Evaluation of Dry Eyes

Policy Number: AHS – G2138 – Evaluation of Dry Eyes	Effective Date: 11/01/2026

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I. Policy Description

Dry eye disease (dysfunctional tear syndrome, DED) is defined by the Dry Eye Workshop II as "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."[1] Five to fifteen percent of the United States population suffers from dry eye disease, leaving a substantial burden on functional vision, general health status, and workplace productivity.[2]

II. Indications and/or Limitations of Coverage

Application of coverage criteria is dependent upon an individual's benefit coverage at the time of the request.

1) Testing of tear osmolarity **MEETS COVERAGE CRITERIA** in **any** of the following situations:
   a) For individuals who are suspected of having dry eye disease.
   b) To help determine the severity of dry eye disease.
   c) To monitor effectiveness of therapy.

2) For individuals suspected of having dry eye disease based on comprehensive eye examination, testing for MMP-9 protein in human tears **DOES NOT MEET COVERAGE CRITERIA** .

3) For individuals suspected of having dry eye disease, testing for lactoferrin and/or IgE **DOES NOT MEET COVERAGE CRITERIA**.

The following does not meet coverage criteria due to a lack of available published scientific literature confirming that the test(s) is/are required and beneficial for the diagnosis and treatment of an individual's illness.

4) For individuals suspected of having dry eye disease, all other testing not discussed above **DOES NOT MEET COVERAGE CRITERIA**.

III. Table of Terminology

Term	Definition
AAO	American Academy of Ophthalmology
AAOPT	American Academy of Optometry

AOA	American Optometric Association
ASCRS	American Society of Cataract and Refractive Surgery
ATD	Advanced tear diagnostics
CA-6	Carbonic anhydrase-6
CLIA ’88	Clinical Laboratory Improvement Amendments of 1988
CMS	Centers for Medicare and Medicaid Services
DED	Dry eye disease
DEWS	Dry eye workshop
DTS	Dysfunctional tear syndrome
FDA	Food and Drug Administration
IgA	Immunoglobulin A
IgE	Immunoglobulin E
IgG	Immunoglobulin G
IgM	Immunoglobulin M
LASIK	Laser-assisted in situ keratomileusis
LDTs	Laboratory-developed tests
MMP	Matrix metallopeptidase
MMP-9	Matrix metalloproteinase-9
NIKBUT	Non-invasive tear breakup time
OSD	Ocular surface disorders
OSDI	Ocular surface disease index
OSS	Ocular surface staining
PSP	Parotid secretory protein
SP-1	Salivary protein-1
SPEED	Standard patient evaluation of eye dryness
TBUT	Tear break-up time
TFBUT	Tear film break-up time
TFOS	Tear film & ocular surface
VAS	Visual analogue scale

IV. Scientific Background

Tears are necessary for maintaining the health of the inner and outer surfaces of the eyelid and for providing clear vision. The tear film of the eye consists of aqueous, mucous, and lipid components. A healthy tear film is necessary for protecting and moisturizing the cornea, as well as for providing a refracting surface for light entering the eye.[3] Dysfunction of any component of the tear film can lead to dry eye disease (dysfunctional tear syndrome, DED). Dry eye is a common and often chronic problem, particularly in older adults as age affects the entire lacrimal functional unit.[4] The exact prevalence of dry eye is unknown due to difficulty in defining the disease and the lack of a single diagnostic test to confirm its presence, but the 2013 National Health and Wellness Survey estimated the rate of dry eye in the United States to be 6.8%, or about 16.4 million people; prevalence tended to increase with age, with the 18-34 age group only comprising 2.7% of the total and the 75+ age group comprising 18.6%.[5,6] Risk

factors for dry eye include increasing age, systemic comorbidities such as diabetes and autoimmune disease, and therapeutic treatments for anxiety, depression, and sleep disorders.[7]

Further, the 2017 Tear Film & Ocular Surface (TFOS) Society International Dry Eye Workshop (DEWS) II reported that "the core mechanism of dry eye disease is tear hyperosmolarity, which is the hallmark of the disease."[1]

Dry eye is classified into two general groups: decreased tear production and increased evaporative loss. Decreased tear production may lead to hyperosmolarity of the tear film and inflamed ocular surface cells. An age-related ductal obstruction is the most common cause of decreased tear production. Increased evaporative loss is typically caused by problems in the meibomian gland when the glands that produce the lipid portion of the tear film fail. This lipid portion normally allows the tear film to spread evenly, minimizing evaporation. In both groups, tear film hyperosmolarity and subsequent ocular surface inflammation lead to the variety of symptoms and signs associated with dry eye.[6]

Most patients will present with symptoms of chronic eye irritation, such as red eyes, light sensitivity, blurred vision, or unusual sensations (gritty, burning, foreign, etc.). However, significant variability in the patient-reported symptoms and signs, as well as a lack of correlation between these symptoms and signs, make it difficult to diagnose dry eye, and no single definitive test to diagnose dry eye exists. Dry eye is typically diagnosed with a combination of patient symptoms and physical findings, such as reduced blink rate or eyelid malposition.[6] Incomplete blinking may also be considered for mild-to-moderate dry eye assessment.[8] Further, visual acuity was found to be particularly poor in those with vision-related symptoms due to dry eyes.[9]

The primary way to treat dry eye is artificial tears, although corticosteroids, topical cyclosporine A, or anti-inflammatories such as Lifitegrast ophthalmic solution five percent may be used to supplement treatment. Avoiding environmental factors, such as heavy smoke or dry heating air, is also recommended.[10] It was recently reported by Holland, et al. (2019), who reviewed two decades worth of data on the safety and efficacy of controlled topical ophthalmic drug administration for DED treatment, that poor standardization of endpoints across studies causes challenges in the improvement of this field. However, recent advances in drug delivery and a greater understanding of DED will assist in the improvement of ophthalmic drugs.

Accurate diagnosis of dry eye disease requires a variety of tests including patient-reported symptom questionnaires, tear film break-up time (TFBUT), Schirmer test, ocular surface staining, and meibomian gland functionality. However, many of these tests lack consistency and reliability in diagnosis. New tools have been developed which allow for the quantification of tear film characteristics including measurement of tear osmolarity and measurement of inflammatory mediators such as matrix metallopeptidase enzymes, and biomarkers such as lactoferrin.[6]

Tear Osmolarity

Osmolarity is a measurement of the concentration of dissolved solutes in a solution. Hyperosmolarity of the tear film is a recognized and validated marker of dry eye. The following tear osmolarity thresholds have been suggested for establishing the severity of dry eyes: 270-308 mOsm/L for normal eyes, 308-316 mOsm/L for mild dry eye, and >316 mOsm/L for moderate to severe dry eye.[12] Tomlinson, et al. (2006) suggested a cut-off of 316 mOsm/L, but the sensitivity was found to be 0.59 when applied to the

independent sample described in the study. Furthermore, decreasing the cut-off to increase the sensitivity decreased the specificity and overall accuracy significantly. Overall, the overlap between normal and dry eyes contributes heavily to the difficulty in establishing a cut-off.[13] Some studies suggest that osmolarity shows the strongest correlation with severity of dry eye based on the metrics used, but at the same time lack correlation to other objective signs of dry eye. In general, tear osmolarity results vary between clinical signs and symptoms, which can make them difficult to interpret.[14]

The test "TearLab" is based on assessment of the osmolarity of tears. TearLab collects a 50 µL tear sample, analyzes its electrical impedance, and provides an assessment of the osmolarity of the sample and thereby the tear.[3] Baenninger, et al. (2018) completed an extensive systematic review investigating 1362 healthy eyes of participants from 33 different studies; this review found a weighted mean osmolarity of 298 mOsm/L via the TearLab test. Final comments from the researchers highlighted the great variability of osmolarity measurements that were found with the TearLab system, suggesting caution when interpreting TearLab osmolarity results.[15]

In 2023, Trukera Medical, the manufacturer of the TearLab Osmolarity System, discontinued production of the first-generation TearLab device and transitioned to its second-generation platform, the ScoutPro Osmolarity System.[16] Similar to the original TearLab, ScoutPro is a point-of-care device designed to assess tear film osmolarity. ScoutPro is based on measurement of tear osmolarity and collects approximately 0.05 µL of tear fluid using a disposable microfluidic test card; the device analyzes the electrical impedance of the sample with temperature correction and reports osmolarity in milliosmoles per liter. The first-generation TearLab system employed a benchtop reader with a separate handheld collection pen, whereas ScoutPro integrates tear collection and analysis into a single handheld device.[17]

Matrix Metallopeptidase (MMP) Enzymes

Inflammation is a common factor across the subtypes of DED. Levels of inflammatory mediators, such as cytokines, may be assessed in the tear film. For example, the matrix metallopeptidase (MMP) enzymes play an important role in wound healing and inflammation by degrading collagen. Elevated levels of MMP-9, a member of the MMP family produced by corneal epithelial cells,[18,19] have been observed in the tears of patients with dry eye.[20] A study with 101 patients with DED and controls (54 controls, 47 with DED) was performed to assess correlation of the protein MMP-9 with dry eye. All 101 underwent MMP-9 testing of the tear film and were evaluated for symptoms and signs of DED. The tear film was then analyzed for MMP-9 by InflammaDry, which detects MMP-9 levels of more than 40 ng/mL. The MMP-9 results were positive in 19 of the 47 dry eye patients (40.4%) and three of the 54 controls (5.6%). The authors concluded that "MMP-9 correlated well with other dry eye tests and identified the presence of ocular surface inflammation in 40% of confirmed dry eye patients," and suggested it may be helpful to identify patients with autoimmune disease and ocular surface inflammation.[21] The American Academy of Ophthalmology (AAO) has noted MMP-9 does not differentiate dry eye from any other inflammatory ocular surface disease and does not include this test in its appendix on diagnostic tests.[14]

Lactoferrin

Another biomarker associated with inflammation is lactoferrin. Lactoferrin is thought to promote the healing process resulting from inflamed dry eyes and is used to assess the lacrimal glands.[3] "Lactoferrin & Dry Eye Disease (DED): The measurement of ocular lactoferrin, as a biomarker, has long been

established and accepted as the "medical standard" in assessing the secretory function of the lacrimal gland. Low lactoferrin levels directly correlate to aqueous deficiency. Normal lactoferrin levels indicate normal lacrimal gland function."[22] The AXIM Eye Lactoferrin test has a specificity of 98%, and a sensitivity of 83%. A High Lf: > 1.0 mg/ml and a Low Lf: < 0.8 mg/ml.[22]

Additional Tests

Other tests noted by the American Academy of Optometry (AAOPT) are the tear break-up time test, the ocular surface dry staining test, the Schirmer test, and the fluorescein dye disappearance test. The tear break-up time test evaluates the precorneal tear film's stability with a fluorescein dye, which is inserted in the lower eyelid. If the tear film layer develops a dark discontinuity (usually blue) in under ten seconds, the result is considered abnormal. The ocular surface dry staining test stains areas of discontinuity of the corneal epithelial surface, which may contribute to dryness. A fluorescein dye is typically used, although a rose bengal dye or a lissamine green dye may be used as well. The Schirmer test quantifies the amount of tears produced by each eye. This is done by placing small strips of filter paper in the lower eyelid and checking the length (in mm) of wet strips in a certain amount of time. This test is noted as an extremely variable test, so it should not be used as the only diagnostic test. Finally, the fluorescein dye disappearance test places a certain amount of fluorescein dye on the ocular surface, and then evaluates how much of that dye was cleared from the surface.[6,14]

Evaluation of dry eyes is difficult for numerous reasons. Currently, no "gold standard" or globally accepted guideline for diagnosis of dry eye exists, and no threshold between healthy and affected eyes has been established. Many other features of testing (repeatability, high variability, including highly variable sensitivity and specificity of tests and dependence on clinical conditions) and the disease itself—its multifactorial status, examiner subjectivity, reliance on patient-based questionnaires, for example—make diagnosis of dry eye especially challenging.[23] Despite promising sensitivities, specificities, or other strong statistical findings, these numbers should still be considered in the context of clinical findings.[14]

Clinical Utility and Validity

Tear Osmolarity

Brissette, et al. (2019) measured the utility of the TearLab test in 100 patients with DED-like symptoms who had normal tear osmolarity results. This study aimed to use the test to identify diagnoses other than DED. All patients included in the study had a normal tear osmolarity test (<308 mOsm/L in each eye, and an inter-eye difference < eight mOsm/L). The researchers report that "A possible alternate diagnosis was established in 89% of patients with normal tear osmolarity testing. The most frequent diagnoses included anterior blepharitis (26%) and allergic conjunctivitis (21%)."[24] This highlights the utility of the TearLab test to differentiate between DED and other eye disorders with overlapping symptoms.

In a retrospective study by Tashbayev, et al. (2020), 757 patients diagnosed with symptomatic DED were recruited to investigate the clinical utility of tear osmolarity measurement. The TearLab osmometer was used to measure osmolarity in both eyes and the results were compared to Ocular Surface Disease Index (OSDI), TFBUT, ocular surface staining (OSS), Schrimer test, and meibomian gland functionality tests. According to their data, TearLab results were not significantly different between the healthy controls and the DED patients. Many studies confirm that tear osmolarity greater than 308 MOsm/mL indicates

a loss of homeostasis in the tear, therefore, is used as a cut-off value. Many of the healthy controls had tear osmolarity levels above the recommended cut-off value of 308 mOsm/L, and a substantial proportion of the diagnosed DED patients had tear osmolarity levels below the cut-off value. In the DED patient group, osmolarity levels in the right and left eye were 275–398 mOsm/L and 272–346 mOsm/L, respectively. In the control group, osmolarity levels in the right and left eyes were 281–369 mOsm/L and 275–398 mOsm/L, respectively. Therefore, the authors suggest that "tear osmolarity measured with TearLab osmometer cannot be used as a key indicator of DED."[25]

As shown in the above studies, there have been issues in the past regarding the use of tear osmolarity as a diagnostic tool. First, no criteria for the measurement of osmolarity have been established. Studies reviewing osmolarity as a diagnostic tool do not use uniform numbers in their calculations (i.e., no uniform cut-off values, no standardized severity measures, etc.). To compound this issue, high variance in osmolarity due to outside factors, such as sleep deprivation, altitude, or even whether the right or left eye was used to produce the tears, can occur. This difficulty in establishing osmolarity ranges has caused an overlap between the ranges of healthy and dry eye osmolarity. Although measuring fluctuations between osmolarity readings has been suggested as a diagnostic (caused by increased instability), the line between healthy eyes and dry eyes is blurred.[3] However, a recent report by the TFOS DEWS II states that tear osmolarity "is a global, early stage marker of the disease and has been shown to be able to effectively track therapeutic response and inform the clinician as to whether there has been a loss of tear film homeostasis."[1]

Published studies evaluating the clinical utility and validity of ScoutPro are limited; however, manufacturer-provided clinical performance data are available. In a multicenter study including 140 participants, the diagnostic performance of ScoutPro for differentiating normal eyes from those with dry eye disease was evaluated using established clinical criteria, including the Ocular Surface Disease Index, tear breakup time, Schirmer test, ocular surface staining, and assessment of meibomian gland dysfunction. Reported test performance demonstrated a sensitivity of approximately 64% and a specificity of 71%. The positive predictive value was approximately 82%, and the negative predictive value was approximately 48%.[17]

ScoutPro can be useful in the clinic for diagnosing DED and monitoring disease progression. However, like other osmolarity devices, ScoutPro cannot differentiate between DED subtypes (e.g., evaporative vs aqueous deficiency) and should be used alongside other clinical assessments for subtype determination and treatment planning.[26]

MMP Enzymes

Chan, et al. (2016) aimed to assess the utility of MMP-9 measurement in patients with post-laser-assisted in situ keratomileusis (LASIK) dry eyes compared to aged-matched controls. The *InflammaDry* was used to measure MMP-9 levels in tear film. Results showed that "The tear film MMP-9 levels were 52.7±32.5 ng/mL in dry eyes and 4.1±2.1 ng/mL in normal eyes ($p<0.001$). MMP-9 levels were >40 ng/mL in seven out of 14 (50.0%) post-LASIK dry eyes. The *InflammaDry* was positive in eight out of 14 (57.1%) post-LASIK eyes. All positive cases had tear film MMP-9 levels ≥38.03 ng/mL. Agreement between *InflammaDry* and MMP-9 was excellent with Cohen κ value of 0.857 in post-LASIK dry eyes."[27] However, only half of the post-LASIK patients with dry eyes exhibited significant inflammation with heightened levels of MMP-9.[27]

A cross-sectional study by Jun JH (2020) investigated if the tear volume in dry eye disease (DED) patients affects the results of the MMP-9 immunoassay (*InflammaDry*). A total of 188 DED patients were enrolled in the study. Positive MMP-9 tests were confirmed in 120 patients, and negative results were noted in 68 patients. However, the authors observed that with a small sample volume, the reliability of the test result was impaired. The manufacturer also pointed out that less than six µl of sample volume could produce false-negative results. In this study, patients with higher tear volumes showed higher band densities, but subjects with lower tear volumes showed lower band densities on the immunoassay. In conditions such as Sjögren syndrome that present with markedly decreased tear secretion, *InflammaDry* could display negative results despite the elevated tear MMP-9 concentration. In addition, "among the participants of the present study, a strong positive band was identified even in patients with mild or nearly no fluorescein staining of the cornea and conjunctiva, who are expected to have very mild inflammatory eye surface inflammation."[28] In conclusion, this study determined the volume dependency of the MMP-9 immunoassay, which could induce false-negative results clinically.[28]

Lee, et al. (2021) conducted a cross-sectional study to analyze the association of MMP-9 immunoassay results with the severity of DED symptoms and signs. Using 320 patients, the researchers evaluated the clinical signs based on the OSDI score, visual analogue scale (VAS), TBUT, "tear volume evaluation by tear meniscometry, and staining scores of the cornea and conjunctiva by the Oxford grading scheme." They found that "positive MMP-9 immunoassay results were significantly related to shorter tBUT, tBUT ≤ three seconds, higher corneal staining score, corneal staining score ≥ two, and conjunctival staining score ≥ two" which indicated a worsening severity of ocular signs in DED. The researchers also performed semiquantitative analyses, basing the reagent band density on a four-point scale ranging from negative (zero) to strongly positive (three), and found that these results positively correlated with higher corneal staining scores and negatively correlated with TBUT. However, despite these correlating results, the researchers found that their quantitative analysis, which would've been the most accurate way to evaluate tear MM-9 levels, yielded no correlation between "immunoassay band density and the clinical signs and symptoms of DE." This likely indicates the need for more studies with less selection bias and greater consideration of DED subtypes, as this finding was contrary to established literature.

Choi, et al. (2023) conducted a study comparing positive MMP-9 presence against an increased tear osmolarity measurement to diagnose severity of DED. The researchers found that those who tested positive for MMP-9 via immunoassay had "higher corneal fluorescein staining score and worse DED severity," as well as a worse ocular surface staining score with statistical significance. In using a cutoff for tear osmolarity level of 308 mOSm/L, they found "no significant difference in dry eye signs and symptoms," but "higher tear osmolarity was associated with ocular surface staining score in patients with severe DED and [evaporative dry eye]." Though historically tear osmolarity has been found to be useful in diagnosing DED, the researchers attribute the difference in their current findings to the study population, and that it may be better for identifying clinical severity in those already diagnosed with DED by other means.[30]

Lactoferrin

A meta-analysis was performed to highlight the potential role of tear lactoferrin as a diagnostic biomarker for DED. All original studies reporting an estimate of the average lactoferrin concentration in healthy subjects and those affected by DED were searched. A pooled mean difference of 0.62 (95% CI, 0.35–0.89) in lactoferrin concentration was observed in DED patients, showing a significant decrease in

lactoferrin concentrations in the tears of subjects affected by DED. A study reported that administration of lactoferrin protein in mice led to a decrease in oxidative damage and an enhancement of tear function.[31] Lastly, the author notes that "to compare data across studies and to validate lactoferrin as a diagnostic biomarker, there is still a need for further development of standardized protocols of tear collection, processing and storage."[32]

V. Guidelines and Recommendations

Dysfunctional Tear Syndrome (DTS) Panel

A study assessed the new diagnostic techniques and treatment options for DED and associated tear film disorders. Experts from the Cornea, External Disease, and Refractive Society (DTS Panel) convened by the study found examining tear osmolarity useful in diagnosis "in combination with other clinical assessments and procedures." The same panel also stated that the use of MMP-9 may only be valid for more severe cases of dry eye since the diagnostic test is only positive past 40 ng/mL. The panel recommended that osmolarity be evaluated before any ocular surface assessment, then an evaluation of ocular inflammation can be done, and finally a Schirmer strip test should be done.[12]

American Academy of Ophthalmology (AAO)

The AAO states "no single test is adequate for establishing the diagnosis of dry eye" and recommends that the combination of findings from diagnostic tests can be useful to understanding a patient's condition. In particular, the AAO states, "tests results should be considered within the context of symptoms and other clinical findings." This statement was reaffirmed in the dry eye syndrome preferred practice pattern guidelines of 2023.[33] "Pharmacological and procedural treatments are associated with improvements in patient symptoms and clinical signs, although chronic therapy and patient compliance are necessary in most instances. Topical cyclosporine treatment has long been used in the treatment of dry eye and shown to have clinical benefits. Topical cyclosporine, in some instances, leads to long-term treatment-free remission of patient symptoms and signs. Lifitegrast is a lymphocyte function-associated antigen-1 antagonist developed to treat dry eye syndrome (also known as dry eye disease), but the exact mechanism of action of lifitegrast in dry eye is unknown. Topical lifitegrast five percent has been approved by the US Food and Drug Administration for treatment of dry eye."[14] In their 2024 summary benchmarks for the cornea/external disease preferred practice pattern guidelines, the AAO cites that diagnostic tests may include "tear break-up time, ocular surface dye staining, Schirmer test, fluorescein dye disappearance test/tear function index, and tear osmolarity test."[34]

Rather than relying solely on a single measure of tear osmolarity, correlation with clinical findings or differences in osmolarity over time or under different conditions is more informative for confirming the diagnosis of dry eye. Indeed, most recent studies confirm that normal subjects have exceptionally stable tear film osmolarity, whereas tear osmolarity values in dry eye subjects become unstable quickly and lose homeostasis with environmental changes. These data reinforce the long-held belief that tear film instability due to increased evaporation of tears resulting in hyperosmolarity (i.e., evaporative dry eye) is a core mechanism of the disease."[14] The guideline covers the currently used diagnostic tests, which are as follows: assessment of tear osmolarity, MMP-9, tear production, fluorescein dye or tear function index, tear break up time, ocular surface dye staining, and lacrimal gland function.[14] The following table is provided by Akpek, et al. (2019):

Table 2: Characteristic Findings for Dry Eye Disease Diagnostic Tests

Test	Characteristic Findings
Tear osmolarity	Elevated; test-to-test variability; inter-eye differences considered abnormal
Matrix metalloproteinase-9	Indicates presence of inflammation which dictates treatment
Aqueous tear production (Schirmer test)	10 mm or less considered abnormal
Fluorescein dye disappearance test/tear	Test result is compared with a standard color scale
Tear break-up time	Less than 10 seconds considered abnormal
Ocular surface dye staining	Staining of inferior cornea and bulbar conjunctiva typical
Lacrimal gland function	Decreased tear lactoferrin concentrations

Tear Film & Ocular Surface (TFOS) Society

In 2025, the Tear Film & Ocular Surface Society (TFOS) published the TFOS DEWS III reports, updating and expanding the 2017 DEWS II recommendations on dry eye disease diagnosis, subclassification, and management with a contemporary evidence-based consensus.[35] From this workshop, the society published recommendations on the management and treatment of DED. The authors state that when diagnosing DED, it is important to distinguish between the type (aqueous deficient dry eye or evaporative dry eye) and to determine the underlying etiology as this is crucial for proper management.[36] TFOS DEWS III revised the definition to describe dry eye as a multifactorial, symptomatic disease characterized by a loss of homeostasis of the tear film and/or ocular surface, in which tear film instability, hyperosmolarity, inflammation, damage, and neurosensory abnormalities are etiological factors.[35] These guidelines also stated that "neurotrophic keratopathy accompanied by neuropathic pain and symptoms should definitely be considered in differential diagnosis of patients with intense symptoms despite mild signs."[36]

Regarding diagnostic testing, the TFOS states that any patient who obtains a positive score on the Dry Eye Questionnaire-5 or a cutoff score of ≥4 on the Ocular Surface Disease Index should be subject to a clinical examination. "The presence of any one of three specified signs; reduced non-invasive break-up time; elevated or a large interocular disparity in osmolarity; or ocular surface staining (of the cornea, conjunctiva or lid margin) in either eye, is considered representative of disrupted homeostasis, confirming the diagnosis of DED. If a patient has DED symptoms and their practitioner does not have access to all these tests, a diagnosis is still possible, based on a positive result for any one of the markers, but may require referral for confirmation if the available homeostasis markers are negative."[36] After confirmation with any of the aforementioned tests (i.e. non-invasive tear break-up time <10 seconds, tear film hyperosmolarity ≥308 mOsm/L or interocular difference >8 mOsm/L, or positive ocular surface staining), further evaluation should be conducted including meibography, lipid interferometry, and tear volume measurement to assess severity and help determine the best treatment plan.[36]

Further, the consensus recommendation from the society on tear osmolarity testing states, "The low variation of normal subjects contributes to the high specificity of the marker and makes it a good candidate for parallelization and therapeutic monitoring. Accordingly, normal subjects don't display elevated osmolarity, so a value over 308 mOsm/L in either eye or a difference between eyes greater than eight mOsm/L are good indicators of a departure from tear film homeostasis and represent a diseased ocular surface."[1]

TFOS DEWS III also introduces an etiological driver-based subclassification, expanding dry eye subtypes to include tear film deficiencies (lipid, aqueous, mucin/glycocalyx), eyelid anomalies (blink/lid closure and lid margin issues), and ocular surface abnormalities (misalignment, neural dysfunction, surface cell damage, and inflammation), each with corresponding clinical assessments to better target management.

Regarding MMP-9 testing, the guidelines state that "With the availability of newer immunosuppressive medications and trials concerning these drugs it is logical that inflammation should be assessed. The exact modality used may need to be varied depending on the pathway or target cell upon which the immunosuppressive drug acts, and such diagnostic tools should be used for refining patient selection as well as monitoring after commencement of treatment. Costs of these diagnostic tests should be considered, but these should be calculated from a holistic standpoint. For example, if the tests can assist the channeling of patients to appropriate healthcare services there may be cost savings for reduced referrals."[1]

American Optometric Association

The AOA published consensus-based clinical practice guidelines for care of a patient with ocular surface disorders. These guidelines note that there is a "lack of a defined diagnostic test or protocol and a lack of congruity between patient symptoms and clinical tests." The AOA also notes that the condition itself is ill defined and that dry eye is often a symptom of another condition such as blepharitis or another glandular dysfunction.[37] There have not been any updates on this topic from the AOA since this 2010 statement.

Consensus Guidelines for Management of Dry Eye Associated with Sjögren Disease

In 2015, clinical guidelines for management of dry eye associated with Sjögren disease were published by a consensus panel which evaluated reported treatments for DED. The recommendations state, "Evaluation should include symptoms of both discomfort and visual disturbance as well as determination of the relative contribution of aqueous production deficiency and evaporative loss of tear volume. Objective parameters of tear film stability, tear osmolarity, degree of lid margin disease, and ocular surface damage should be used to stage severity of dry eye disease to assist in selecting appropriate treatment options. Patient education with regard to the nature of the problem, aggravating factors, and goals of treatment is critical to successful management. Tear supplementation and stabilization, control of inflammation of the lacrimal glands and ocular surface, and possible stimulation of tear production are treatment options that are used according to the character and severity of dry eye disease."[38] Further, tear osmolarity was identified as the testing method with the highest level of evidence for all DED related tests.

In addition to the 2015 consensus panel guideline, the Sjögren's Syndrome Foundation has published U.S. clinical practice guidelines for ocular management that reinforce individualized evaluation of aqueous and evaporative components and recommend comprehensive clinical testing — including tear film break-up time, tear production measures, and osmolarity—as part of staging and treatment planning.[39]

American Society of Cataract and Refractive Surgery (ASCRS) Cornea Clinical Committee

American Society of Cataract and Refractive Surgery (ASCRS) released guidelines to aid surgeons in diagnosing visually significant ocular surface disorders (OSD) before refractive surgery. The ASCRS Cornea Clinical Committee recommends initial screening procedures including ASCRS Standard Patient

Evaluation of Eye Dryness (SPEED) II questionnaire, tear osmolarity, and matrix metalloproteinase (MMP-9) testing. If any of the three initial screening tests are abnormal, the patient is at risk for ocular surface disease, and additional diagnostic tests can be performed to determine dry eye sub-type. Non-invasive tests are recommended to minimize disruption to the ocular surface, cornea, and tear film. These tests include tear lipid layer thickness, noninvasive tear breakup time (NIKBUT), tear meniscus height, meibography, topography, tear lactoferrin levels, and measures of optical scatter. However, these tests are not essential to the fundamental algorithm.

The ASCRS also notes a point of care test that assesses lactoferrin levels (TearScan). The guideline notes its three proprietary biomarkers which are as follows: "salivary protein-1 (SP-1, immunoglobulin A [IgA], immunoglobulin G [IgG], immunoglobulin M [IgM]); (2) carbonic anhydrase-6 (CA-6, IgA, IgG, IgM); and (3) parotid secretory protein (PSP, IgA, IgG, IgM)." The authors comment that this test can be used to detect Sjögren syndrome early. However, the authors also note that "no member of the ASCRS Cornea Clinical Committee has used it [TearScan] in clinical practice."[40]

VI. Applicable State and Federal Regulations

Food and Drug Administration (FDA)

Many labs have developed specific tests that they must validate and perform in house. These laboratory-developed tests (LDTs) are regulated by the Centers for Medicare and Medicaid (CMS) as high-complexity tests under the Clinical Laboratory Improvement Amendments of 1988 (CLIA '88). As an LDT, the U. S. Food and Drug Administration has not approved or cleared this test; however, FDA clearance or approval is not currently required for clinical use.

On December 3, 1993, the FDA approved the lactoferrin microassay system by Touch Scientific, Inc.[41] Lactoferrin diagnostic kits are commercially available options for tear film biomarkers.[3]

On May 14, 2009, the FDA approved the TearLab Osmolarity System created by Ocusense Inc. From the FDA site: this device is used "to measure the osmolality of human tears to aid in the diagnosis of patients with signs or symptoms of DED, in conjunction with other methods of clinical evaluation."[42] In 2022, Ocusense Inc. rebranded as Trukera Medical and continues to manage the TearLab Osmolarity System.[43]

On November 20, 2013, the FDA approved InflammaDry created by Rapid Pathogen Screening Inc. From the FDA site: "InflammaDry is a rapid, immunoassay test for the visual, qualitative in vitro detection of elevated levels of the MMP-9 protein in human tears from patients suspected of having dry eye to aid in the diagnosis of dry eye in conjunction with other methods of clinical evaluation. This test is intended for prescription use at point-of-care sites."[44]

VII. Applicable CPT/HCPCS Procedure Codes

Procedure codes appearing in medical policy documents are only included as a general reference. This list may not be all inclusive and is subject to updates. In addition, codes listed are not a guarantee of payment.

CPT	Code Description
82785	Gammaglobulin (immunoglobulin); IgE
83516	Immunoassay for analyte other than infectious agent antibody or infectious agent antigen; qualitative or semiquantitative, multiple step method

83520	Immunoassay for analyte other than infectious agent antibody or infectious agent antigen; quantitative, not otherwise specified
83861	Microfluidic analysis utilizing an integrated collection and analysis device, tear osmolarity

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VIII. Evidence-based Scientific References

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IX. Revision History

Revision Date	Summary of Changes
01/01/2022	Initial Effective Date
07/19/2022	Updated background, guidelines, and evidence-based scientific references. Literature review did not necessitate any modifications to the coverage criteria. Revised code disclaimer statement
06/28/2023	Updated background, guidelines, and evidence-based scientific references. Literature review did not necessitate any modifications to the coverage criteria. Committee approved: 06/28/2023
05/14/2024	Reviewed and Updated: Updated the background, guidelines and recommendations, and evidence-based scientific references. Literature review did not necessitate any modifications to coverage criteria. Committee approved: 05/14/2024
05/21/2025	Reviewed and Updated: Updated the background, guidelines and recommendations, and evidence-based scientific references. Literature review did not necessitate any modifications to coverage criteria. Committee approved: 05/21/2025
06/17/2026	CAB Review Q2 2026: Reviewed and Updated: Updated the background, guidelines and recommendations, and evidence-based scientific references. Literature review did not necessitate any modifications to coverage criteria. The following changes were made for clarity and consistency: CC1 edited for clarity and consistency

	Committee Approved: 06/17/2026