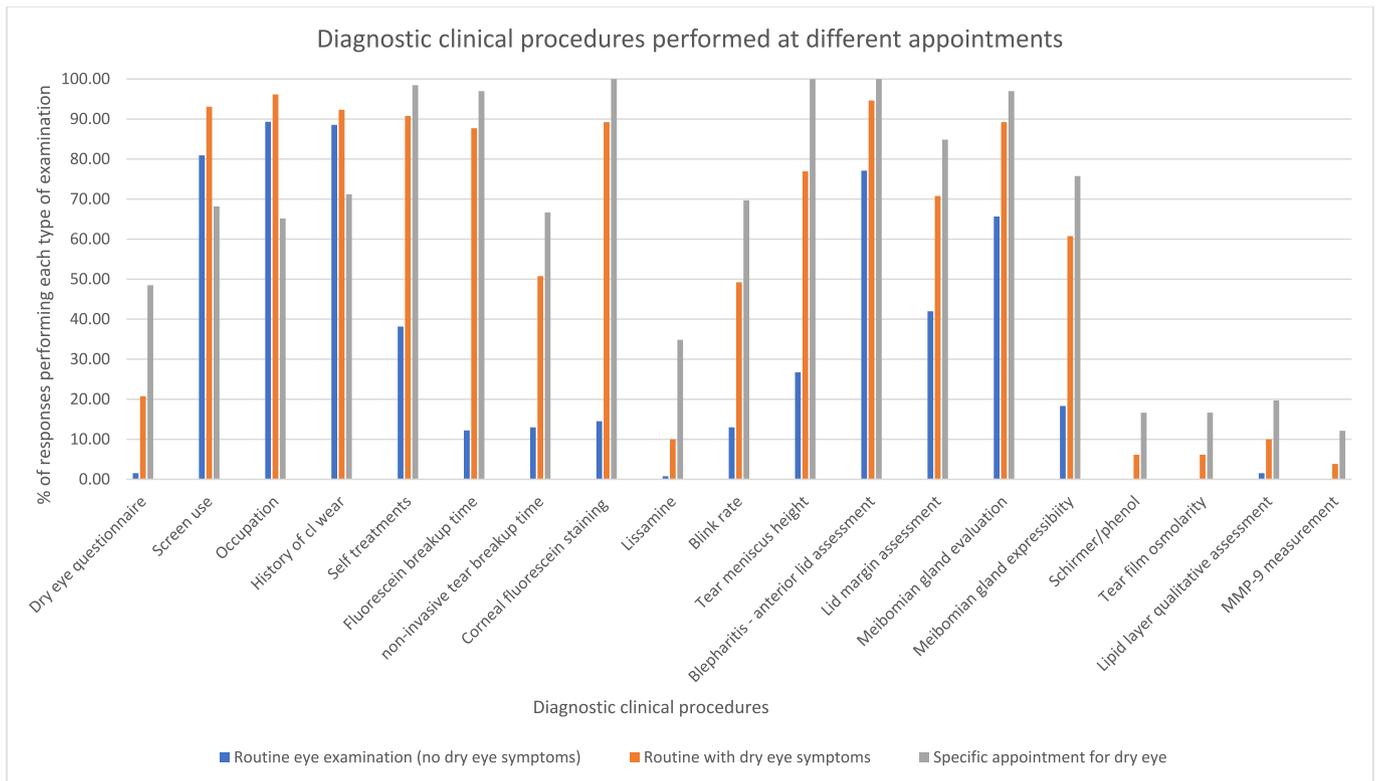


Fig. 3. The percentage of responses at each type of examination for each diagnostic procedure.

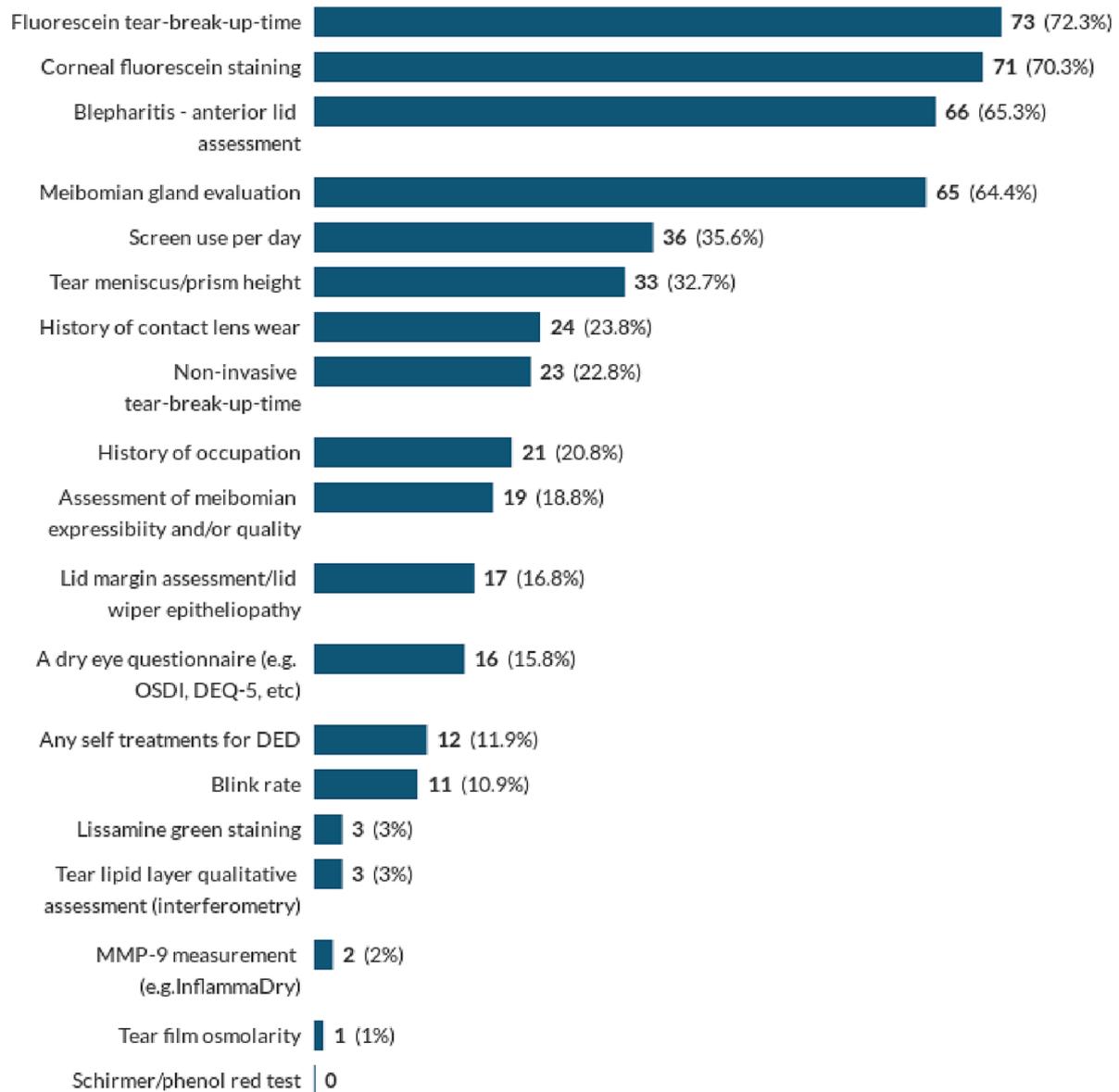


Fig. 4. The five most commonly used clinical procedures preferred for diagnosis of DED. Numbers in bold represent the number of responses.

Table 2

Number of responses to the question regarding the management options for mild, moderate, and severe DED.

Treatment modality	Severity of dry eye disease, n		
	Mild n (%)	Moderate n (%)	Severe n (%)
Modification of local environment - drying conditions and environmental pollutants	89 (71.8)	117* (82.3)	121 (81.5)
Modification of local environment - managing use of digital devices	93 (75.0)	123* (81.5)	122 (83.1)
Dietary advice - diet rich in Omega 3 essential fatty acids	58 (48.3)	103* (96.0)	120* (100)
Lid hygiene and hot compresses	85 (65.9)	124* (92.2)	128 (88.4)
Preserved tear supplements	59 (79.7)	38* (59.4)	25 (39.1)
Liposomal sprays	35 (57.4)	38* (62.3)	40 (67.2)
Non-preserved tear supplements	76 (62.3)	115* (93.4)	116 (89.3)
Topical ointment at bedtime	6 (4.9)	87* (64.2)	116* (93.5)
Punctal plugs	2 (2.7)	15* (19.2)	73* (98.6)
Topical corticosteroids	1 (2.4)	9* (21.4)	41* (100)
Systemic tetracycline e.g., doxycycline	0	8* (14.8)	54* (100)
Topical macrolide e.g., azyster	0	3 (12.5)	23* (100)
Systemic macrolide e.g., azithromycin	0	6* (18.8)	32* (100)
Cyclosporin	0	2 (7.4)	27* (100)
Advanced therapies such as thermal pulsation (Lipiview) or intense pulsed light (IPL)	4 (10.3)	14* (35.9)	38* (97.4)
Protection with therapeutic contact lenses	0	7* (14.3)	49* (100)
Scleral contact lenses	0	3 (11.1)	27* (100)
Refer to a colleague	0	11* (19.3)	57* (100)
Refer to an ophthalmologist	0	9* (8.2)	110* (99.1)

*Indicates a statistically significant difference from the previous severity category where $p < 0.05$, using Fishers Exact test.

Step 1 of the TFOS DEWS II staged management and treatment recommendations for dry eye disease are indicated in the green boxes, Step 2 in yellow and Step 3 in orange. The % given is the percentage of responses to the question.

evaluating the meibomian glands during a routine examination. Interestingly, none of the tear film assessments such as NIBUT, FBUT or TMH were performed during routine eye examination by many practitioners. MMP-9, Schirmer's/Phenol, and tear osmolarity tests are not performed at this stage, and only one optometrist would instill lissamine green dye.

The responses changed substantially when patients report dry eye symptoms. Approximately 90% of the practitioners would ask about self-treatments and perform fluorescein corneal staining and break up time, and meibomian gland evaluation, in addition to the tests performed for routine non-dry eye symptoms. Additional attention would be given to tear film parameters, lid margin, and meibomian gland expressibility when patients report dry eye symptoms. When patients are booked specifically for dry eye management (including a MECS-type appointment), all optometrists would perform assessment for blepharitis, TMH, corneal fluorescein staining, and meibomian gland expression. Tear film osmolarity, lipid layer qualitative assessment and MMP-9 measurements were performed relatively rarely; approximately 1 in 5 at specific dry eye appointments.

Respondents were also asked to specify any procedures they use for diagnosis which were not already listed for this question. Incomplete blinking, conjunctival redness grading, and tear film assessment were

individually listed by four respondents.

3.4. Five most commonly used clinical methods for DED diagnosis

Twenty-nine responses were excluded from the analysis due to more than five options being selected. Fluorescein breakup time was the most commonly used clinical procedure, favoured by more than 72% of the respondents (Fig. 4). This was followed by corneal fluorescein staining (greater than 70%), assessment of blepharitis (65%), and meibomian gland evaluation (64%) which were the other three popular choices. None of the participants preferred Schirmer's or Phenol red test for this purpose.

3.5. Preferred management options for mild, moderate, and severe DED

Table 2. details the number of responses to the questions regarding management options for mild, moderate, and severe DED. Response rates to some questions varied and therefore percentages of the responses are also given. Modification of local environment such as drying conditions and digital device use, lid hygiene and hot compresses, and prescribing non-preserved tear supplements were the preferred treatments for managing mild DED. In addition, dietary advice, topical ointment at bedtime and advanced therapies such as IPL or Lipiview were preferred for moderate DED management. Preserved tear supplements were largely avoided for moderate and severe DED cases.

For severe DED, practitioners preferred to add almost all remaining additional measures that ranged from punctal plugs, systemic and topical medications, to therapeutic and scleral lenses. All respondents would like to manage mild DED cases by themselves, whereas a small number of optometrists may refer moderate cases to a colleague or ophthalmologist. The majority of respondents would consider referring severe cases that they did not feel they could manage satisfactorily themselves. Interestingly one respondent also suggested that patients could monitor urine colour as an indicator of dehydration.

Table 3 details the responses, as a percentage, from optometrists who examined patients under a MECS/PEARS or non- MECS/PEARS appointment. These show similar trends, with no significant differences between management preferences between the two appointment types.

Table 4 shows the percentage of IP and non-IP responses that indicated preferences in DED treatment modalities for mild, moderate, and severe cases. When treating a patient with mild DED, a significantly ($p < 0.05$) higher percentage of IP-qualified optometrists preferred to modify the local environment, such as protection against drying conditions and environmental pollutants. When considering moderate DED, a significantly higher percentage of IP-qualified optometrists preferred to use punctal plugs, topical corticosteroids, systemic tetracycline, topical and systemic macrolides, cyclosporin and other advanced therapies. A similar trend was observed when treating patients with severe DED. However, in contrast, a significantly higher percentage of non-IP qualified optometrists would prefer to refer to a colleague ($P < 0.05$).

Around a third (34.1%) of all respondents reported recommending a prescription of topical steroids, while 19.4% and 41.9% reported recommending cyclosporine or systemic tetracycline, respectively for severe DED. Practice location, practice type and years of experience did not have any bearing on these recommendations.

3.6. Three most commonly used procedures determining success of treatment

Corneal fluorescein staining and fluorescein tear break up were the most commonly used tests to determine success of ongoing treatment (Fig. 5). This was followed by assessment of blepharitis, meibomian gland evaluation and use of DED questionnaires. Schirmer's test, MMP-9 measurement, tear lipid layer quantification and blink rates were the least popular tests to characterise treatment outcome.

Table 3

Treatment modality responses as a percentage from participants who indicated whether they examined patients under a MECS/PEARS or non-MECS/PEARS appointment.

Treatment Modality	Severity of dry eye disease (%)					
	Mild		Moderate		Severe	
	MECS/ PEARS (n = 59)	Non-MECS/ PEARS (n = 65)	MECS/ PEARS (n = 59)	Non-MECS/ PEARS (n = 65)	MECS/ PEARS (n = 59)	Non-MECS/ PEARS (n = 65)
Modification of local environment - drying conditions and environmental pollutants	64.4	72.3	93.2	87.7	94.9	90.8
Modification of local environment - managing use of digital devices	71.2	72.3	89.8	86.2	98.3	89.2
Dietary advice - diet rich in Omega 3 essential fatty acids	44.1	44.6	74.6	81.5	91.5	89.2
Lid hygiene and hot compresses	67.8	63.1	94.9	95.4	96.6	96.9
Preserved tear supplements	47.5	43.1	28.8	32.3	11.9	26.2
Liposomal sprays	30.5	26.2	40.7	43.1	50.8	46.2
Non-preserved tear supplements	59.3	60.0	89.8	90.8	94.9	92.3
Topical ointment at bedtime	1.7	6.2	59.3	64.7	93.2	95.4
Punctal plugs	3.4	0	6.8	15.4	57.6	56.9
Topical corticosteroids	1.7	0	3.4	9.2	32.2	32.3
Systemic tetracycline e.g., doxycycline	0	0	5.1	7.7	42.4	41.5
Topical macrolide e.g., azyster	0	0	1.7	1.5	15.3	21.5
Systemic macrolide e.g., azithromycin	0	0	3.4	4.6	22.0	27.7
Cyclosporin	0	0	1.7	1.5	20.3	21.5
Advanced therapies such as thermal pulsation (Lipiview) or IPL	3.4	3.1	8.5	13.8	28.8	30.8
Protection with therapeutic contact lenses	0	0	3.4	6.2	40.7	35.4
Scleral contact lenses	0	0	0	3.1	20.3	20.0
Refer to a colleague	0	0	3.4	9.2	40.0	46.2
Refer to an ophthalmologist	0	0	1.7	7.7	84.7	81.5

Step 1 of the TFOS DEWS II staged management and treatment recommendations for dry eye disease are indicated in the green boxes, Step 2 in yellow and Step 3 in orange.

3.7. Decision on artificial tears

The majority of respondents would prefer to prescribe preservative free artificial tears. Almost half of their prescriptions would depend on work-place availability and/or drop ingredients. Other considerations practitioners reported when choosing which artificial tears to prescribe included type of dry eye, cost, personal experience of the product, viscosity, lipid content, ease of use/manipulation, and regional formulary prescribing guidelines. Sixty percent of optometrists felt all their patients are satisfied with and could be managed with artificial tears alone.

4. Discussion

This survey has demonstrated a wide range of attitudes towards DED amongst UK optometrists. While it is possible that those who completed the survey in response to links distributed at CPD events may have altered their opinions through what was presented, the questions related to current practice and so the responses are unlikely to have been influenced. It was also made clear that the opinions of optometrists with any level of interest in DED were being sought.

Most practitioners expressed positive views regarding the importance of DED, and their knowledge and confidence in managing it. Previously, a smaller UK based survey found an overall poor satisfaction with diagnostic and therapeutic options [7]. While ECPs have recently expressed thoughts of 'frustration' and 'dread' in the context of a disease with a perceived 'time-consuming' nature with 'limited therapeutic options' [8], there does appear to be an increased awareness of evidence based practice, with engagement in training for extended roles and further qualifications a likely reason.

UK based practitioners did not show any significant agreement or disagreement to the statement 'I am not always confident that I have prescribed the most effective treatment for a given patient and would like to be able to target treatment more precisely'. A similar result was found when isolating the responses of those who reported recommending a topical steroid, suggesting there is still some uncertainty. Years of experience did not appear to affect their response.

This study showed that practitioners estimated 47% of their adult patients have DED. This is in close agreement with estimated global

prevalence reported to range from 5 to 50% [14], with the large variation presumed to be the result of several factors including geographical location, study population variations and lack of consistent diagnostic criteria. More recently, prevalence of DED (defined by the TFOS DEWS II criteria) in the UK adult population has been reported to be 32.1% (95% confidence interval 25.5–37.7%) [15].

Practitioners reported examining around 33 patients a month with DED, but with a range of 1 to 130. If nearly half of the practitioners' adult patients are estimated to have DED, then this may suggest that some patients are not having their dry eye managed. Further information regarding the total number of patients examined per month would be needed to verify this, including its reason. The results of this UK survey are in agreement with a retrospective study in 2000, which looked at the records of 467 patients with a previous diagnosis of DED. That study found the most commonly performed objective tests after symptom assessment (82.8%), were fluorescein staining (55.5%), TBUT (40.7%), and tear assessment (22.2%) [16].

Only 15.8% of the UK optometrists who responded said they incorporate a dry eye questionnaire as one of their five most used procedures for diagnosis; of those who ranked it first, all were IP qualified optometrists. However, DED is defined as the presence of both clinical signs and patient reported symptoms using one of the two validated questionnaires [12]. The relatively low usage of these questionnaires would imply an unfounded confidence in DED diagnosis with most practitioners not using the well-established global consensus established by the Tear Film and Ocular Surface Society (TFOS) Dry Eye Workshop DEWS II [12].

Just over a fifth of respondents ranked a dry eye questionnaire as one of their three most commonly used clinical procedures for determination of successful treatment. These percentages are lower than the 31% (for diagnostic use) reported by Downie et al, in 2016 [11]. However, this study had a greater diversity of respondents, being directed towards general optometry, rather than those with a specialist interest in the anterior eye or contact lenses. Furthermore, just under one half (48.5%) of the UK practitioners who responded to this survey, who perform specific dry eye appointments said they would use a questionnaire.

It is possible that practitioners prefer a verbal assessment of symptoms, as could be inferred by the higher ratings for questions regarding

Table 4
Percentage (%) of IP and non-IP respondents that indicated recommending each dry eye treatment modality for managing mild, moderate, and severe disease.

Treatment Modality	Severity of dry eye disease (%)					
	Mild IP (n = 23)		Moderate IP (n = 23) Non-IP (n = 98)		Severe IP (n = 23) Non-IP (n = 98)	
Modification of local environment - drying conditions and environmental pollutants	91.3*	65.3	100	87.8	100	93.9
Modification of local environment - managing use of digital devices	82.6	71.4	95.7	88.8	91.3	93.9
Dietary advice - diet rich in Omega 3 essential fatty acids	39.1	45.9	82.6	78.6	87.0	92.9
Lid hygiene and hot compresses	73.9	65.3	100	100	100	99.0
Preserved tear supplements	43.5	39.8	39.1	28.6	21.7	19.4
Liposomal sprays	21.7	29.6	34.8	41.8	42.9	50.0
Non-preserved tear supplements	47.8	62.2	95.7	91.8	100	94.9
Topical ointment at bedtime	0	5.1	60.9	60.2	91.3	94.9
Punctal plugs	4.35	0.0	26.1*	7.1	65.2	55.1
Topical corticosteroids	4.35	0.0	26.1*	2.0	65.2*	24.5
Systemic tetracycline e. g., doxycycline	0	0.0	26.1*	2.0	78.2*	33.7
Topical macrolide e.g., azyter	0	0.0	8.70*	0.0	30.4*	15.3
Systemic macrolide e.g., azithromycin	0	0.0	21.7*	0.0	56.2*	17.3
Cyclosporin	0	0.0	8.70*	0.0	34.9	17.3
Advanced therapies such as thermal pulsation (Lipiview) or intense pulsed light (IPL)	4.35	3.1	26.1*	7.1	39.1	26.5
Protection with therapeutic contact lenses	0	0.0	13.0	3.1	52.2	34.7
Scleral contact lenses	0	0.0	0	2.0	26.1	18.4
Refer to a colleague	0	0.0	0	8.2	17.4	51.0*
Refer to an ophthalmologist	0	0.0	0	5.1	82.6	85.7

*Indicates statistically significant differences between the percentages of the two groups ($p < 0.05$), using Fishers exact test. Step 1 of the TFOS DEWS II staged management and treatment recommendations for dry eye disease are indicated in the green boxes, Step 2 in yellow and Step 3 in orange.

risk factors for DED (screen use, history of CL wear, occupation) over a validated questionnaire. Further research questions exploring the use of questionnaires and any barriers to their uptake, such as ease of use and time constraints, could address this question.

The survey questions exploring management of different severities of

DED has provided evidence that practitioners are incorporating a step-wise treatment approach, consistent with the TFOS DEWS II management recommendations, into their practice [13]. Patient education regarding local environment, digital device-use, diet, artificial tears, and warm compress recommendations (step 1 interventions) were found to be a common approach among practitioners. Statistically significant increases were found for all treatment options falling into Step 2 recommendations when comparing mild to moderate disease. Statistically significant increases were also found for all treatment options when comparing moderate to severe disease, except for preserved tear supplements which declined in recommendation as severity increased. Provision of an extended service did not alter the management options employed.

In this survey, sixty percent of respondents reported that all their patients are satisfied/managed with artificial tears alone. In 2020, Craig et al. reported that one in three of their participants did not respond with improved signs or symptoms to either of the newer, more targeted artificial tear therapies evaluated [17]. While practitioners prescribe artificial tears across all severity levels of DED, they are more than twice (2.24 times) as likely to prescribe preservative free supplements over preserved options; more than that found in a recent global survey including ophthalmologists (1.27 times) [9]. This study also indicates that unpreserved options, as with lubricating ointment at bedtime, are more likely to be prescribed in the UK as the severity of the disease increases.

The IP practitioners were significantly more likely to manage a patient with a pharmaceutical agent. Of the total respondents with IP training, 87% agreed that the qualification had widened their ability to diagnose and treat DED. This widened ability was reflected in the IP optometrist's higher likelihood of recommending prescription medications for the treatment of moderate and severe DED. IP optometrists were more than twice as likely to recommend a topical steroid to treat the inflammation associated with moderate and severe DED compared to non-IP optometrists. Previously a significant difference in the prevalence of topical steroid prescribing for moderate (1% and 14%) and severe DED (8% and 52%) has been reported between the UK and Australia respectively [11]. The low rate of steroid prescribing by UK practitioners when the survey took place in 2016, was attributed to the low number of prescribing optometrists at the time; approximately 2% of the workforce. Therefore, this study provides evidence of an increase in steroid prescribing for moderate and severe DED in the UK.

Interestingly, 82.6% of IP qualified optometrists, a similar percentage to non-IP qualified optometrists (85.7%), would still refer severe DED to an ophthalmologist. A previously reported reason for over 50% of UK referrals was for prescription of topical medications [11]. This survey did not address the current reasons for referral. However, although more optometrists are now able to prescribe, regional differences in Clinical Commissioning Group prescribing formularies are known to exist. A third of the IP optometrists who responded in this survey would recommend, but not necessarily be able to prescribe, cyclosporin for severe DED. This survey did not identify any regional differences in prescribing.

Regarding clinical procedures used to determine successful treatment, reduction in corneal fluorescein staining was the primary indicator reported, followed by FBUT and anterior lid assessment. A symptomology questionnaire was ranked fifth. Previously an international survey, including dry eye researchers and corneal specialists, reported corneal fluorescein staining as the top sign to indicate treatment response [18] despite its reported poor repeatability [19]. Another study reported patient history as the primary gauge of therapeutic effect [20]. Regardless of whether clinical signs or patient reported symptoms are used, the low associations between them and the low repeatability of clinical tests can confound DED assessment and monitoring of response to treatment [2]. Hence the need for further research and identification of biomarkers that give a more reliable metric of treatment response.

For that reason, one of the aims of this survey was to ascertain

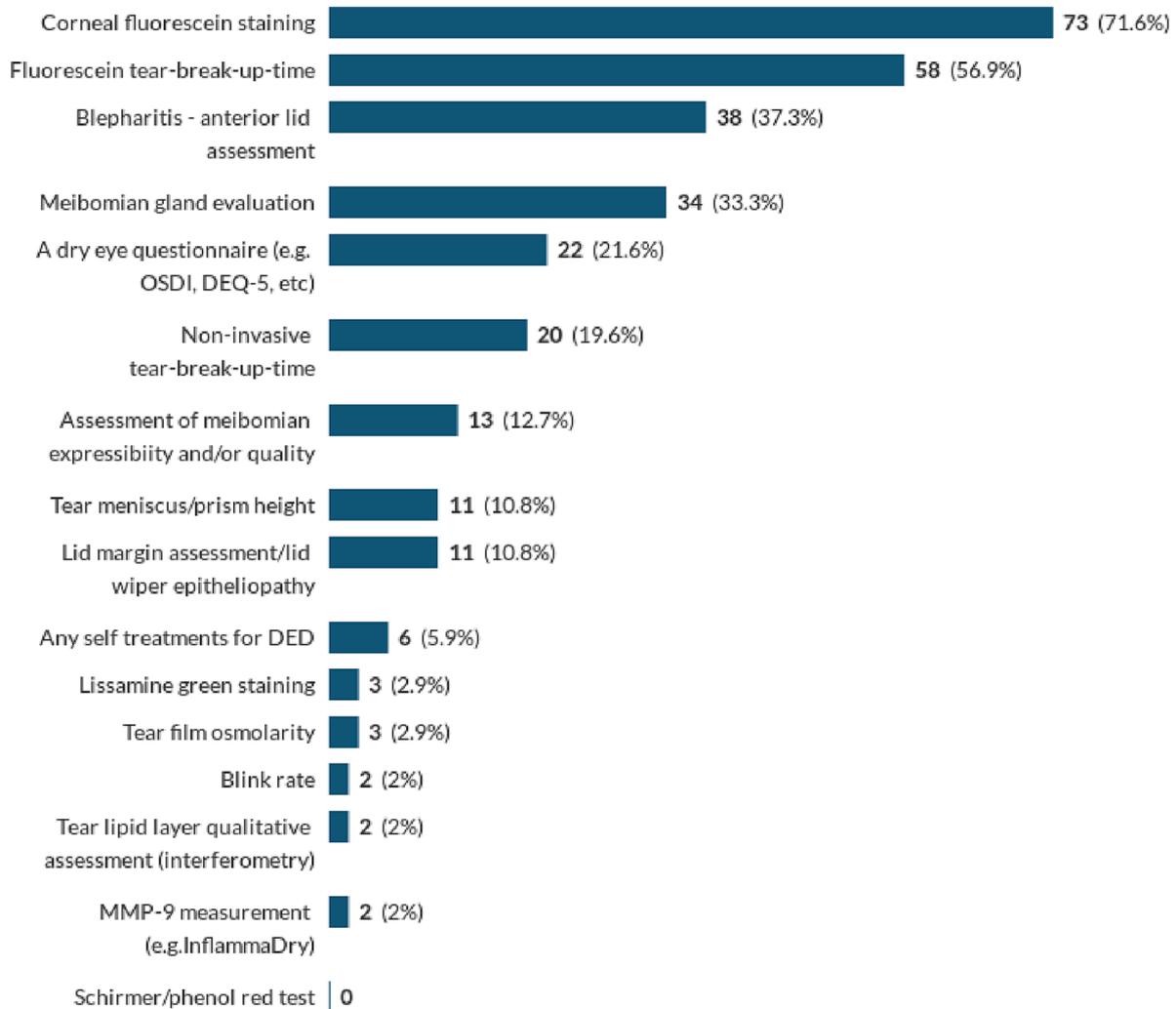


Fig. 5. The three most commonly used clinical procedures preferred for determination of successful treatment. Numbers in bold indicate the number of responses.

whether dry eye research is being translated into practice, specifically the use of tear film biomarkers to give a more quantitative measurement. Very few practitioners reported using tear film osmolarity or MMP-9 measurement to assist in DED diagnosis, even though there is a good evidence base for them [21,22]. Tear osmolarity has been reported to be the best single metric both to diagnose and classify dry eye disease and has been shown to correlate with dry eye severity [23]. While less than ten percent of respondents (7.6%) reported using InflammDry® (Positive Impact, East Sussex, UK) at a specific dry eye appointment, practitioners appeared willing to incorporate a similar device at a very similar cost. Practitioners would also be willing to wait a similar length of time for the results of such an in-office device.

This survey was completed by 131 participants. Limitations of the study include the unknown response rate and whether the study is truly representative of all experience levels i.e., a sufficient sample size. A priori sample size calculation for a *t*-test with medium effect size (Cohen's 0.5) and 80% power was 128, with 64 in each group. For comparisons of the respondents involved in MECS provision with those who are not, post hoc data analysis showed the study was slightly underpowered for a medium effect size (power = 0.78) but exceeded the desired power (0.99) for a large effect size.

In conclusion, this study has provided a current view of UK optometrists opinions and clinical practice patterns with regard to DED diagnosis and management. It has identified an increase in therapeutic management and shown that a stepwise approach to management is being employed. Although an increase in evidence-based practice can be

seen, the limited adoption of tear film biomarkers for diagnosis and management highlights the potential to further improve the translation of dry eye research evidence into clinical practice.

Transparency Declaration

The corresponding author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and there is no discrepancy from the study as planned.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.clae.2023.101889>.

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