Ophthalmol Ther (2026) 15:47–61
https://doi.org/10.1007/s40123-025-01261-5

REVIEW

A Narrative Review on the Diagnosis of Dry Eye Disease: Insights from the Italian Dry Eye Consensus (IDEC) Group

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Received: August 12, 2025 / Accepted: October 6, 2025 / Published online: November 12, 2025

ABSTRACT

The purpose of this manuscript is to report the state-of-the-art advances and consensus proposed by an Italian Dry Eye Consensus Group (IDEC) for the diagnosis of dry eye disease (DED). A targeted review of the literature was carried out, not intended as a meta-analysis or systematic review, but as a selection of authoritative evidence-based guidelines and consensus papers issued by scientific societies or expert panels, which provided the basis for structured group discussion. The diagnostic criteria reported in these publications were organized in tables with a subdivision into levels, from basic to more complex tests, and were discussed in light of both the published data and daily clinical experience. The IDEC consensus highlights a pragmatic, stepwise diagnostic workflow: careful documentation of symptoms (using validated questionnaires where possible), identification of risk factors, slit-lamp assessment with vital stains (fluorescein and lissamine green), and measurement of tear film stability by tear break-up time (TBUT)—or by noninvasive TBUT measurement (NIBUT) where available, and corneal sensitivity—represent the minimum cost-effective core set. A series of second-level targeted tests can then be selectively applied to refine the diagnosis, including corneal sensitivity, osmolarity, meibography, Schirmer I test or meniscometry, and ocular surface imaging. The group also discussed the potential role of all-in-one high-tech devices and digital tools (e.g., smartphone-based applications) as these become more accessible. Grounded in real-life clinical experience, the IDEC consensus offers a pragmatic and cost-effective diagnostic workflow that complements international guidelines and can be readily applied in daily practice.

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PLAIN LANGUAGE SUMMARY

Dry eye disease is a common, chronic condition that affects the surface of the eye and can cause discomfort, vision problems, and a reduced quality of life. Diagnosing dry eye disease can be challenging because symptoms vary greatly from person to person, and the relationship between symptoms and measurable signs is often weak. The Italian Dry Eye Consensus (IDEC) Group—made up of 35 eye specialists from across Italy—reviewed scientific studies and combined them with real-life clinical experience to develop practical suggestions for diagnosing dry eye disease. They recommend starting with a detailed patient history to identify risk factors, using symptom questionnaires (such as OSDI or DEQ-5), and examining the eyes with a slit lamp and special dyes to detect surface damage. Basic tests, such as measuring tear stability (TBUT), tear production (Schirmer test), and corneal sensitivity, are key for all patients. In some cases, additional targeted tests—such as meibography, tear osmolarity measurement, or imaging with high-tech devices—can help identify specific types of dry eye disease and guide treatment choices. The IDEC approach provides a step-by-step diagnostic pathway that can be adapted to different clinical settings, aiming for accurate diagnosis and tailored treatment for each patient.

Keywords: Dry eye disease; Diagnostic consensus; Italian Dry Eye Consensus Group; Tear film assessment; Ocular surface evaluation

Key Summary Points

Why carry out this study?

Dry eye disease (DED) is complex, with varied symptoms and signs, making diagnosis challenging and often inconsistent between clinics.

Although international guidelines provide recommendations for diagnosing DED, there is still variability in how these protocols are applied in clinical practice, and the choice and interpretation of tests can differ between settings.

The Italian Dry Eye Consensus Group aimed to create a practical, stepwise diagnostic approach on the basis of both scientific evidence and everyday clinical experience in Italy.

What was learned from this study?

A combination of patient history, symptom questionnaires, slit-lamp examination with vital stains, tear stability, and corneal sensitivity measurement forms the essential first step in DED diagnosis.

Additional tests—such as meibography, meniscometry, tear osmolarity, or high-tech imaging—should be used selectively to identify DED subtypes and guide targeted treatments.

This tiered diagnostic pathway is adaptable to different clinical settings, improves diagnostic consistency, and supports more personalized patient care.

INTRODUCTION

Dry eye disease (DED) is a chronic and progressive condition of the ocular surface system, which comprises the epithelia of the cornea and conjunctiva, the main and accessory lacrimal glands, the meibomian gland, the tears, the eyelashes with the glands of Moll and Zeis, the parts of the eyelids responsible for blinking, and the nasolacrimal duct. All components of this system are linked functionally by continuity of the epithelia, innervation, and the endocrine, immune, and vascular systems [1].

The human eye is usually protected from evaporation and dehydration by the homeostasis of the tear film, which regulates tear secretion and distribution on the ocular surface in response to the blink reflex. DED is characterized by a low quantity and/or quality of tears, destabilizing this microenvironment. The primary mechanism in DED is evaporative water loss resulting in tear hyperosmolarity. These mechanisms result in ocular surface inflammation and cell apoptosis in both corneal and conjunctival

epithelial cells and conjunctival goblet cells [2]. Dry eye has two basic subclassifications: aqueous deficient dry eye (ADDE), with primary and secondary Sjögren's syndrome (SS), and evaporative dry eye (EDE), owing to either intrinsic or extrinsic factors [3].

Diagnosis begins with determining the essential nature of the dry eye: ADDE or EDE. Given that Sjögren's syndrome (SS) is a primary cause of aqueous-deficient DED, it requires specific consideration. SS is a chronic autoimmune disease leading to exocrine gland dysfunction [4, 5] and should be distinguished from non-Sjögren ADDE, which may also result from age-related lacrimal hypofunction, duct obstruction, reflex block, or systemic medications such as anticholinergics. Evaporative dry eye (EDE) may result from intrinsic factors such as meibomian gland dysfunction, incomplete blinking, or isotretinoin therapy [3], and from extrinsic factors including topical medications or preservatives, contact lens wear, prolonged screen use, dry environments, ocular surface allergies, or vitamin A deficiency [2, 6]. More recently, environmental pollution, hormonal alterations, and intestinal dysbiosis have also been implicated [2].

DED prevalence ranges from 5 to 50% worldwide, this wide variation is related to several factors, including geographical differences and diagnostic criteria [7]. The growing and aging population, along with changes in lifestyle habits and risk behaviors, is expected to lead to a rise in the number of people affected by DED, which is increasingly recognized as a condition influenced by lifestyle factors [8]. As a consequence of the intensive research work on the etiopathogenesis of DED, its definition has changed over the years, gradually recognizing the complexity of the disease and the involvement of several biological processes at the basis. The most recent definition of DED states that "Dry eye is a multifactorial disease of the ocular surface characterized by a loss of homeostasis of the tear film and accompanied by ocular symptoms in which tear film instability and hyperosmolarity, ocular surface inflammation and damage, and neurosensory abnormalities play etiological roles" [9].

Symptoms can commonly range from itching or foreign body sensation to burning and stinging. However, there is consensus that the association between subjective symptoms and clinical objectivity is weak in DED [10]. In daily practice, it is common to observe patients reporting even severe subjective symptoms of discomfort or pain but without objective pathological signs on the ocular surface or, conversely, asymptomatic patients with severe signs. Recognizing the underlying multifactorial and heterogeneous nature of the disease and the wide variation in symptoms has certainly led to greater complexity in the clinical recognition process of the disease, with deep implications and increasing difficulties for diagnosis and treatment.

The diagnosis of DED is no longer limited to identifying aqueous tear deficiency but encompasses a broader spectrum of pathogenic mechanisms. Over the years, the diagnostic process has evolved into multi-tiered algorithms that incorporate an increasing number of clinical tests and imaging techniques. The main challenge is not the inadequacy of available tests per se, but rather the lack of consensus regarding their standardization, the definition of reliable cut-off values, and the establishment of a hierarchy of use based on the core mechanisms underlying DED.

Numerous tests are available to assess DED signs, from tear function to ocular surface integrity, yet no standardized protocol exists to reliably track disease progression or treatment response. In addition, the assessment of symptoms remains a critical component of the diagnostic pathway. Several validated questionnaires are in use, with the ocular surface disease index (OSDI) being the most widely applied in both clinical practice and research. Its use in contact lens wearers has been questioned, since the OSDI was not developed for this population, whereas the CLDEQ-8 was specifically designed for it [11], underscoring the need to choose questionnaires appropriate to the patient group. A group of recognized expert clinicians and researchers in Italy, who deal with ocular surface disease issues, convened to share common knowledge and experiences on DED clinical practice from different parts of the country, each with varying patient backgrounds. The Italian Dry Eye Consensus (IDEC) group emphasized the need to define a common approach to

DED management, fully aware of the urgency in adopting a standardized protocol. The IDEC group has worked together in creating the "Eye Care 4 Care" project that also includes counseling, patient education, and establishing a medical alliance to promote effective treatment [12, 13].

The aim of this paper is to report the workflow proposed by the Italian Dry Eye Consensus Group and focused on DED diagnosis. The complexity of the disease, the widely different clinical presentations, and the varying contexts in which patients with DED may be managed suggest pursuing a work method based on scientific data as well as real-life experience.

This manuscript presents a narrative review developed to support an expert consensus, rather than a systematic review or meta-analysis, on diagnosing DED. The IDEC review integrates selected literature from authoritative consensus statements with the real-life clinical insights of group members, with the aim of offering a pragmatic and consolidated diagnostic approach.

METHODS

This article is based on previously conducted studies and does not contain any new studies with human participants or animals performed by any of the authors.

Phase 1 of the consensus consisted of a narrative literature review, designed not to be systematic but to identify the most authoritative consensus statements and guideline-type publications on DED diagnosis as a qualified basis for expert discussion.

A PubMed search (January 1993–December 2023) was performed using the terms "dry eye disease" AND "diagnosis" AND "guidelines". The objective was not to retrieve all available publications, but rather to identify the most authoritative sources to inform the consensus process, and we included publications from scientific societies and from expert consensus panels. Accordingly, eight key articles were deliberately selected because they were produced by recognized scientific societies or expert panels, developed through a consensus methodology, and specifically addressed diagnostic aspects of DED. The diagnostic criteria extracted from these articles were organized into tables and subsequently discussed by the IDEC members. In Phase 2, participants convened for two in-person meetings, held in November 2021 and February 2024, to review the diagnostic criteria compiled in Phase 1 and compare them with the group's real-world clinical experience [14].

PHASE 1 – WHAT WAS ALREADY KNOWN

The list of published papers selected included eight manuscripts [15–22]. All groups but one [20] split the diagnostic tests into two levels. Specifically, the first-level tests included:

1. Evaluating the subjective symptoms, possibly by questionnaires;
2. Evaluating the ocular surface damage by applying fluorescein and lissamine vital stains, possibly staged using scoring systems;
3. Evaluating tear film stability using tear break-up time (TBUT), the amount of time in seconds that elapses between a complete blink and the appearance of the first break in the tear film, after fluorescein instillation;
4. Evaluating tear production using Schirmer tear test-1, measured by the length of paper wetting at 5 min;
5. Assessing meibomian gland dysfunction and evaluating the eyelid margins, measured using unspecified or inconsistent methods without scoring systems;
6. Analyzing tear osmolarity when high-tech technical equipment is available;
7. Determining corneal sensitivity, preferably using a Cochet-Bonnet aesthesiometer;
8. Evaluating inflammatory status using the matrix metalloproteinase-9 (MMP-9) test, a point-of-care medical device.

Information about the tests and their relative cut-offs, if indicated, is in Table 1. The following paragraphs describe and briefly report discussion of the IDEC group on data emerged from the review of these first-level tests.

Table 1 First level diagnostic tests and their cut-offs, as emerged by the eight papers included in the analysis during the Phase 1 of the IDEC work

	DTS Study Group [15]	Cut-off	ODISSEY European Consensus Group [16]	Cut-off	Messmer [17]	Cut-off	Foulks et al. [18]	Cut-off	Asia Dry Eye Society [19]	Cut-off	P.I.C.A.S.S.O. board [20]	Cut-off	TFOS DEWS II [2]	Cut-off	ASCRS [22]	Cut-off
First-Level Diagnostic Tests																
Symptoms questionnaire	OSDI		OSDI	> 33	OSDI		OSDI		OSDI				OSDI	≥ 13	SPEED	*
					IDEEL		SPEED		DEQ-5				DEQ-5	≥ 6		
							IDEEL		McMonnies							
							SANDE		Women's Health Study							
Ocular surface staining (fluorescein/lissamine)			Oxford scale	Cornea (fluo) ≥3	Oxford scale	Cornea (fluo) ≥3			Not mandatory					>5 corneal spots		
			Oxford scale	Conj.va (lissamine) ≥3	Van Bijsterveld index	Conj.va (lissamine) >3,5								>9 conj.val spots		
Tear break-up time (TBUT)				< 3 sec		< 10 sec		< 10 sec		< 5 sec			TBUT	< 10 sec	Second level test NI-TBUT	< 10 sec
													NI-TBUT	< 2,7 sec		
Schirmer's test (paper wetting length 5')				< 3mm		< 5 mm		< 10 mm	Not mandatory	< 5 mm				6-10 mm		
Meibomian gland dysfunction				Severe										MGD stage 1		
Eyelid margins					interblink interval	6-2,6 sec	marginal tear strip	< 1mm								
					lid incongruity / insufficient closure											
Tear osmolarity				> 328 mOsm/L	Not mandatory									>308 mOsm/L or interocular difference >8		>307 mOsm/L or interocular difference >7
Corneal sensitivity																
Matrix metalloproteinase-9 (MMP-9)					Not mandatory									≥ 40 ng/ml		≥ 40 ng/ml

* ≤2 = asymptomatic, 5 = mild, 6.6 = moderate, 9.9 = severe DED. § Ocular/visual symptoms sometimes, often, always, daily life limited.

LEGENDA: Present Lacking Not indicated.

FIRST LEVEL TESTS

Symptoms Assessment

Evaluating the subjective symptoms is a first-level criterion common to all the papers listed in Table 1. Symptoms reported, such as foreign body sensation, burning, lacrimation, desire to keep one's eyes closed, dryness, redness, itching, sporadic fuzzy vision, and asthenopia, serve as a useful guide for identifying subjects suffering from DED. Unfortunately, these symptoms are not specific to DED and can differ wildly from patient to patient. Additionally, it is widely recognized that discomfort symptoms and objective signs are often poorly related in patients with DED, as reported above [10], in such a way that an algorithm crossing symptomatic or asymptomatic patients with or without signs has been introduced by the TFOS DEWS II report [9]. Other researchers explored this issue further, and some authors proposed classifying patients into categories, i.e., those suffering from neuropathic pain (severe or moderate symptoms) and those with a preclinical state of DED (mild or moderate symptoms) [23]. Other Authors instead suggested stratifying asymptomatic patients with objective signs into those with reduced corneal sensitivity due to neurological disorders, and those predisposed to developing DED, for example, following ophthalmic surgery [22].

In Table 1, the OSDI was the questionnaire of choice by six out of eight groups. The TFOS DEWS II report [21] also associates with the execution of DEQ-5. Messmer et al. [17] also suggest using the Impact of Dry Eye on Everyday Life (IDEEL) questionnaire to better assess the impact of symptoms on quality of vision, and Foulks et al. [18] also refer to Symptom Assessment in Dry Eye (SANDE). The American Society of Cataract and Refractive Surgery (ASCRS) group [22] created a specific questionnaire called the Standard Patient Evaluation of Eye Dryness (SPEED), which is intended primarily to highlight the presence of hazardous risk factors for patients who are candidates for eye surgery. For the specifics of the questionnaires and their comparison, readers are referred elsewhere [24].

Tear Film Stability

Measuring TBUT is the most frequently used test to evaluate tear film stability, chosen by seven out of eight groups. The TFOS DEWS II report recommends using the noninvasive TBUT measurement (NIBUT), which avoids fluorescein instillation, although the two methods are highly correlated [25]. Since noninvasive tests for DED also require alternating blinking or strong illumination, the order in which tests are conducted can have an impact on the outcomes. Tests should therefore be conducted in order of increasing invasiveness. The subjective judgement of the observer is a significant drawback of TBUT measurement, and efforts have been made to automate it as a result [26].

Ocular Surface Staining

Staining the ocular surface with vital dyes, such as fluorescein and even better with double staining using fluorescein and lissamine green, is considered by 6 out of 8 researchers to be a first-level diagnostic test, while it would be considered a second-level test for the members of the Asian Dry Eye Society and the ASCRS. Staining with vital dyes would be especially useful to assess the height of the lacrimal meniscus [17, 18] and perform a staging of the severity of the damage to the epithelium of the ocular surface, such as the Oxford grading score [16, 17, 21].

Eyelid and Meibomian Gland

Researching the presence of signs of pathology of the meibomian glands and eyelids as well as alterations in blinking are considered fundamental first-level tests by 5 out of 8 researchers, as shown in Table 1. Tsubota and the Asian DED Society prefer observing and investigating the presence of MGD, especially in the patient's symptom interview.

Corneal Sensitivity

Only two of the reviewed groups considered reduced corneal sensitivity a first-level diagnostic feature, but the IDEC panel stresses its value in patients at risk of nerve fiber damage, such as those with neuropathic pain or post-surgical changes [16, 20].

Tear Osmolarity

Assessing tear osmolarity is considered a first-level test in only two consensus reports (ASCRS and TFOS DEWS II [21, 22]); Messmer et al.[17] noted that it is not mandatory, while the other documents did not include it among the recommended diagnostic assessments. There is greater inter-eye variability of osmolarity in DED than in normal eyes [27], and the inter-eye differences increase with disease severity, with the threshold of 8 mOsm/L being an indication of the loss of tear film homeostasis that occurs with DED [28].

Schirmer Test

The relevance and importance of a historical test for diagnosing DED, such as Schirmer's test, today have been re-evaluated, as shown in Table 1, where this test is considered a first-level diagnostic test by only four out of eight researchers [16, 17, 21, 27]. However, for the other groups, it is regarded as a second-level diagnostic test. This is owing to the ongoing academic discussion on the specificity and sensitivity of the Schirmer test in diagnosing DED, as there is wide variation between patients, which reduces the performance of the test.

Ocular Surface Inflammation

Measuring the level of inflammatory biomarkers on the surface of the eye, such as the MMP-9, is generally considered a second-level diagnostic test, while for the ASCRS, this test is considered fundamental for presurgical screening.

SECOND LEVEL TESTS

The second-level diagnostic tests included a variety of other tests, as listed in Table 2. Some researchers emphasized using technological tools useful in second-level diagnosis, with the most cited being meibography [7–9], studying tear meniscus height (TMH) using meniscometry with video meniscometry or OCT [8, 13], confocal microscopy observation of eventual tissue damages or infiltration [7, 8], and measuring the thickness of the lipid layer of the tear film or LLT [8, 13]. However, none of these tests is suggested and included by more than two out of eight groups.

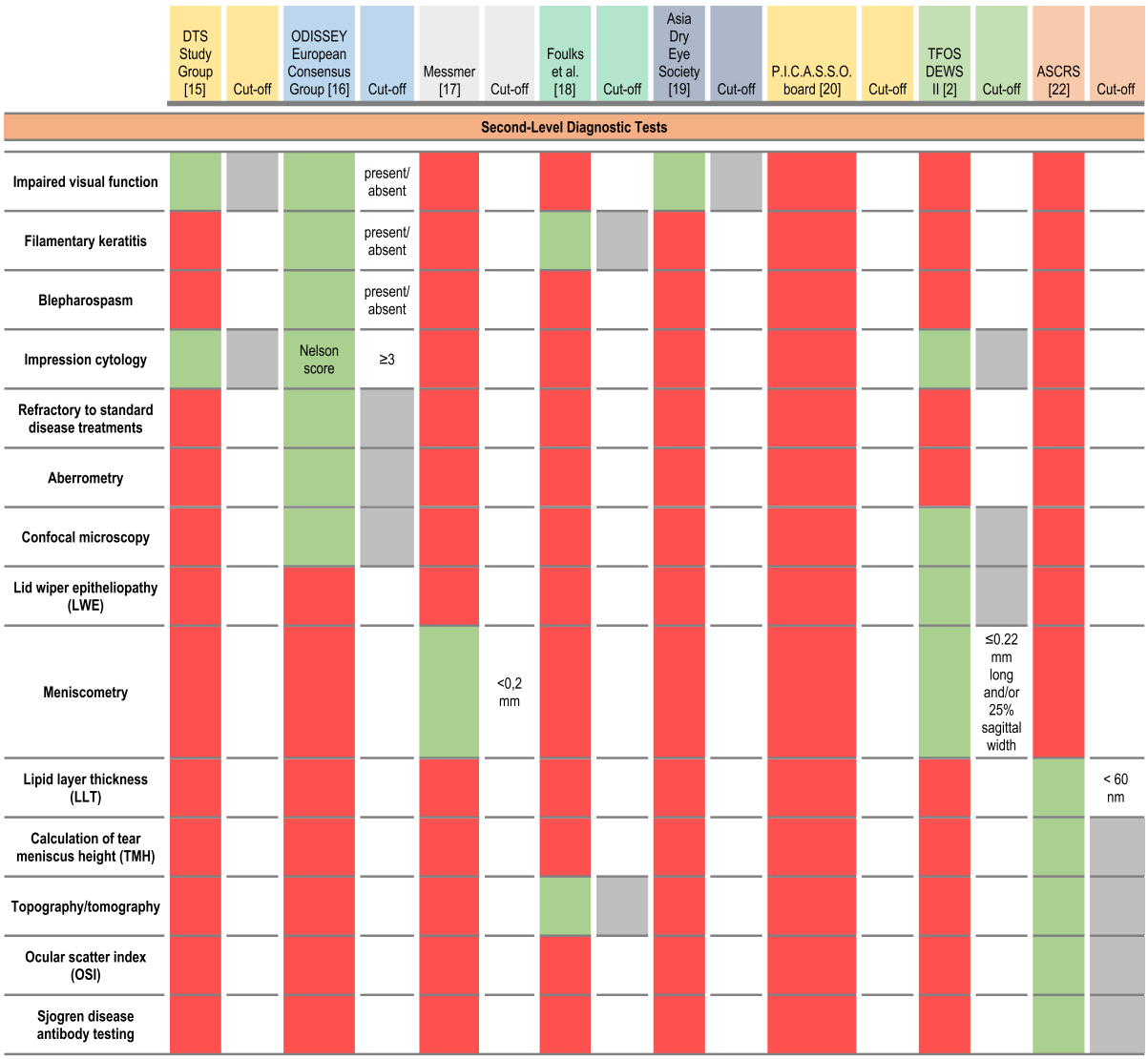
Evaluating functional visual acuity (FVA) and FVA variability [29] associated with blinking or instillation of artificial tears and the application of impression cytology for evaluating squamous metaplasia in conjunctival epithelial cells were included by three out of eight groups. Impression cytology sampling and analysis has contributed to significant advances in DED diagnosis and research and has been used increasingly, as it may provide biomarkers that can be used as outcome measures in clinical trials [30].

Impression cytological samples can also be examined by scanning electron microscopy, which allows the evaluation of the microvilli of the epithelial cells; the number and morphology of these cell protrusions are a very sensitive index of the health status of the epithelial surface and allow the evaluation of initial suffering of the epithelium and of the trophic or toxic effects of drugs [31–33].

PHASE 2 – DIAGNOSTIC SUGGESTIONS ARISING FROM THE IDEC GROUP

The collaborative work of the 35 Italian doctors who make up the Italian Dry Eye Consensus Group, although it cannot replace the scientific rigor of a systematic review or meta-analysis, aimed to draw suggestions on the management

Table 2 Second level diagnostic tests and their cut-offs, as emerged by the eight papers included in the analysis during the Phase 1 of the IDEC work



LEGENDA: Present Lacking Not indicated.

of DED on the basis of scientific literature and of real life experiences to apply certain guidelines in specific reference contexts [12].

IDEC members had previously evaluated Tables 1 and 2 and met in person to discuss the application of the listed tests in daily practice. For the diagnostic evaluation and for the preliminary identification of risk factors, the IDEC group considered the patient's interview history to be crucial and recommended asking specific questions, such as:

- Inquiring about environmental conditions, including work activities, and the coexistence of other eye disorders (allergic conjunctivitis, lacrimal duct disorders, etc.)

- Systemic diseases (diabetes, rosacea, rheumatoid arthritis, thyroid issues, autoimmune diseases, or family histories of diseases)
- Ongoing therapies (antidepressants, gastroprotectants, hormone replacement therapy)
- Previous eye surgeries
- Hormonal status, namely perimenopause.
- Use of contact lenses, including type, duration of wear, and adherence to proper wearing regimen.

The assessment of self-reported subjective symptoms was considered crucial to identify patients with DED, as highlighted by the literature analyzed above in the first step and in Table 1. The IDEC group recommended the use of standardized symptom questionnaires whenever time permitted, with a preference for the OSDI and, for its brevity and sensitivity to symptom intensity, the DEQ-5. While the CLDEQ-8 was specifically developed for contact lens wearers and may provide additional insights in this subgroup [11], it is less commonly adopted in daily practice in Italy. The cut-offs indicated by the literature are > 13 out of 100 and > 6 out of 22, respectively. The group also discussed the use of visual analogue scales (VAS) and questionnaires such as the SANDE pain scale or VAS, which should also be taken into consideration for the continuous evaluation of comfort. The IDEC Panel agreed that diagnostic tests should be performed in a logical order, starting from the least invasive and moving to the most invasive, so as to avoid disturbing the tear film and compromising the reliability of subsequent evaluations.

In accordance with the groups listed in Table 1, the IDEC Group included slit-lamp evaluation of the ocular surface (eyelids and eyelid margins, conjunctiva, cornea, tear meniscus), preferably enriched with vital stains, as a fundamental diagnostic test. IDEC members examined how factors, such as tear hyperosmolarity, inflammation, and meibomian gland dysfunction, contribute to DED onset and progression; in particular, they emphasize the importance of assessing for signs of inflammation and epithelial surface damage and believe that the frequency of meibomian gland dysfunction in clinical practice is underestimated and underdiagnosed. The importance of evaluating blinking behavior was also discussed, focusing on incomplete blinks – as the percentage is high in patients with DED [34] and is related to symptoms and tear stability [35, 36]. Fluorescein and lissamine green are dyes used in clinical practice. The first stains the precorneal tear film and epithelial erosions in the conjunctiva and cornea and the second highlights superficially damaged cells with a defective mucin layer [37]. Staining of the ocular surface is also useful for evaluating the height of the tear meniscus [17, 18] and staging the severity of damage to the corneal and conjunctival epithelium using standardized indices such as the Oxford grading and NEI score [16, 17, 21]. The literature suggested counting the number of fluorescein-stained spots with pathological values for corneal spots > 5 and conjunctival spots > 9, according to NEI score [21].

Furthermore, the IDEC Panel recommended testing tear film stability by measuring TBUT, with a cut-off value of less than 10 s from the appearance of the first black spot after fluorescein instillation, as indicated by the literature. Non-invasive TBUT (NIBUT) has also been proposed, but its repeatability in DED is limited by tear film instability; therefore, three consecutive measurements are usually averaged, although variability remains high [38]. The impact of tear film instability on FVA was also highlighted in the discussion and the use of FVA as an indirect sign of the severity of DED, but particularly useful in assessing quality of life, was mentioned. Even the measurement of corneal sensitivity with cotton thread or with a Cochet-Bonnet aesthesiometer, when available, has been considered a fundamental test, especially in patients undergoing anterior segment surgery or suffering from diseases with possible damage to the nerve fibers, and as emerges from analysis of the literature, with a cut-off level of < 50 mm extrusion filament length.

The IDEC group highlighted how the introduction of further levels of instrumental tests is useful to better address the diagnostic subtypes of DED. Identification of specific deficits in the ocular surface system could provide a useful rationale to guide clinical management and timing (Fig. 1). An algorithm developed by IDEC for diagnosing DED integrates patient history,

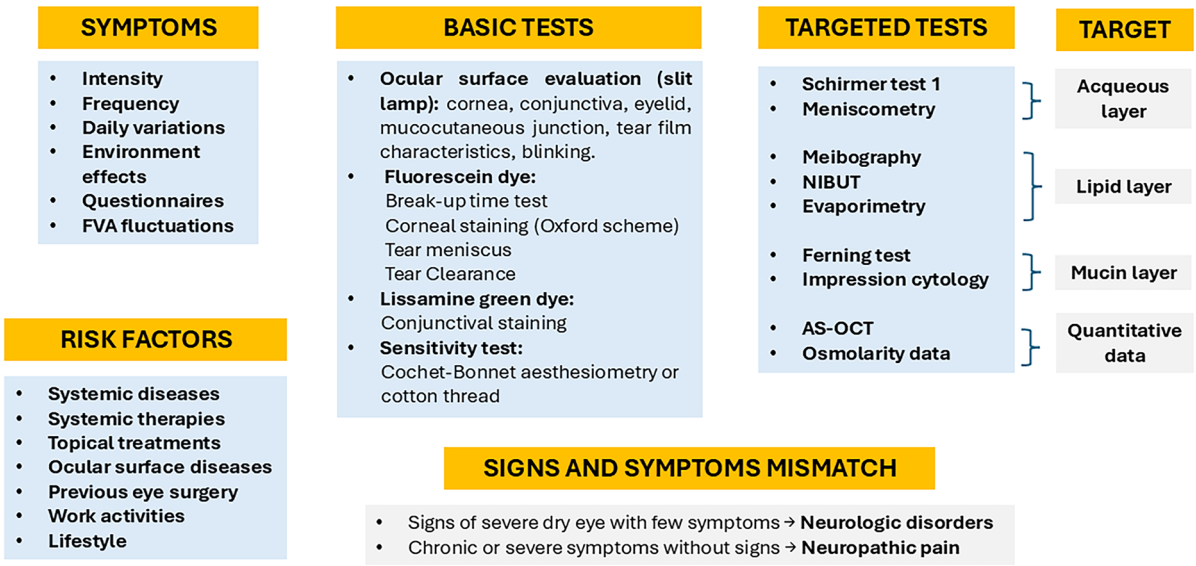


Fig. 1 Stepwise diagnostic workflow proposed by the IDEC consensus, designed as a practical guide for clinicians. The figure summarizes the organization of tests based on the scientific literature reported in Tables 1, 2 and their targeted use in clinical practice. After anamnesis and evaluation of risk factors, the basic tests are performed—indicated in most guidelines and recommendations as level I tests and considered essential for a correct patient classification—followed, when appropriate, by targeted in-depth tests. On the right, the corresponding "targets" highlight the added value of these additional investigations in defining diagnostic subtypes of DED. The sequence follows the principle of moving from the least to the most invasive tests

symptom assessment, and tiered diagnostic testing with a targeted progression from basic pathological changes to a more refined qualitative or quantitative assessment of the pathogenic components most involved in the individual case. Figure 1 outlines a stepwise approach, allowing clinicians to identify DED subtypes and guide treatment. This includes a thorough history and basic testing such as slit-lamp assessment, TBUT, staining, and sensitivity testing, and progression to targeted tests for more complex cases, ensuring comprehensive care. This diagnostic workup is strongly oriented towards planning the subsequent therapeutic strategy.

In patients suffering from predominantly hyperevaporative DED and with alterations of the eyelid margin, the opportunity to specifically evaluate the quality of the lipid layer of the tear film and the dysfunction of the Meibomian glands (MGD) is highlighted. It was believed that acquisition of images of the meibomian gland using cameras connected to slit lamps equipped with infrared filters (or analysis of meibography using high-tech instruments) may be important for diagnosing and staging the degree of MGD, as well as to adequately follow patients over time. The quantity of tears can be measured with the Schirmer test or with meniscometry (with high-tech equipment), although it is recognized that, historically, the Schirmer test is too variable and nonspecific, but it is often the only one tool available in practice to identify and provide quantitative data on hyposecretive forms, such as Sjogren's syndrome.

In Table 3 we summarized the main diagnostic tests together with their cutoff values, as suggested by the literature, and a brief description of the purpose of each test.

Among the many useful tests proposed by the literature review, the IDEC group highlighted the usefulness of some of them for detecting other disorders that may be potential targets in patient management. The mucous layer of the tear film can be assessed by the ferning test, although its clinical utility remains debated. (Authors' note: the IDEC consensus meetings were held before

Table 3 Main diagnostic tests and their diagnostic cutoffs suggested by the literature

Diagnostic Test	Purpose	Cut-Off Value
OSDI	Symptom severity assessment	≥ 13 out of 100
DEQ-5	Symptom intensity and brevity	≥ 6 out of 22
Tear Break-Up Time (TBUT)	Tear film stability assessment	< 10 s
Schirmer Test I	Tear production measurement	< 5 mm /5 min
Staining (NEI score)	Epithelial damage	corneal spots > 5 conjunctival spots > 9
Meniscometry	Tear production	< 0,2 mm
Sensitivity test (Cochet Bonnet)	Nerve fiber damage	< 50 mm

the publication of the TFOS DEWS III diagnostic report; the latter emphasized that hyperosmolarity also affects the ferning pattern and therefore recommended caution in interpreting this test [21]. The degree of dryness can be assessed by analyzing conjunctival epithelial cells and goblet cells sampled by impression cytology, and objective measurements of ocular surface structures can be acquired with the segment anterior OCT or evaluation of tear osmolarity. The latter tests are not part of a diagnostic routine but can be useful in specific cases to clarify the diagnosis and define the degree of involvement of the various components of the ocular surface. The application of diagnostic technical instruments can enhance the categorization of the different subtypes of DED: Meibography and the assessment of NIBUT more accurately delineate the modifications of the Meibomian glands and the stability and distribution of the tear film, which are frequently disrupted in patients with EDE. The Schirmer 1 test, despite its limits, meniscometry evaluated using AS-OCT, and the assessment of tear film osmolarity more accurately characterize the changes in tear film volume commonly observed in individuals with substantial ADDE abnormalities. The role of Goblet cells and the modifications of the mucin layer can be assessed by the Ferning test and impression cytology, which are nonstandard exams that enhance the comprehension of the ocular surface's degree of impairment.

In fact, it is suggested to execute tests of greater complexity or technological commitment in a targeted manner, when the need to delve deeper or quantify some aspects of the pathology is revealed from the basic evaluation. This will establish the most appropriate therapeutic strategy for the specific case.

DED DIAGNOSIS—AID FROM HIGH-TECH DEVICES NOW AND IN THE FUTURE

Given that clinical manifestations of DED are highly variable, the group also discussed and agreed that diagnosis should be based on a combination of symptoms, signs, and clinical tests since a significant number of patients are excluded by using any one test alone. Furthermore, recognition and characterization of patients, in terms of disease sub-type and severity, is of clear relevance, as any therapeutic choice should be tailored to each patient by targeting the specific mechanisms involved.

Recent technological advances have been introduced in clinical settings, with quite a number of high-tech diagnostic devices, a kind of all-in-one instrumentation providing several measurements simultaneously. These instruments show improvements over traditional methods of diagnosis, such as being noninvasive, delivering

standardized and objective results, and being user friendly without any particularly difficult learning curve for collecting and interpreting data [37]. These instruments include:

- Tearscope-Plus™ (Keeler, Windsor, UK)
- EasyTear View+® (EasyTear, Rovereto, Italy)
- Oculus Keratograph® 5 M (Oculus, Arlington, WA, USA) (K5M)
- LipiView® interferometer (TearScience Inc., Morrisville, NC, USA)
- IDRA® Ocular Surface Analyzer (SBM Systemi, Orbassano, Torino, Italy)
- LacryDiag® Ocular Surface Analyzer (Quantel Medical, Cournon-d'Auvergne, France)
- CA-800 topographer equipped with ocular surface analysis modules (Topcon, Japan)
- Ocular Surface Analyzer (SBM Systemi, Orbassano, Torino, Italy).

(Authors' note: This list is not exhaustive; newer automated/AI-assisted devices have since been described, such as the Mediworks D-130, reported here only as an example [38]).

Common measurements include evaluating conjunctival hyperemia (by comparing with consolidated severity scales), meniscus height, lipid layer pattern (based on interferometry), NIBUT, based on Placido ring distortion evaluation, meibomian gland analysis (based on comparing infrared images with scoring systems or estimated by internal semi-automated software for image analysis). Despite the enormous benefits provided by shifting diagnostic to a standardized and less operator-dependent procedure, thus enabling more appropriate monitoring of disease progression and treatment effectiveness, some recent reviews suggest the reliability of these devices needs further improvement [39]. Readers are directed to reviews for deepening the knowledge on the performance of each of the instruments above listed [39, 40].

The group also discussed how diagnosis might change in the future, given the increasing number of patients affected (not even considering another dramatic health management issue due to a future pandemic) and the difficulties in managing these patients in a timely manner. Owing to this potential overload, patients with DED could remain undiagnosed and inadequately treated. Interestingly, evidence and proposals on using mobile health smartphone apps are now emerging in the literature, developed as a noninvasive, noncontact, and remote screening device [41, 42]. The ocular surface is the preferred site for standardized imaging acquisition, which can be then quantitatively analyzed. Smartphones and mobile applications are already being used in the real world for communication, medical education, and training, with patients keeping a structured diary to help monitor the situation over time and aid in clinical decision making. However, concerns about patient data protection and privacy have yet to be resolved, so caution is recommended in the extensive use of these devices, even from a legal standpoint for healthcare professionals.

CONCLUSIONS

The stepwise diagnostic approach outlined in the IDEC consensus (history/symptom assessment, slit-lamp examination with double vital staining, TBUT, and targeted second-level testing) shows substantial similarities to the recently published TFOS DEWS III diagnostic report [21]. Both emphasize the combination of symptoms and at least one marker of tear film homeostasis loss, favoring less invasive tests first and integrating selected second-level procedures to define the clinical phenotype.

Participants in the IDEC group are listed in the Appendix to acknowledge their contribution and to reflect the diversity of their clinical settings and geographic distribution across Italy. This narrative review summarizes a consensus process grounded in literature discussion and expert real-life experience, aimed at defining a pragmatic diagnostic approach applicable in various clinical contexts. The group continues to promote and refine this workflow through educational events based on a "learning by doing" approach.

In summary, the IDEC group identifies a clear priority: start with symptoms and risk factors, then proceed with vital-stained slit-lamp findings and TBUT as core tests. These simple,

low-cost steps secure an accurate diagnosis. Second-level tests, such as corneal sensitivity, osmolarity, or ocular surface imaging, can then add precision, thus defining subtypes and guiding truly personalized care as technology becomes more widely accessible.

ACKNOWLEDGEMENTS

The Authors wish to express their gratitude to all the members of the Italian Dry Eye Consensus (IDEC) Group . The IDEC group members are Pasquale Aragona, Giuseppe Giannaccare, Rita Mencucci, Pierangela Rubino, Emilia Cantera, Claudia Yvonne Finocchiaro, Francesco Aiello, Elena Antoniazzi, Stefano Barabino, Stefano Bonini, Gianpaolo Carlini, Chiara Chierego, Rossella Anna Maria Colabelli Gisoldi, Antonio Di Zazzo, Romina Fasciani, Antonella Franch, Giovanna Gabbriellini, Caterina Gagliano, Andrea Leonardi, Angelo Macrì, Luigi Mosca, Vincenzo Orfeo, Antonio Pinna, Augusto Pocobelli, Romolo Protti, Paolo Rama, Laura Rania, Miguel Rechichi, Andrea Russo, Vincenzo Scorcia, Leopoldo Spadea, Marco Trentadue, Salvatore Troisi, Piera Versura, Edoardo Villani, and Maurizio Rolando—for their valuable contributions to the development, discussion, and consensus-building process that led to the recommendations presented in this work. The authors also thank Théa Pharma for supporting the IDEC Group meetings.

Author Contributions. Conceptualization, Romina Fasciani, Salvatore Troisi, and Piera Versura; methodology, Romina Fasciani, Salvatore Troisi, and Piera Versura; writing—original draft preparation, Romina Fasciani, Salvatore Troisi, and Piera Versura; writing—review and editing, Romina Fasciani, Salvatore Troisi, Piera Versura, Mario Troisi, and Silvia Odorici. All authors have read and agreed to the published version of the manuscript. All authors meet the International Committee of Medical Journal Editors (ICMJE) criteria for authorship for this article, take responsibility for the integrity of the work, and have given their approval for this version to be published.

Funding. The IDEC consensus meetings received logistical support (travel and accommodation) from Théa Pharma (Clermont-Ferrand, France). Théa had no influence on the content of the discussions, the literature selection, or the manuscript preparation. The journal's publication costs are also covered by Théa Pharma, without any involvement in the scientific content.

Data Availability. Data sharing is not applicable to this article as no datasets were generated or analyzed during the current study.

Declarations

Conflict of Interest. Romina Fasciani, Salvatore Troisi, Mario Troisi, Silvia Odorici, and Piera Versura declare no conflict of interest related to this work. Patients were not involved in the design of the study or the dissemination of the results. Romina Fasciani, Salvatore Troisi, and Piera Versura serve as members of the Italian Dry Eye Consensus (IDEC) Group.

Ethical Approval. This article is based on previously conducted studies and does not contain any new studies with human participants or animals performed by any of the authors.

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