



EVIDENCE-BASED CLINICAL PRACTICE GUIDELINE

# **Comprehensive Adult Eye and Vision Examination**

*Second Edition*



AMERICAN OPTOMETRIC ASSOCIATION



# OPTOMETRY: THE PRIMARY EYE CARE PROFESSION

## About the American Optometric Association

The American Optometric Association (AOA) is the leading authority on and advocate for quality eye health care, representing more than 48,000 doctors of optometry, optometry students and optometric professionals. As the sole primary eye care provider in many communities across America, doctors of optometry are often a patient's first entry into the health care system, and have extensive, ongoing training to examine, diagnose, treat and manage disorders, diseases and injuries that affect the eye and visual system. Through a nationwide public health initiative, AOA's [Eye Deserve More](#) campaign is fostering awareness of the importance of eye health and vision care and the overall health benefits of in-person, comprehensive eye examinations with AOA doctors of optometry for all Americans.

## Disclosure Statement

This Evidence-based Clinical Practice Guideline was funded by the AOA without financial support from any commercial sources. The Evidence-based Optometry Guideline Development Group and other guideline participants provided full written disclosure of conflicts of interest prior to each meeting and prior to voting on the quality of evidence or strength of clinical recommendations contained within this guideline.

## Disclaimer

Recommendations made in this guideline do not represent a standard of care. Instead, the recommendations are intended to assist the clinician in the decision-making process. Patient care and treatment should always be based on a clinician's independent professional judgment, given the patient's circumstances, and in compliance with state and federal laws and regulations.

The information in this guideline is current to the extent possible at the time of publication.

# COMPREHENSIVE ADULT EYE AND VISION EXAMINATION

## *SECOND EDITION*

Developed by the AOA Evidence-based Optometry Guideline Development Group

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## EVIDENCE-BASED CLINICAL GUIDELINES

### A. WHAT IS THE EVIDENCE-BASED PROCESS?

As a result of the Medicare Improvements for Patients and Providers Act of 2008, Congress commissioned the Secretary of Health and Human Services to create a public-private program to develop and promote a common set of standards for the development of clinical practice guidelines (CPGs). These standards address the structure, process, reporting, and final products of systematic reviews of scientific research and evidence-based clinical practice guidelines.

The Institute of Medicine (IOM), now the Health and Medicine Division of the National Academies of Sciences, Engineering, and Medicine (NASEM), in response to a request from the Agency for Healthcare Research and Quality (AHRQ), issued two reports in March 2011: *Clinical Practice Guidelines We Can Trust* and *Finding What Works in Health Care: Standards for Systematic Reviews*.

In *Clinical Practice Guidelines We Can Trust*,<sup>1</sup> the IOM redefined CPGs as follows:

*“Clinical practice guidelines are statements that include recommendations intended to optimize patient care that are informed by a systematic review of the evidence and an assessment of the benefits and harms of alternative care options.”*

The report states that to be trustworthy, guidelines should:

- Be based on a systematic review of existing evidence.
- Be developed by a knowledgeable, multidisciplinary panel of experts and key stakeholders.
- Consider important patient subgroups and preferences, as appropriate.
- Be based on a transparent process that minimizes conflicts of interest and biases.
- Provide a clear explanation of the logical relationships between alternative care options and health outcomes.
- Provide a grading of both the quality of evidence and the strength of the clinical recommendation.
- Be revised as appropriate when new evidence warrants modifications of recommendations.

Based on the IOM/NASEM reports, the AOA Evidence-based Optometry (EBO) Committee developed a 14-step process to meet the current evidence-based recommendations for trustworthy guidelines.

<b>AOA's 14 Steps to Evidence-based Clinical Practice Guideline Development</b>	
1.	<b>Guideline Development Group (GDG):</b> The Evidence-based Optometry (EBO) Committee selects a multidisciplinary panel of experts, including patient and public representatives, to act as the Guideline Development Group (GDG).
2.	<b>Transparency and COI*:</b> The GDG manages all conflict of interest (COI), which is documented by AOA staff and reviewed during face-to-face meetings.
3.	<b>Clinical Questions*:</b> The GDG defines the literature search criteria and identifies all clinical questions through a question formulation meeting.
4.	<p><b>Search for Evidence:</b> The AOA staff sends the search criteria and clinical questions for a systematic review of the literature (outside researchers) and provides all obtained papers to the Guideline Development Reading Group (GDRG). Systematic reviews, when available, are included in the guideline. No systematic review authors are participants in the GDG or GDRG.</p> <p><b>Inclusion Criteria (must meet all):</b> Scientific studies written in English that address the clinical question and that meet the patient population or age range being addressed.</p> <p><b>Exclusion Criteria (meets any of the following):</b> Scientific studies that are not in English, animal studies, studies outside the patient population or age range (if relevant), studies not addressing any topic of the clinical questions searched.</p>
5.	<b>Grade Evidence/Quality:</b> Two scientific readers and one member from the GDRG are randomly selected to read and grade each paper. They separately grade the paper for quality of evidence based on predetermined grading criteria and state the clinical recommendation(s).
6.	<b>Articulate Clinical Recommendations/Strength*:</b> The GDRG and GDG clinical experts review all clinical recommendations and articulate each for inclusion in the guideline during an “articulation of recommendations” meeting(s). There are single and/or aggregate recommendations made and a strength level is assigned. Potential benefits and harms, costs, and patient preferences are identified, as well as any gaps in research, and each is documented.
7.	<b>Write the Draft:</b> The AOA staff send the articulation results to the writer to develop draft 1.
8.	<b>Draft Review and Edits*:</b> The GDG reads draft 1, discusses, and edits.
9.	<b>Rewrite/Final Drafts:</b> The AOA staff send the draft results to the writer for writing/revisions for draft 2 (peer review draft) and send to medical editor for copy editing. Additional reviews are completed as necessary.
10.	<b>Approval and Posting for Peer Review:</b> The AOA staff and/or EBO Committee chair sends the peer review draft to AOA Board of Trustees for approval to post for peer and public review. The draft is posted on the AOA website, along with a comment form, and the review period is announced. Comments are solicited/collected electronically and comment authors are not made public.
11.	<b>Final Document Produced*:</b> The GDRG and GDG clinical experts review all peer comments and revise the final document. They may choose to include the peer review comment, not include the comment, and/or identify further gaps to review when preparing the next edition. All comments are documented regarding actions taken/not taken and the final draft is produced.
12.	<b>Final Draft Approval and Legal Review:</b> The final draft is reviewed by the AOA Board of Trustees and AOA Legal Counsel for approval and verification that the GDG followed the evidence-based process as outlined by the National Academies of Sciences, Engineering, and Medicine (NASEM) – Health and Medicine Division, previously the Institute of Medicine.
13.	<b>Post Guidelines:</b> The AOA staff posts the evidence-based guideline to AOA website for public use.
14.	<b>Schedule Reviews:</b> The GDG schedules a review to meet the NASEM guideline development standards and reviews all previously identified gaps in medical research and any new evidence and revises the evidence-based guideline every 2 to 5 years.

\*Denotes virtual meetings in 2020/2021/2022 due to the COVID-19 pandemic travel limitations

## B. HOW TO USE THIS GUIDELINE

The following table provides the grading system used in this guideline for rating evidence-based clinical statements. Grades are provided for both quality of the evidence and strength of clinical recommendations.

Key to Evidence Quality and Strength of Clinical Recommendation Levels	
Study Type	
<b>Grade</b>	<ul style="list-style-type: none"> <li>• <b>Meta-Analysis</b></li> <li>• <b>Systematic Review</b></li> <li>• <b>Randomized Clinical Trial</b></li> <li>• <b>Diagnostic Studies (Grade A)</b> <ul style="list-style-type: none"> <li>○ Do not have a narrow population</li> <li>○ Do not use a poor reference standard</li> <li>○ No case control studies of diseases or conditions</li> </ul> </li> </ul>
<b>A</b>	
<b>B</b>	<ul style="list-style-type: none"> <li>• <b>Randomized Clinical Trial</b> (weaker design)</li> <li>• <b>Cohort Studies</b> <ul style="list-style-type: none"> <li>○ Retrospective</li> <li>○ Prospective</li> </ul> </li> <li>• <b>Diagnostic Studies</b> (Grade B - only one of the following) <ul style="list-style-type: none"> <li>○ Narrow population</li> <li>○ Sample used does not reflect the population to whom the test would apply</li> <li>○ Uses a poor reference standard</li> <li>○ Comparison between the test and reference standard is not blinded</li> <li>○ Case control studies of diseases or conditions</li> </ul> </li> </ul>
<b>C</b>	<ul style="list-style-type: none"> <li>• <b>Case Control Studies</b> <ul style="list-style-type: none"> <li>○ Study of sensitivity and specificity of a diagnostic test, population-based descriptive study of diseases or conditions</li> <li>○ Retrospective</li> <li>○ Prospective</li> </ul> </li> <li>• <b>Diagnostic Studies</b> (Grade C - at least <i>two or more</i> of the following) <ul style="list-style-type: none"> <li>○ Narrow population</li> <li>○ Sample used does not reflect the population to whom the test would apply</li> <li>○ Uses a poor reference standard</li> <li>○ Comparison between the test and reference standard is not blinded</li> </ul> </li> <li>• <b>Studies of Strong Design</b> <ul style="list-style-type: none"> <li>○ With substantial uncertainty about conclusions or serious doubts about generalizations, bias, research design, or sample size</li> </ul> </li> <li>• <b>Nonrandomized Trials</b></li> </ul>
<b>D</b>	<ul style="list-style-type: none"> <li>• <b>Cross Sectional Studies</b></li> <li>• <b>Case Reports/Series</b></li> <li>• <b>Reviews</b></li> <li>• <b>Position Papers</b></li> <li>• <b>Expert Opinion</b></li> <li>• <b>Reasoning from Principle</b></li> </ul>

<b>Strength of Clinical Recommendation Levels</b>
<p><b>Strong Recommendation:</b> The benefits of the recommendation clearly exceed the harms (or the harms clearly exceed the benefits in the case of a negative recommendation) and the quality of evidence is excellent (Grade A or B). In some clearly identified circumstances, a strong recommendation may be made on lesser evidence when high-quality evidence is impossible to obtain and the anticipated benefits strongly outweigh the harms.</p> <p><i>This recommendation should be followed unless a clear and compelling rationale for an alternative approach is present.</i></p>
<p><b>Recommendation:</b> The benefits of the recommendation exceed the harms (or the harms exceed the benefits in the case of a negative recommendation), but the quality of evidence is not as strong (Grade B or C). In some clearly identified circumstances, a recommendation may be made on lesser evidence when high-quality evidence is impossible to obtain and the anticipated benefits strongly outweigh the harms.</p> <p><i>This recommendation should generally be followed but remain alert for new information.</i></p>
<p><b>Discretionary:</b> The current evidence is insufficient to assess the balance of benefits and harms of the recommendation. Evidence may be lacking, of poor quality, or conflicting, and the balance of benefits and harms cannot be determined.</p> <p><i>There should be an awareness of this recommendation but a flexibility in clinical decision-making, as well as remaining alert for new information.</i></p>

**Clinical Notes and Statements** shown throughout the guideline may have quality of evidence grades (A, B, C, or D). For example, a clinical note or statement with a quality of evidence grade of “B” is shown as “(Evidence Grade: B).”

**Evidence-based Action Statements** will be highlighted in an “Action” box, with the quality of evidence, level of confidence, and clinical recommendation level information listed. For example:

**EVIDENCE-BASED ACTION STATEMENT:** Older individuals ( $\geq 60$  years of age) with central and/or peripheral vision loss should be counseled by their eye doctor about the potential for an increased risk of falls.<sup>205-208</sup>

**Evidence Quality:** Grade B, Systematic Review, Cohort-Prospective Studies, Cohort-Retrospective Study.

**Level of Confidence:** Medium.

**Clinical Recommendation Level:** Recommendation. This recommendation should generally be followed but remain alert for new information.

**Evidence Statements:** In the Salisbury Eye Evaluation Study, visual field loss was reported to be the primary vision component that increases the risk of falls. For each 10 percent loss in visual field, individuals experienced 8 percent higher odds of falling, after adjustment for other factors. Peripheral visual field loss, in particular, was statistically significant. Visual field reduction is most likely related to the risk of falls through its effects on postural stability, the ability to maneuver around objects and decreased ability to detect steps or changes in surfaces. Although visual field loss cannot be reversed, persons with such deficits may benefit from mobility training to navigate the environment more safely and reduce the risk of falling.<sup>205</sup> (Evidence Grade: B)

The Los Angeles Latino Eye Study found that both central and peripheral visual impairment were associated with increased risk of falls and falls with injury, independent of age, gender and co-morbidities. Impairment in central vision increased the risk of falls by 2.4 times and falls with injury by 2.8 times. Peripheral vision loss increased falls risk 1.4-fold for both outcomes. Patients may benefit from being counseled about the impact of impaired vision on the increased risk of falls.<sup>207</sup> (Evidence Grade: B)

A combination of interventions, including exercise and vision assessment and treatment, may help prevent injurious falls.<sup>208</sup> (Evidence Grade: B)

Impaired vision is an important and independent risk factor for falls. Strong association exists between depth perception and falls, and distance edge contrast sensitivity and visual acuity, have also been linked to the risk of falls. Good visual acuity and distance edge contrast sensitivity have been shown to be important for detecting and avoiding hazards in the environment, especially when walking. The strong association between depth perception and falls suggests intact stereoacuity may be important for fall prevention.<sup>206</sup> (Evidence Grade: C)

Cost-effective measures such as ensuring patient's spectacle correction is current, or the use of cataract surgery, when indicated, may also maximize vision and have an impact on preventing falls in older people.<sup>206</sup> (Evidence Grade: C)

**Potential Benefits:** Patients with central and/or peripheral vision loss/impairment may benefit from fall prevention counseling and intervention when initially diagnosed.

**Potential Risks/Harms:** None.

**Benefits and Harms Assessment:** Benefits significantly outweigh harms.

**Potential Costs:** Direct costs of counseling as part of a comprehensive eye and vision examination.

**Value Judgments:** None.

<b>Role of Patient Preferences:</b> Moderate.
<b>Intentional Vagueness:</b> Specific type/form of counseling is not stated, as it is patient specific.
<b>Gaps in Evidence:</b> Research is needed to further evaluate the relationship between different forms of vision loss/impairment and falls.

The Action Statement profile provides additional information related to the development and implementation of the clinical recommendation. The following is an explanation of the categories listed in the profile:

**Evidence Quality** – The quality of evidence grade (A, B, C, or D) or the aggregate quality of evidence grade (if multiple studies were available for review) and the type of research study or studies reviewed.

**Level of Confidence** – The consistency of the evidence and the extent to which it can be trusted, specified as high, medium, or low.

**Clinical Recommendation Level** – The level (Strong Recommendation, Recommendation, or Discretionary) assigned to the implementation of the clinical recommendation made in the Action Statement.

**Evidence Statements** – The clinical statements derived from research studies reviewed that support the Action Statement.

**Potential Benefits** – Favorable changes which would likely occur if the Action Statement was followed.

**Potential Risks/Harms** – Adverse effects or unfavorable outcomes that may occur if the Action Statement was followed.

**Benefits and Harms Assessment** – A comparison of the relationship of benefits to harms specified as “benefits significantly outweigh harms” (or vice versa) or a “balance of benefits and harms.”

**Potential Costs** – Direct and indirect costs may include costs of the procedure, test, or medication; time spent by the eye doctor counseling the patient; administrative time; patient/caregiver time off from work; etc.

**Value Judgments** – Determinations made by the Guideline Development Group in the development of the Action Statement relating to guiding principles, ethical considerations, or other priorities.

**Role of Patient Preference** – The role the patient has in shared decision-making regarding implementation of the Action Statement specified as large, moderate, small, or none.

**Intentional Vagueness** – Specific aspects of the Action Statement that are left vague due to factors such as the role of clinical judgment, patient variability, concerns over setting legal precedent, etc.

**Gaps in Evidence** – Areas identified during evaluation of the research that show gaps in available evidence.

**Consensus-based Action Statements**, based on consensus by the GDRG, will be highlighted in an “Action” box, without any strength of evidence or clinical recommendation grading information listed. For example:

**CONSENSUS-BASED ACTION STATEMENT:** At the conclusion of an eye and vision examination, the diagnosis of any eye or vision problems should be explained to the patient and related to the patient’s symptoms, along with a discussion of treatment plans and prognosis.

**Evidence Quality:** There is a lack of published research to support or refute the use of this recommendation.

**Benefits and Harms Assessment:** Implementation of this recommendation is likely to increase patient understanding of any diagnosed eye or vision problems and improve compliance with any recommended treatment. The benefits of this recommendation were established by expert consensus opinion.

### C. SUMMARY LISTING OF ACTION STATEMENTS

The following is a listing of the evidence-based and consensus-based recommendations for care contained in the guideline:

Eye doctors should not rely on a single, normal confrontation visual field test result as proof that a field loss is not present and should conduct formal perimetry on patients if there is a clinical suspicion of a visual field defect.<sup>134-137</sup> (*Evidence Grade: B, Recommendation*)

A comprehensive adult eye and vision examination should include, but is not limited to:

- Patient and family history, including visual, ocular and general health, medication usage, and vocational and avocational visual requirements
- Measurement of visual acuity
- Determination of refractive status
- Assessment of ocular motility, binocular vision and accommodation, as appropriate, based on patient’s age, visual signs, and symptoms
- Ocular health examination, including evaluation of the anterior and posterior segments (dilated, unless otherwise contraindicated), measurements of intraocular pressure, and visual field testing
- Systemic health assessment, as indicated
- Ancillary testing, as needed. (*Consensus Statement*)

At the conclusion of an eye and vision examination, diagnosis of any eye or vision problems should be explained to the patient and related to the patient’s symptoms, along with a discussion of treatment plans and prognosis. (*Consensus Statement*)

Eye doctors should advise patients on appropriate and trustworthy sources of eye and vision care information, including providing educational materials and counseling about eye health and vision care topics, as needed.<sup>155,156,160,161,163,164</sup> (*Evidence Grade: B, Recommendation*)

Eye doctors should counsel their patients on the benefits of a healthy lifestyle and remain alert for new research that demonstrates the effects of diet and exercise on ocular and general health. (*Consensus Statement*)

Eye doctors should counsel their patients on smoking cessation. They should document discussions with their patients about their smoking status and inform them about the benefits to their eyes, vision, and overall health through smoking cessation.<sup>176,183</sup> (*Evidence Grade: B, Recommendation*)

Eye doctors should counsel their patients who are monocular or, when indicated, at-risk for ocular injuries to wear appropriate eye protection with impact-resistant properties. *(Consensus Statement)*

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Since exposure to ultraviolet (UV) radiation is a risk factor for disorders of the eye, eye doctors should advise their adult patients about the benefits of the regular use of sunglasses that effectively block at least 99 percent of UVA and UVB radiation and the use of hats with brims when outdoors. *(Consensus Statement)*

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Older individuals ( $\geq 60$  years of age) with central and/or peripheral vision loss should be counseled by their eye doctor about the potential for an increased risk of falls.<sup>205-208</sup> *(Evidence Grade: B, Recommendation)*

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Patients who will undergo or have undergone ocular surgery or other specialty care should be counseled by their eye doctor regarding their ongoing need for periodic comprehensive eye and vision examinations. *(Consensus Statement)*

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Comprehensive eye and vision examinations are recommended annually for persons 18 through 39 years of age to optimize visual function, evaluate eye changes and provide for the early detection of sight-threatening eye and systemic health conditions. Risk factors present may result in recommendations for more frequent evaluations. *(Consensus Statement)*

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Comprehensive eye and vision examinations are recommended annually for persons 40 through 64 years of age to optimize visual function, evaluate eye changes and provide for the early detection of sight-threatening eye and systemic health conditions. Risk factors present may result in recommendations for more frequent evaluations. *(Consensus Statement)*

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For persons 65 years of age or older, annual comprehensive eye and vision examinations are recommended to optimize visual function, evaluate eye changes and provide for the early detection of sight-threatening eye and systemic health conditions. Risk factors present may result in recommendations for more frequent evaluations.<sup>18,30,223</sup> *(Evidence Grade: C, Recommendation)*

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Adult patients should be advised by their eye doctor to seek eye care more frequently than the recommended re-examination interval if new ocular, visual, or systemic health problems develop. *(Consensus Statement)*

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## I. INTRODUCTION AND GUIDELINE OBJECTIVES

This Evidence-based Clinical Practice Guideline for the Comprehensive Adult Eye and Vision Examination describes appropriate examination procedures for evaluation of the eye health and vision status of adult patients to reduce the risk of vision loss and provide clear, comfortable vision. It contains recommendations for timely diagnosis, intervention, and, when necessary, referral for consultation with and/or treatment by another health care provider.

The recommendations in this guideline were developed to assist doctors of optometry in providing eye and vision examinations for adults. Others who assist in providing coordinated patient care for specific services may also gain insight from this document.

The objectives of this Guideline are to help doctors of optometry achieve the following:

- Recommend an appropriate timetable for eye and vision examinations for adults (age 18 or older).
- Select appropriate examination procedures for adults.
- Effectively examine the eye health, vision status, and ocular manifestations of systemic disease of adults.
- Minimize or avoid the adverse effects of eye and vision problems in adults through prevention, early detection and diagnosis, and patient management, including education and counseling.
- Inform and educate individuals and other health care practitioners about the importance of good vision and the need for, and frequency of, comprehensive adult eye and vision examinations.

## II. BACKGROUND

Eye and vision disorders have broad implications in health care because of their potential for negatively impacting activities of daily living, resulting in decreased quality of life.<sup>2-5</sup> They are associated with loss of mobility and independence,<sup>6,7</sup> difficulty maintaining employment,<sup>8</sup> and can lead to reduced social interaction and depression.<sup>9-11</sup> Many eye and vision disorders are chronic conditions that can affect individuals for their entire lives. The economic and social burdens of these conditions are substantial and projected to continue to increase as the aging population expands.<sup>12-14</sup>

In 2015, a total of 1.02 million people in the United States were legally blind (best-corrected visual acuity of 20/200 or less in the better-seeing eye) and approximately 3.22 million people had visual impairment (best-corrected visual acuity less than 20/40 in the better-seeing eye). In addition, up to 8.2 million people had reduced vision due to uncorrected refractive errors. By 2050, the number of individuals with these conditions is projected to double to approximately 2.01 million people with legal blindness, 6.95 million people with visual impairment and 16.4 million with reduced vision due to uncorrected refractive errors.<sup>15</sup>

Visual impairment increases with age among all racial and ethnic groups. The elderly population (65 years and older) in the United States was approximately 56 million in 2020 and is estimated by the United States Census Bureau to reach nearly 86 million by 2050.<sup>16</sup>

It is estimated that at least 40 percent of vision loss in the United States is either preventable or treatable with timely intervention, yet many people are undiagnosed and untreated.<sup>17</sup> The diagnosis and treatment of eye diseases such as

cataracts and glaucoma, and vision problems including refractive errors and presbyopia, can result in improved visual function and health-related quality of life for adults of all ages.<sup>18-20</sup>

## **A. ADULT EYE AND VISION CHANGES**

Adulthood involves a wide range of activities in which good visual function and eye health are of great value and importance. Changes in visual function can affect an individual's ability to perform many activities of daily living.<sup>3,4,21-26</sup> Since these changes can develop gradually and occur without symptoms, their effect on visual function and performance may not be readily apparent.<sup>27-29</sup>

Normal age-related changes in visual function and ocular structures, and increases in the prevalence and incidence of ocular and systemic disease with age, combine to make comprehensive eye and vision care services particularly important for older adults.<sup>30</sup> The leading causes of vision impairment and blindness in the United States, other than refractive errors, are primarily age-related diseases such as cataracts, glaucoma, and age-related macular degeneration.<sup>31</sup> In addition, diabetic retinopathy, the most common microvascular complication of diabetes, can occur in adults of any age.<sup>32</sup>

Refractive errors, cataracts, age-related macular degeneration, and diabetic retinopathy usually reduce central vision, especially for reading and other near activities. Glaucoma characteristically affects peripheral vision, which may alter balance and walking. Untreated, these conditions lead to problems with taking medications, keeping track of personal information, walking, watching television, driving, and reading, and often create social isolation. Early detection and treatment of these conditions are likely to translate into substantial economic savings and result in improved quality of life.<sup>33</sup>

## **B. OCULAR MANIFESTATIONS OF SYSTEMIC DISEASE**

The eye is the only part of the human body where blood vessels and nerve tissue can be viewed directly in their natural state. Alterations in retinal blood vessels allow the clinician to draw conclusions about the status of blood vessels in the entire body.<sup>34</sup> Changes in the eye often precede or occur concurrently with various systemic conditions and can represent important prognostic indications of disease progression.<sup>35</sup> A comprehensive eye examination presents a unique opportunity to observe and evaluate the impact that systemic health problems such as diabetes, hypertension, and hyperlipidemia have on the body and the eyes.

For some individuals, signs of an undetected systemic disease may initially be found during an eye examination. Detection of systemic diseases through a comprehensive eye and vision examination can lead to earlier treatment resulting in better patient care, avoidance of complications, and reduced health care costs.<sup>36,37</sup>

The following is a partial listing of systemic diseases whose ocular signs or symptoms may be observed or reported during a comprehensive eye and vision examination.

**Table 1**  
**Systemic Diseases with Ocular Complications**

Albinism <sup>38</sup>	Hypertension <sup>53,54</sup>	Sarcoidosis <sup>72</sup>
Alzheimer's disease <sup>39</sup>	Influenza <sup>55</sup>	Scleroderma <sup>73</sup>
Ankylosing spondylitis <sup>40</sup>	Kawasaki disease <sup>56</sup>	Sickle cell disease <sup>74,75</sup>
Arteriosclerosis <sup>35</sup>	Leukemia <sup>57</sup>	Sinusitis <sup>76</sup>
Behçet's disease <sup>41</sup>	Marfan syndrome <sup>58</sup>	Sjögren's syndrome <sup>56,77</sup>
Chlamydia <sup>42,43</sup>	Migraine <sup>59</sup>	Stevens-Johnson syndrome <sup>78</sup>
Cogan's syndrome <sup>44</sup>	Multiple sclerosis <sup>60,61</sup>	Sturge-Weber syndrome <sup>79</sup>
Crohn's disease <sup>45</sup>	Myasthenia gravis <sup>62</sup>	Syphilis <sup>42</sup>
Diabetes mellitus <sup>32,35</sup>	Nerve diseases and palsies <sup>35</sup>	Systemic lupus <sup>80,81</sup>
Fabry disease <sup>46</sup>	Neurofibromatosis <sup>63</sup>	Thyroid dysfunction (e.g., Graves' disease) <sup>35</sup>
Gonorrhea <sup>43</sup>	Pituitary tumors <sup>64</sup>	Toxocariasis <sup>82,83</sup>
Hepatitis <sup>47</sup>	Psoriasis <sup>65</sup>	Toxoplasmosis <sup>84</sup>
Herpes simplex <sup>48</sup>	Reiter's syndrome <sup>66</sup>	Tuberculosis <sup>85,86</sup>
Herpes zoster <sup>49</sup>	Rheumatoid arthritis <sup>67,68</sup>	Usher syndrome <sup>87</sup>
Histoplasmosis <sup>50</sup>	Rosacea <sup>69,70</sup>	Vitamin A deficiency <sup>88</sup>
HIV/AIDS <sup>51,52</sup>	Rubella <sup>71</sup>	

### C. FAILURE TO SEEK CARE

Although comprehensive eye and vision examinations are essential for timely diagnosis and treatment of eye diseases and maintenance of good vision, many individuals do not seek regular eye care.<sup>89</sup> The cost of eye care, lack of insurance, or perception that no care is needed were found to be the most common reasons for not seeking eye care in adults age 40 years or older.<sup>90,91</sup> A lack of transportation and difficulty trusting and communicating with the doctor have also been reported as barriers to care.<sup>92,93</sup> In addition, many individuals may be unaware they have a sight-threatening eye condition due to a lack of early symptoms<sup>27,94</sup> and some people may not seek care because they wrongly assume nothing can be done to improve their vision.<sup>95</sup> Others are not well informed or knowledgeable about eye health, eye disease, or the need for regular eye examinations because messages about eye health and vision care may not be conveyed to them by the media or their primary care provider.<sup>96</sup>

Also, there may be confusion regarding the terminology of what constitutes an "eye examination." Limited screening procedures, such as a visual acuity test given during a general physical examination or by the state Department of Motor Vehicles, use of an online visual acuity screening, and other forms of public health vision screenings are not a substitute for a comprehensive eye and vision examination. There is no evidence that visual acuity screening alone for older adults is any better for improving clinical outcomes than no screening at all.<sup>97</sup> (Evidence Grade: A)

Some individuals may choose to compensate for blurred vision by purchasing over-the-counter reading glasses instead of seeking an examination to determine the cause of any reduced vision. In so doing, they fail to receive the benefit of a comprehensive eye and vision examination, which may uncover sight-threatening eye or health problems.

The comprehensive adult eye and vision examination is an important component in the evaluation of an individual's overall health status. Its extensive nature enables assessment of an individual's eye, vision, and related health care needs, and may provide access to other primary and preventive care services.

## D. EPIDEMIOLOGY OF EYE AND VISION DISORDERS IN ADULTS

The prevalence of common eye and vision conditions underscores the importance of regular eye and vision care. Among the more frequent eye and vision conditions experienced by adults are:

- Refractive errors

Vision changes due to refractive errors (myopia, hyperopia, and/or astigmatism) are among the most frequent reasons for consultation with an eye care practitioner. In addition, uncorrected refractive errors are the most common cause of reduced vision.<sup>98-101</sup> Blurred vision due to uncorrected refractive errors can have immediate and long-term consequences such as lost educational and employment opportunities, reduced productivity, impaired safety, and decreased health-related quality of life.<sup>100,102</sup> Correction of refractive errors can lead to improvement in visual acuity in the majority of patients over a wide range of ages.<sup>103</sup>

Clinically significant refractive errors affect more than half of the United States population age 20 years or older. Estimates based on the 1999-2004 National Health and Nutrition Examination Survey found the prevalence of refractive errors in persons 20 years of age or older to be: myopia ( $\leq -1.00D$ ) 33.1 percent; severe myopia ( $\leq -5.00D$ ) 6.5 percent; hyperopia ( $\geq +3.00D$ ) 3.6 percent; astigmatism ( $\geq 1.00D$ ) 36.2 percent. The prevalence of myopia is approximately equal in 20 to 39 and 40 to 59-year age groups (36.2 percent compared to 37.7 percent) but is markedly lower for the  $\geq 60$ -year age group (20.5 percent). Hyperopia increased from 1.0 percent in the 20 to 29-year age group to 2.4 percent in 40 to 59-year age group and to 10 percent in  $\geq 60$ -year age group.<sup>104</sup>

Although most refractive errors first develop in childhood, the eye continues to undergo refractive changes throughout adult life. The Beaver Dam Eye Study, involving persons older than 40 years of age, reported changes in refractive error occurring over ten years. Younger people became more hyperopic, while older people became more myopic.<sup>105</sup>

- Presbyopia

Presbyopia, which results from the loss of eye focusing ability with age, can have multiple effects on quality of vision and activities of daily living. Because presbyopia is the result of aging changes to the eye's accommodative mechanism,<sup>106</sup> its prevalence is directly related to the proportion of the aging population. Most individuals first begin experiencing the effects of presbyopia around ages 40 to 45.

When presbyopia is defined as a visual condition of everyone over the age of 45, the United States Census Bureau 2020 population estimates would suggest that about 139 million Americans have presbyopia. Approximately one in eight Americans  $\geq 50$  years of age have near-vision impairment due to uncorrected presbyopia.<sup>107</sup>

- Cataracts

A cataract is an opacification of the crystalline lens of the eye. It is a leading cause of vision loss in adults. Cataracts are clinically significant if they cause a decrease in visual acuity or a functional visual impairment. Advancing age is the major risk factor for the development of cataracts; however, a cataract may be present at or develop shortly after birth or occur later as a result of a metabolic condition, medications, exposure to radiation, electric shock, trauma, and ocular or systemic diseases.

Approximately 17.2 percent of Americans aged 40 years and older have developed cataracts in one or both eyes. By age 80, more than half are affected.<sup>108</sup>

- Glaucoma

Glaucoma is a group of eye diseases characterized by optic neuropathy often resulting from abnormally high intraocular pressure. It is one of the leading preventable causes of blindness. Primary open-angle glaucoma is the most common form of the disease, and is often asymptomatic in the initial stages. The disease process can begin at any age, but the risk of glaucoma development increases greatly after age 40.

An estimated 2.1 percent of persons 40 years of age and older in the United States have glaucoma. It affects 2.9 million individuals, including 1.4 million women; 1.5 million men; 2.3 million people 60 years of age and older; and 0.9 million minorities, including Black and Hispanic Americans. Cases of glaucoma are expected to reach 5.5 million by 2050, an increase of over 90 percent from 2014.<sup>109</sup>

The National Health and Nutrition Survey (2005-2008) found that over half of persons with glaucoma were unaware that they had the disease.<sup>110</sup> It is estimated that approximately 2.4 million persons in the United States have undetected and untreated glaucoma. Overall, prevalence of both diagnosed and undiagnosed glaucoma is much higher in minorities and the elderly. Among those with definite glaucoma, individuals younger than 60 years of age have a greater proportion of undetected disease.<sup>111</sup>

[AOA Evidence-based Clinical Practice Guideline on Care of the Patient with Open-Angle Glaucoma currently in the review process.](#)

- Diabetic retinopathy

Diabetic retinopathy (DR), one of the most common microvascular complications of diabetes, is the leading cause of new cases of blindness and low vision among adults 20 to 74 years of age in the United States.<sup>32,112</sup> It is often asymptomatic early in the disease, and visual loss is primarily due to the development of diabetic macular edema, vitreous hemorrhage, or traction retinal detachment.<sup>113</sup> Diabetes duration and sustained hyperglycemia are among the primary risk factors for the development of diabetic retinopathy;<sup>114</sup> however, vision loss from DR is preventable with early detection and prompt intervention.<sup>115</sup>

The number of persons with diabetes having diagnosed DR increased from 4.06 million to 7.69 million between 2000 and 2010. Projected numbers from the Vision Health Initiative by the Centers for Disease Control and Prevention (CDC) predict that the number of people with DR by 2050 will increase to 16 million.<sup>112</sup>

[AOA Evidence-based Clinical Practice Guideline on Eye Care of the Patient with Diabetes Mellitus](#)

- Age-related macular degeneration

Age-related macular degeneration (AMD) causes a progressive loss of photoreceptors in the macula. Risk factors include older age, smoking, dyslipidemia, obesity, white race, female sex, and a family history of AMD. There are two types of AMD: nonexudative (dry or geographic atrophy) and exudative (wet or neovascular). Both cause progressive central vision loss with intact peripheral vision. Nonexudative AMD accounts for 80 to 90 percent of all advanced cases, but more than 90 percent of patients with severe vision loss have exudative AMD.<sup>116</sup>

AMD is among the most common causes of legal blindness in the United States and some form of AMD is thought to affect more than 9 million individuals.<sup>116</sup> Persons with AMD are expected to double by 2050, reaching 17.8 million among people age 50 or older.<sup>109</sup>

- Dry eye disease

Dry eye disease (DED), a form of ocular surface disease, is one of the most common ocular problems in the United States, particularly among older women.<sup>117</sup> It is a multifactorial disease of the tears and ocular surface resulting in symptoms of discomfort, visual disturbance, and tear film instability, with potential damage to the ocular surface.<sup>118</sup>

Results from the National Health and Wellness Survey estimate 6.8 percent of adults in the United States (aged ≥18 years) have diagnosed DED. Prevalence is higher among women (8.8 percent) than men (4.5 percent) and for individuals with autoimmune disease. DED increases with age from 2.7 percent in persons aged 18 to 34 to 18.8 percent in persons ≥75 years old.<sup>119</sup>

## E. COST OF EYE AND VISION DISORDERS

Eye disorders and vision loss are generally chronic conditions that continue for the duration of an individual's life, resulting in ongoing expenses for treatment and the related social costs of vision loss. The total economic costs of eye disorders and vision loss for all adults 18 years of age or older in the United States in 2013 was estimated to be \$133.2 billion.<sup>120</sup> This includes both the direct costs for eye care services and vision aids, as well as the indirect costs for reduced productivity, decreased quality of life, and loss of independence. The majority of these costs (55 percent) occur in persons aged 65 years and older and is likely to increase due to the aging population. Adults younger than 40 years of age may incur as much as \$21.6 billion of the total cost of vision loss and eye disorders. When the costs of lost productivity are included, adults younger than 40 years of age may account for more than a third of the total cost.<sup>12</sup>

In 2013, the costliest eye and vision condition for adults in the United States was refractive error (\$14.2 billion). Cataracts were the second costliest disorder (\$10.6 billion), followed by blindness and low vision (\$9.9 billion). Costs for retinal disorders and glaucoma totaled \$8.6 billion and \$5.7 billion, respectively. Although correction of refractive error is the costliest disorder due to the high prevalence of this condition in the adult population, per-person vision correction costs were lower than all other eye and vision disorders at an estimated \$81 per person, per year.<sup>120</sup>

## III. CARE PROCESS

### A. COMPREHENSIVE ADULT EYE AND VISION EXAMINATION

The comprehensive adult eye and vision examination provides the means to evaluate the structure, function, and health of the eyes and vision system. The examination is a dynamic and interactive process. It involves collecting subjective data directly from the patient and obtaining objective data by observation, examination, and testing. (See [Appendix 1: Comprehensive Adult Eye and Vision Examination: A Flowchart](#))

The nature of the eye and vision system is such that many conditions have the same or similar symptoms. For example, blurred vision can result from many causes, including uncorrected refractive errors, binocular vision dysfunction, ocular and systemic diseases and sight- or life-threatening conditions such as eye or brain tumors. In addition, potentially blinding conditions such as glaucoma or diabetic retinopathy may cause no symptoms until they are advanced and the ocular damage is irreparable.

The goals of the comprehensive adult eye and vision examination are to:

- Evaluate the functional status of the eyes and vision system, taking into account special vision demands and needs.
- Assess ocular health and related systemic health conditions.
- Establish a diagnosis (or diagnoses).
- Formulate a treatment and management plan.

- Counsel and educate the patient regarding his or her visual, ocular and related systemic health care status, including recommendations for prevention, treatment, management, or future care.

## 1. General Considerations

This Guideline describes the comprehensive eye and vision examination for patients 18 years of age or older. The examination components described are not intended to be all-inclusive. Professional judgment and individual patient symptoms and findings may significantly influence the nature and course of the examination. The examination process may also vary from that delineated in this Guideline according to patient cooperation and comprehension, as well as the examination setting. For example, professional judgment may dictate modification of the examination for the developmentally delayed or frail adult, or for the adult in an institutional setting such as an extended care facility.

It is important for eye care services to be provided in a healthy and safe environment. Doctors of optometry should take reasonable precautions to minimize the risk of exposure to infection for patients and staff. This may include routine application of standard infection control precautions including appropriate handwashing, utilization of single use medical supplies/instruments, appropriate disposal of waste, proper methods of disinfection when items are reused, staff vaccinations, and use of more rigorous infection control procedures for individuals who are known to be infected or immuno-suppressed.<sup>121</sup>

## 2. Examination Procedures\*

A comprehensive eye and vision examination includes an in-depth patient history; tests to thoroughly evaluate the patient's visual function, ocular health, and related systemic health status; an assessment of examination findings; and the development of a plan for treatment/management and future care.

**\*NOTE:** *Specific test and procedures listed are provided as examples only and are not a complete listing of testing options. Clinicians should remain alert for new and emerging technologies, instruments, and procedures, and incorporate them into the clinical examination, as appropriate.*

The examination should include:

### a. Patient History

The patient history is an initial and ongoing component of the examination. The objective is to obtain specific information about the patient's perception of their eye and vision status and important background information on related medical issues. It helps to identify and assess problems, and it provides an opportunity to become acquainted with the patient, establishing a relationship of confidence and trust. The collection of demographic data generally precedes the taking of the patient history.

Major components of the patient history include:

- Nature and history of the presenting problem, including chief complaint.
- Visual and ocular history.
- General health history, including a social history and review of systems.
- Family ocular and health histories.

**Clinical note:** *Some patients may fail to disclose medically-relevant information to clinicians, which can undermine patient care or even lead to patient harm. Nondisclosure of information may occur because of embarrassment or a desire to avoid potential judgement or lecturing.<sup>122</sup>*

- Medication usage, including prescription and nonprescription drugs; use of mineral, herbal and other vitamin supplements; documentation of medication allergies; and utilization of other complementary and alternative medicines.

**Clinical note:** Any systemic medication or supplement used by a patient should be reviewed for ocular risk factors or side effects.<sup>123</sup> ([U.S. National Library of Medicine information regarding the side effects of Drugs, Herbs and Supplements](#))

- Vocational and avocational visual requirements.
- Names of and contact information for the patient's other health care providers.

### **b. Visual Acuity**

Visual acuity should be measured monocularly and binocularly, with and without the patient's most recent spectacle or contact lens correction, using the following procedures:

- Distance visual acuity.
- Near visual acuity.
- Pinhole acuity, when indicated.
- Visual acuity at identified vocational or avocational working distances.

**Clinical note:** When assessing visual acuity in patients without pre-existing ocular disease, Snellen and Early Treatment Diabetic Retinopathy Study (ETDRS) charts can be used interchangeably.<sup>124</sup> (Evidence Grade: C)

### **c. Refraction**

A refraction may include objective and subjective assessment of the patient's refractive status; however, the results of a refraction do not provide all the information needed to determine an optical prescription. The refractive error measured should be analyzed with other testing data, and an assessment of the patient's visual needs obtained during an in-person examination. This information is used to determine if, and in what amount, an optical correction is needed to provide optimal vision and comfort for all viewing distances. The refractive analysis may include:

- Measurement of the patient's most recent or habitual optical correction (e.g., lensometry).
- Objective measurement of refractive status (e.g., retinoscopy, autorefraction).
- Subjective measurement of refractive status (e.g., phoropter).
- Cycloplegic refraction, if needed.

### **d. Ocular Motility, Binocular Vision and Accommodation**

Depending on the patient's age, visual signs and symptoms, and preliminary test results, appropriate tests of ocular motility, binocular visual function at distance and near, and accommodation may be incorporated into the examination. The interrelationship of these functional aspects of vision is especially critical for clear, comfortable vision for reading and other close work. Procedures may include:

- Evaluation of ocular alignment and motility (e.g., cover test, versions).

**Clinical note:** The estimated cover test, prism neutralized objective cover test, and the prism neutralized subjective cover test are equally reliable and comparable when performed by skilled clinicians for determining heterophoria, while the subjective prism neutralized test is recommended for those less experienced in use of the cover test.<sup>125</sup> (Evidence Grade: C)

**Clinical note:** A focused patient history can often provide a framework for accurately localizing the cause of any diplopia and help to direct the examination to an underlying cause.<sup>126</sup> (Evidence Grade: D)

- Assessment of heterophorias, vergence amplitude and facility (e.g., near point of convergence (NPC), heterophoria measurement).

**Clinical note:** Measurement of lateral heterophoria may be performed using the prism neutralized cover test, von Graefe test, or Modified Thorington test. The Modified Thorington test has been shown to have the highest inter-examiner correlation and provides the most repeatable method of the three cover tests for evaluating near heterophoria.<sup>127</sup> (Evidence Grade: C)

**Clinical note:** Diagnosis of binocular vision dysfunctions for the symptomatic patient with normal distance phoria and accommodative convergence/accommodation (AC/A) ratio can be improved through the use of vergence facility testing at near.<sup>128</sup> (Evidence Grade: D)

**Clinical note:** Clinicians should consider screening for near point of convergence as part of a concussion evaluation in athletes to help diagnose and guide treatment recommendations, academic accommodations, and referrals for vision therapy, when needed.<sup>129</sup> (Evidence Grade: D),<sup>130</sup> (Evidence Grade: C)

- Testing for suppression (e.g., stereopsis testing).
- Measurement of accommodative amplitude and facility (e.g., push-up technique, positive and negative relative accommodation, flipper lenses).

#### **e. Ocular Examination and Systemic Health Assessment**

Thorough assessment of the health of the eyes and associated structures is an important and integral component of the comprehensive adult eye and vision examination. The eyes and associated structures are not only sites for primary ocular diseases, but are also subject to systemic disease processes that affect the body as a whole (e.g., disorders of neurologic, vascular, endocrine, immune, or neoplastic origin). This part of the examination contributes to the diagnosis of diseases and disorders that have ocular manifestations, and helps determine the impact of any systemic disease on the eye and associated structures.

The components of an ocular and systemic health assessment may include:

- Observation of pupil size and pupillary responses.
- Evaluation of the ocular anterior segment and adnexa (e.g., slit lamp biomicroscopy).
- Measurement of intraocular pressure (IOP) (e.g., tonometry).

The Goldmann applanation tonometer is considered the reference standard for the measurement of IOP. Non-contact and handheld applanation tonometers, however, can provide IOP measurements close to, but marginally higher than, the Goldmann.<sup>131</sup> (Evidence Grade: A) Because of intra-measurement variations, clinicians may want to take more than one reading when using an applanation tonometer to reduce measurement errors.<sup>132</sup> (Evidence Grade: D)

**Clinical note:** Measurement of a patient's IOP should include a record of the type of instrument used and time of day. Consistent use of the same tonometer during clinical follow-up testing may be as important as the choice of tonometer.<sup>133</sup>

- Evaluation of the ocular media (e.g., slit lamp biomicroscopy).
- Dilated (unless otherwise contraindicated) evaluation of the ocular posterior segment (e.g., direct or indirect ophthalmoscopy).
- Visual field testing (e.g., confrontation visual field, Amsler grid).

Confrontation visual field testing may be used as a screening test, if the clinician understands its limitations.<sup>134</sup> (Evidence Grade: B) It is a simple and inexpensive method of identifying visual field loss. Subjective description of the clinician's face and quadrant finger counting are not very sensitive, but might quickly identify a substantial loss in visual field. A study of persons who underwent confrontation visual field testing and automated static perimetry at the same time found that normal visual fields on automated perimetry were often normal on confrontation testing, with a high specificity of 93.4 percent.<sup>135</sup> (Evidence Grade: B)

When a defect is detected with confrontation visual fields, it is almost always real; however, confrontation fields have a relatively low sensitivity for detecting visual field defects (63 percent) due to poor sensitivity to arcuate and superior defects. Confrontation visual fields can find large peripheral and dense defects and should be a part of the adult eye examination when a field defect is suspected.<sup>136</sup> (Evidence Grade: B)

The diagnostic accuracy of confrontation visual field testing is low when performed as a stand-alone test.<sup>134</sup> (Evidence Grade: B) The sensitivity of confrontation testing can be improved by using additional test procedures. Testing of the central 20 degrees of the visual field with a small red target and the red color comparison test<sup>137</sup> (Evidence Grade: C) or testing with a 5mm red target along with the static finger wiggle test (using two index fingers) have been shown to increase testing sensitivity and specificity. However, formal perimetry should be conducted if there is a strong clinical suspicion of a visual field defect.<sup>134</sup> (Evidence Grade: B)

- Systemic health assessment (e.g., blood pressure measurement; carotid artery assessment, laboratory testing, imaging, cranial nerve assessment).

**EVIDENCE-BASED ACTION STATEMENT:** Eye doctors should not rely on a single, normal confrontation visual field test result as proof that a field loss is not present, and should conduct formal perimetry on patients if there is a clinical suspicion of a visual field defect.<sup>134-137</sup>

**Evidence Quality:** Grade B, Cohort-Retrospective Study, Cohort-Prospective Studies.

**Level of Confidence:** Medium.

**Clinical Recommendation Level:** Recommendation. This recommendation should generally be followed but remain alert for new information.

<p><b>Evidence Statements:</b> When a defect is detected with confrontation visual fields, it is almost always real; however, confrontation fields have a relatively low sensitivity for detecting visual field defects (63 percent) due to poor sensitivity to arcuate and superior defects. Confrontation visual fields can find large peripheral and dense defects and should be a part of the adult eye examination when a field defect is suspected.<sup>136</sup> (Evidence Grade: B)</p> <p>Normal visual fields on automated perimetry were often normal on confrontation testing, with a high specificity of 93.4 percent.<sup>135</sup> (Evidence Grade: B)</p> <p>Testing of the central 20 degrees of the visual field with a small red target and the red color comparison test<sup>137</sup> (Evidence Grade: C) or testing with a 5mm red target along with the static finger wiggle test (using two index fingers) have been shown to increase testing sensitivity and specificity. However, formal visual field testing should be conducted if there is a strong clinical suspicion of a visual field defect.<sup>134</sup> (Evidence Grade: B)</p> <p>Confrontation visual field testing may be used as a screening test, if the clinician understands its limitations.<sup>134</sup> (Evidence Grade: B)</p>	
<p><b>Potential Benefits:</b> Decreased likelihood that a visual field defect will be missed.</p>	<p><b>Potential Risks/Harms:</b> Potential patient discomfort as a result of testing.</p>
<p><b>Benefits and Harms Assessment:</b> Benefits significantly outweigh harms.</p>	
<p><b>Potential Costs:</b> Direct cost of testing as a component of a comprehensive eye and vision examination.</p>	
<p><b>Value Judgments:</b> The sensitivity of confrontation visual field testing can vary depending on the type and location of field loss and the method used to perform the testing.</p>	
<p><b>Role of Patient Preferences:</b> Small.</p>	
<p><b>Intentional Vagueness:</b> Specific types of confrontation visual field testing are not stated as they are considered practice of medicine decisions.</p>	
<p><b>Gaps in Evidence:</b> None identified.</p>	

### **f. Ancillary Testing**

During an eye and vision examination, the eye doctor continually assesses information obtained from the patient along with the clinical findings gathered. The interpretation of subjective and objective data may reveal the need for additional testing, either performed or ordered by the eye care provider. Ancillary procedures may be performed at the initial examination or during subsequent examinations. If ancillary tests are performed, an interpretation and report may be required.

Additional testing may be indicated to confirm or rule out differential diagnoses, enable more in-depth assessment, or provide alternative means of evaluating patients who may not be fully cooperative or who may not comprehend testing procedures. Testing may include, but is not limited to:

- Color vision testing – used to diagnose and differentiate congenital and acquired color vision deficiency.
 

**Clinical note:** Some pseudoisochromatic plate tests only detect protan and deutan color vision deficiency, while other color vision tests provide the added advantage of detection of tritan defects and may be able

*to identify mild defects. Additional tests (e.g., Farnsworth D-15, anomaloscope) may be needed to properly categorize moderate or severe color vision deficiency.<sup>138</sup> (Evidence Grade: B)*

- Contrast sensitivity testing – measures the ability to detect low contrast images and subtle changes in vision not measured by visual acuity and may be used to evaluate patients with macular degeneration, cataract, or glaucoma.
- Dark adaptometry – measures the ability of the eyes to adapt from bright light to darkness and may be used to evaluate complaints of poor night vision and the presence of retinal diseases (e.g., age-related macular degeneration, cone dysfunction syndrome).
- Dry eye assessment – evaluates the quantity and quality of tears and may include measurement of tear production, evaluation of ocular surface staining, tear-film break-up time, and blink rate.
- Fundus photography – used to document the status of the retina and to evaluate the progression of retinal disease.
- Glare testing – evaluates any reduction in the retinal image caused by intraocular light scattering (e.g., the effects of cataracts or an ocular media opacity on vision).
- Gonioscopy – used to visualize and evaluate the anterior chamber angle to determine if it is open or narrowed, or the possibility of it becoming closed.
- Keratometry/corneal topography/corneal tomography – measure the curvature of the surface of the cornea to determine the extent of corneal astigmatism for the fitting of contact lenses, identifying keratoconus, and monitoring corneal pathology.
- Optical coherence tomography – provides in vivo, cross-sectional high-resolution images of the anterior chamber, retina, optic nerve head, and retinal nerve fiber layer.
- Pachymetry – used to measure corneal thickness and diagnose and/or monitor glaucoma, keratoconus and other corneal dystrophies, and post-surgical edema.
- Threshold visual field testing – identifies defects in peripheral vision (e.g., for the diagnosis of glaucoma and other diseases) and is used to monitor treatment to determine if the disease is under control or if vision loss is progressing.

**CONSENSUS-BASED ACTION STATEMENT:** A comprehensive adult eye and vision examination should include, but is not limited to:

- Patient and family history, including visual, ocular and general health, medication usage, and vocational and avocational visual requirements
- Measurement of visual acuity
- Determination of refractive status
- Assessment of ocular motility, binocular vision, and accommodation, as appropriate, based on patient's age, visual signs and symptoms
- Ocular health examination, including evaluation of the anterior and posterior segments (dilated, unless otherwise contraindicated), measurements of intraocular pressure, and visual field testing
- Systemic health assessment, as indicated
- Ancillary testing, as needed.

(See [Appendix 1 : Comprehensive Adult Eye and Vision Examination: A Flowchart](#))

**Evidence Quality:** There is a lack of published research to support or refute the use of this recommendation.

**Benefits and Harms Assessment:** Implementation of this recommendation is likely to result in more effective diagnosis of eye and vision problems in adults. The benefits of this recommendation were established by expert consensus opinion.

### 3. Assessment and Diagnosis

At the completion of the examination, the eye doctor should assess and evaluate the data to establish a diagnosis (or diagnoses) and formulate a treatment and management plan. The nature and severity of the problem(s) diagnosed determine the need for an optical prescription (e.g., eyeglasses or contact lenses) or other treatment (e.g., prescription of ocular pharmaceuticals, vision rehabilitation services, vision therapy). A prescription for correction of any refractive error is provided at the conclusion of the examination. For some patients, further assessment and/or treatment by another eye doctor, the patient's primary care physician, or another health care provider may be indicated.

### 4. Potential Benefits and Harms of Testing

The potential benefits of a comprehensive adult eye and vision examination may include:

- Optimizing visual function through diagnosis, treatment and management of refractive, ocular motor, accommodative, and binocular vision problems.
- Improving quality of life by preventing and/or minimizing vision loss through early diagnosis, treatment, and management of ocular health conditions.
- Detecting systemic disease and referral for appropriate care.
- Counseling and educating patients on current conditions and preventive care to maintain ocular and systemic health and visual function.

Potential harms associated with a comprehensive adult eye and vision examination may include:

- Patient anxiety about testing procedures or resulting diagnosis.
- Adverse ocular and/or systemic reactions.
- Temporary visual disturbances resulting from testing, or allergic responses to diagnostic pharmaceutical agents or materials used.
- Missed or misdiagnosis of eye health or vision problems.
- Unnecessary referral or treatment.

## 5. Clinical Record Keeping

Clinical record keeping is an integral part of patient care. Regardless of the form of the records (e.g., paper or electronic), good record keeping provides a legally binding account of the care provided, supports clinical decision-making, and helps to direct ongoing care. Record keeping in the United States health care system, including optometric practices, has undergone significant transition from paper-based records to electronic health records (EHRs).

The 21st Century Cures Act is intended to set a foundation for sharing of electronic health information to support patient care.<sup>139</sup> The rule is designed to provide patients and health care providers with secure access to electronic health information and support the easy exchange of that information. Information in the EHR that must be shared with patients includes consultation, history, physical examination notes, laboratory reports, and progress notes.

The EHR's impact on patient-doctor communications remains unclear. Despite objective evidence that EHR use may negatively impact patient-doctor communication,<sup>140</sup> (Evidence Grade: D) a study examining patient perceptions of EHR use found no change in patient satisfaction or patient-doctor interaction.<sup>141</sup> (Evidence Grade: A) It is important for clinicians to remain patient-centered while effectively using EHRs.<sup>142</sup>

Patients' access to their clinical records has increased with the implementation of EHRs. A study of eye care patients found that most were strongly in favor of having online access to their clinical record and were optimistic this access would improve their understanding and self-care, although over 40 percent had concerns about privacy issues. Providing online access to patients' clinical notes may enhance doctor-patient communications and improve clinical outcomes.<sup>143</sup> (Evidence Grade D)

When comparing traditional paper to EHRs, generally paper records are found to be significantly more complete. Therefore, additional training in data collection and improving the design of EHRs may be needed to enhance the usability and completeness of EHRs in clinical settings.<sup>144</sup> (Evidence Grade: D)

## B. MANAGEMENT

### 1. Patient Counseling and Communication

Counseling of the patient at the conclusion of a comprehensive adult eye and vision examination should include a review and discussion of examination findings and anticipated outcomes based upon the results of the assessment. Patients expect to receive information about their diagnosis, recommended treatment, and prognosis explained in understandable language.<sup>145</sup>

Patient counseling may include:

- Review of the patient's visual and ocular health status in relation to their visual symptoms and complaints.

- Discussion of any refractive correction that provides improved visual efficiency and/or appropriate eye protection.
- Explanation of available treatment options for diagnosed eye or vision conditions, including risks, benefits, and expected outcomes.
- Recommendation of a course of treatment with the reasons for its selection and the prognosis.
- Discussion of the importance of patient compliance with the treatment prescribed.
- Recommendation for follow-up care, re-examination, or referral.

When appropriate, patients should be counseled about the need for referral. When referral for ocular surgery or other specialty care is indicated, patients need to receive information about the purpose of the referral and the potential benefits and harms of the procedure or service.

**CONSENSUS-BASED ACTION STATEMENT:** At the conclusion of an eye and vision examination, diagnosis of any eye or vision problems should be explained to the patient and related to the patient’s symptoms, along with a discussion of treatment plans and prognosis.

**Evidence Quality:** There is a lack of published research to support or refute the use of this recommendation.

**Benefits and Harms Assessment:** Implementation of this recommendation is likely to increase patient understanding of any diagnosed eye or vision problems and improve compliance with any recommended treatment. The benefits of this recommendation were established by expert consensus opinion.

Doctor-patient communication plays an important role in the delivery of high-quality health care.<sup>146</sup> It is one of the most essential dynamics in health care, affecting the course of patient care and patient compliance with recommendations for care. Optimal doctor-patient communications involve a balance of talk and interruptions, everyday discourse rather than scripted communication, active listening, and proper nonverbal communication.<sup>147</sup> (Evidence Grade: D)

When communicating with patients, it is important to take their level of health literacy into consideration. Health literacy is “the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate decisions regarding their health.”<sup>148</sup> Poor health literacy is associated with worse health-related outcomes in many chronic conditions.

Clinicians should tailor their communication styles to match patients’ educational backgrounds and language ability.<sup>149</sup> (Evidence Grade: B) Language and cultural differences or misunderstandings may prevent individuals from accepting a doctor’s recommendations. For example, many individuals with vision impairment do not understand what vision rehabilitation entails and how they could benefit. A heightened awareness of low vision rehabilitation may be achieved with better communication by eye care professionals.<sup>150</sup> (Evidence Grade: D)

In addition, anxiety reduces the effectiveness of patient-practitioner communications and results in reduced attention, recall of information, and compliance with treatment. The use of patient-centered communications and active listening can help reduce anxiety and improve patient satisfaction and outcomes.<sup>151</sup>

The use of mobile phone technology, particularly text messaging, is a low cost and easy method for communicating with patients. It can provide information effectively and concisely and may improve patient attendance at appointments and medication adherence.<sup>152</sup> (Evidence Grade: A) Mobile phone text messaging reminders may increase attendance at healthcare appointments compared to either no reminders or postal reminders. Text

messaging reminders are similar to telephone reminders in terms of their effect on attendance rates, but cost less than telephone reminders.<sup>153</sup> (Evidence Grade: A)

In compliance with the Americans with Disabilities Act (ADA), eye care providers need to make reasonable accommodations to ensure that whatever is written or spoken is clear and understandable to individuals with disabilities. Appropriate auxiliary aids and services must be made available, when needed, to enable effective communications when evaluating, treating, or counseling persons with hearing, vision or speech impairments. According to the ADA, auxiliary aids and services for individuals who are hearing impaired include qualified interpreters, note takers, computer-aided transcription services, written materials, telephone handset amplifiers, assistive listening systems, telephones compatible with hearing aids, closed caption decoders, open and closed captioning, telecommunications devices for the deaf (TDDs), videotext displays and exchange of written notes. For individuals with vision impairments, auxiliary aids and services include qualified readers, taped texts, audio recordings, magnification software, optical readers, Braille materials and large print materials. Examples for individuals with speech impairments include TDDs, computer terminals, speech synthesizers and communication boards.<sup>154</sup>

## 2. Patient Education

Effective patient education often requires frequent repetition of instructions and reinforcement of benefits of proposed treatment. A high rate of concordance can be achieved through intensive patient education. It is very important for clinicians to repeat and continue repeating instructions to patients.<sup>155</sup> (Evidence Grade: B)

The use of video-based media appears to be effective in improving patient understanding and in certain cases may ameliorate overall outcome.<sup>156</sup> (Evidence Grade: B) Also, the use of educational videos may enhance patient techniques (e.g., eye drop installation) at little cost or time burden to the clinician.<sup>157</sup> (Evidence Grade: C) In one study, education about how to administer drops for glaucoma was associated positively with percentage of the correct number of doses taken each day and percentage of the prescribed doses taken on time.<sup>158</sup> (Evidence Grade: C)

**Clinical note:** *While clinicians should make efforts to assist patients in adhering to medication use, no specific strategies have been shown to be more effective than others in improving patient adherence to the prescribed treatment regimen.*<sup>159</sup> (Evidence Grade: A)

Showing and explaining personal retinal images as part of patient education may be a practical strategy for clinicians to improve motivational and health outcomes in patients with diabetes.<sup>160</sup> (Evidence Grade: B) Patient education and patient reminders also may play a positive role in encouraging individuals with chronic medical conditions such as diabetes to seek an annual eye examination.<sup>161</sup> (Evidence Grade: A),<sup>162</sup> (Evidence Grade: B)

Unfortunately, many patient education materials may not be written at a readability level for patients with low health literacy. Patient education can be improved by selecting materials that are in the range of sixth- to eighth-grade reading levels, which can help to improve patient understanding.<sup>163</sup> (Evidence Grade: B) In addition, there is a need to lower the difficulty of online educational materials on eye and vision care so they are easier to understand. The average difficulty of materials on the internet is significantly higher than United States Department of Health and Human Services recommendations that materials be written at or below the sixth-grade reading level to optimize comprehension.<sup>164</sup> (Evidence Grade: B)

<p><b>EVIDENCE-BASED ACTION STATEMENT:</b> Eye doctors should advise patients on appropriate and trustworthy sources of eye and vision care information, including providing educational materials and counseling about eye health and vision care topics, as needed.<sup>155,156,160,163,164</sup></p>	
<p><b>Evidence Quality:</b> Grade B, Randomized Clinical Trial, Systematic Review, Cohort-Prospective Studies, Case Series.</p> <p><b>Level of Confidence:</b> Medium.</p> <p><b>Clinical Recommendation Level:</b> Recommendation. This recommendation should generally be followed but remain alert for new information.</p>	
<p><b>Evidence Statements:</b> There is a need to lower the difficulty of online educational materials on eye and vision care so they are easier to understand. The average difficulty of materials on the internet is significantly higher than United States Department of Health and Human Services recommendations that materials be written at or below the sixth-grade reading level to optimize comprehension.<sup>164</sup> (Evidence Grade: B)</p> <p>Many patient education materials may not be written at a readability level for patients with low health literacy. Patient education can be improved by selecting materials that are in the range of sixth- to eighth-grade reading levels, which can help to improve patient understanding.<sup>163</sup> (Evidence Grade: B)</p> <p>A high rate of concordance can be achieved through intensive patient education, which by necessity involves frequent repetition of instructions and re-enforcement of benefits. It is very important for clinicians to repeat and continue repeating instructions to patients.<sup>155</sup> (Evidence Grade: B)</p> <p>Showing and explaining personal retinal images as part of patient education may be a practical strategy for clinicians to improve motivational and health outcomes in patients with diabetes.<sup>160</sup> (Evidence Grade: B)</p> <p>The use of video-based media appears to be effective in improving patient understanding and in certain cases may ameliorate overall outcomes.<sup>156</sup> (Evidence Grade: B)</p>	
<p><b>Potential Benefits:</b> Counseling and educating patients about eye and vision care topics may provide them with a better understanding of diagnosed eye and vision conditions and enhance compliance with treatment and management recommendations.</p>	<p><b>Potential Risks/Harms:</b> None.</p>
<p><b>Benefits and Harms Assessment:</b> Benefits significantly outweigh harms.</p>	
<p><b>Potential Costs:</b> Direct cost of counseling as part of a comprehensive eye and vision examination.</p>	
<p><b>Value Judgments:</b> None.</p>	
<p><b>Role of Patient Preferences:</b> Large.</p>	
<p><b>Intentional Vagueness:</b> Specific type/form of counseling/educational materials is not stated as it is patient specific.</p>	
<p><b>Gaps in Evidence:</b> Research is needed to identify the most effective methods of patient education.</p>	

Areas of patient education may include:

**a. Healthy Lifestyle**

A healthy diet and regular exercise are important to good eye health. Maintaining a healthy lifestyle may help to prevent or slow the progression of glaucoma, cataracts, diabetic retinopathy, and age-related macular degeneration in certain individuals<sup>165-170</sup> and may be a factor in lowering blood pressure and preventing cardiovascular disease.<sup>171-174</sup>

<p><b>CONSENSUS-BASED ACTION STATEMENT:</b> Eye doctors should counsel their patients on the benefits of a healthy lifestyle and remain alert for new research that demonstrates the effects of diet and exercise on ocular and general health.</p>
<p><b>Evidence Quality:</b> An evaluation of published research to support or refute the use of this recommendation was not conducted for this guideline.</p>
<p><b>Benefits and Harms Assessment:</b> Implementation of this recommendation is likely to increase patient awareness of the value of a healthy diet and exercise on their eye and general health. The benefits of this recommendation were established by expert consensus opinion.</p>

**b. Smoking Cessation**

Smoking can play a significant role in general and ocular health. Individuals who smoke are at increased risk for the development of cardiovascular disease, cancer, and diabetes.<sup>175</sup> In addition, cigarette smoking places them at risk for a number of eye diseases, including cataracts,<sup>176,177</sup> age-related macular degeneration,<sup>178,179</sup> glaucoma,<sup>180</sup> ocular surface disorders,<sup>181</sup> and the development of visual impairment.<sup>182</sup>

Smoking cessation, along with an active lifestyle, may be important in preserving visual function and reducing visual impairment. Therefore, behavioral modifications may play a role in preventing visual impairment in adults.<sup>183</sup> (Evidence Grade: B) Smoking cessation is associated with a reduced risk of cataract formation, and some early lens damage may be reversible. The reduction in risk appears strongest for those who have quit smoking within the past decade, but is not so robust in those who quit longer than ten years ago.<sup>176</sup> (Evidence Grade: B)

Although they are aware of the impact of smoking on ocular health, doctors of optometry don't always talk to their patients about smoking or encourage smoking cessation. They should discuss the use of tobacco products and advise cessation treatment, if appropriate.<sup>184</sup> (Evidence Grade: D)

**Clinical note:** Smoking plays a significant role in ocular disease. Assessing a patient's smoking status, as well as addressing smoking cessation, are important topics for discussion with patients.<sup>185</sup> (Evidence Grade D)

<p><b>EVIDENCE-BASED ACTION STATEMENT:</b> Eye doctors should counsel their patients on smoking cessation. They should document discussions with their patients about their smoking status and inform them about the benefits to their eyes, vision, and overall health through smoking cessation.<sup>176,183</sup></p>
<p><b>Evidence Quality:</b> Grade B, Cohort-Prospective Studies.</p> <p><b>Level of Confidence:</b> Medium.</p> <p><b>Clinical Recommendation Level:</b> Recommendation. This recommendation should generally be followed but remain alert for new information.</p>

<p><b>Evidence Statements:</b> Smoking cessation, along with an active lifestyle, is important in preserving visual function and reducing visual impairment. Therefore, behavioral modifications may play a role in preventing visual impairment in adults.<sup>183</sup> (Evidence Grade: B)</p> <p>Smoking cessation is associated with a reduced risk of cataract formation, and some early lens damage may be reversible. The reduction in risk appears strongest for those who have quit smoking within the past decade, but is not so robust in those who quit longer than ten years ago.<sup>176</sup> (Evidence Grade: B)</p>	
<p><b>Potential Benefits:</b> Counseling and educating patients about the potential impact of smoking may help promote general and ocular health, as well as visual function.</p>	<p><b>Potential Risks/Harms:</b> Patient may be sensitive to discussing the topic.</p>
<p><b>Benefits and Harms Assessment:</b> Benefits significantly outweigh harms.</p>	
<p><b>Potential Costs:</b> Direct cost of counseling as part of a comprehensive eye and vision examination.</p>	
<p><b>Value Judgments:</b> Persons who smoke may benefit from counseling to reduce the risk of general and ocular health problems.</p>	
<p><b>Role of Patient Preferences:</b> Large.</p>	
<p><b>Intentional Vagueness:</b> Specific type/form of counseling is not stated as it is patient specific.</p>	
<p><b>Gaps in Evidence:</b> None identified.</p>	

### **c. Protection from Eye Injury**

Eye injury is an important contributor to the burden of vision impairment and blindness in the United States. Many individuals are unaware of the ocular hazards they face, particularly at home or while playing sports.<sup>186</sup> Most eye injuries are preventable with appropriate use of protective eyewear.<sup>187,188</sup> It is, therefore, important to discuss eye safety issues with patients, including eye hazards at work, school, or home and during recreational activities.<sup>189</sup>

Eye trauma occurs more frequently during the spring and summer months. Prevention efforts would likely be most effective if implemented in this timeframe and if targeted to men and those under age 60.<sup>190</sup> (Evidence Grade: D) In persons  $\geq$  65 years of age, most eye injuries from consumer products occur in men, at home and involve chemical injuries. The most preventable injuries were those that occurred during construction and resulted in contusions and abrasions. Many of these injuries can be prevented through the use of safety glasses.<sup>191</sup> (Evidence Grade: B)

- Sports and recreation

Approximately 30,000 individuals present annually to emergency departments in the United States with sports-related eye injuries. Injuries occur most commonly in males and happen most frequently as a result of playing basketball, baseball, or softball, or shooting an air gun.<sup>192</sup> Although contact sports have not been shown to result in a higher prevalence of severe ocular injury, evaluation of athletes should occur prior to their commencing contact sports and on an ongoing basis, as eye and vision problems may increase with age and duration of activity.<sup>193</sup> (Evidence Grade: B)

- Workplace injuries

As a group, individuals aged between 18 and 64 years are at high risk for chemical injuries in the workplace. Continued efforts by the Occupational Safety and Health Administration to strengthen and enforce regulations associated with protective eyewear in the workplace are important to preventing chemical eye injuries.<sup>194</sup> (Evidence Grade: D)

- Laser eye protection

The effect of lasers on the eye depends on various factors, including pupil size, pigmentation, laser pulse duration and repetition, and wavelength. Different wavelengths will penetrate the eyes to different levels and may cause damage to the cornea, lens or retina. Laser eyewear can be used to attenuate the laser radiation for eye protection. Laser safety glasses must meet very specific requirements and should be labeled per the American National Standards Institute (ANSI) Z136.1 Standard for the Safe Use of Lasers.<sup>195</sup>

High-powered recreational lasers with the potential to cause severe ocular injuries are becoming increasingly available to the general public. The expanding use of lasers in everyday life increases the risk of injuries associated with laser exposure.<sup>196</sup> (Evidence Grade: D) Natural protective responses such as the blink reflex, pupillary constriction, and aversive head-turn response typically minimize sustained ocular exposure, but do not prevent accidental laser eye injuries from occurring. Most reported cases of laser injuries occur in occupational environments.<sup>197</sup>

**Clinical note:** Clinicians should be aware of the signs and symptoms of ocular laser injuries. Vision loss usually occurs immediately after laser exposure. The primary mode of prevention is with appropriate eye protection using goggles specifically matched to the laser's wavelength.<sup>197</sup>

- Use of protective eyewear

Dress prescription eyeglasses are not an adequate substitute for protective eyewear meeting the ANSI Z-87.1 Standard for Occupational and Educational Eye and Face Protection Devices. Spectacle wearers need to be made aware of the potential risks associated with wearing dress prescription eyeglasses during medium- to high-risk activities. The protective ability of eyewear is dependent upon the frame and lens as a complete unit.<sup>198</sup> (Evidence Grade: D)

The 2016 National Health Interview Survey found that use of protective eyewear has been increasing in the United States, and individuals who are older, male, white and who wear corrective lenses are more likely to use protective eyewear during recreational activities. Also, a recent visit with an eye care practitioner appears to increase the likelihood of an individual using protective eyewear.<sup>199</sup> (Evidence Grade: D)

Monocular patients are often not informed of the necessity of eye protection to improve the long-term visual prognosis of the remaining functional eye. Clinicians should make a point of recommending eye protection to all monocular patients.<sup>200</sup> (Evidence Grade: D)

**CONSENSUS-BASED ACTION STATEMENT:** Eye doctors should counsel their patients who are monocular or, when indicated, at-risk for ocular injuries to wear appropriate eye protection with impact resistant properties.

**Evidence Quality:** An evaluation of published research to support or refute the use of this recommendation was not conducted for this guideline.

**Benefits and Harms Assessment:** Implementation of this recommendation is likely to increase patient's use of eye protection based on their personal risk factors. The benefits of this recommendation were established by expert consensus opinion.

- Ultraviolet radiation protection

Patients should be advised about the need to protect their eyes from exposure to ultraviolet (UVA and UVB) radiation. Exposure to high levels of UV radiation can cause photokeratitis and photoconjunctivitis. Chronic exposure to even low levels of UV radiation is a risk factor for developing cataracts, pterygium, squamous cell carcinoma of the cornea and conjunctiva, and skin cancer.<sup>201</sup>

**CONSENSUS-BASED ACTION STATEMENT:** Since exposure to ultraviolet radiation (UV) is a risk factor for disorders of the eye, eye doctors should advise their adult patients about the benefits of the regular use of sunglasses that effectively block at least 99 percent of UVA and UVB radiation and the use of hats with brims when outdoors.

**Evidence Quality:** An evaluation of published research to support or refute the use of this recommendation was not conducted for this guideline.

**Benefits and Harms Assessment:** Implementation of this recommendation is likely to decrease patient risk of eye health problems from chronic exposure to UV radiation. The benefits of this recommendation were established by expert consensus opinion.

#### **d. Fall Prevention**

Maintaining good vision may play a role in preventing falls.<sup>202</sup> Falls are a common occurrence in older adults and can have serious consequences.<sup>203</sup> A national survey (2014 Behavioral Risk Factor Surveillance System) of adults aged  $\geq 65$  found 46.7 percent of persons with, compared with nearly 28 percent without, self-reported severe visual impairment reported at least one fall in the previous year.<sup>204</sup>

In the Salisbury Eye Evaluation Study, visual field loss was reported to be the primary vision component that increases the risk of falls. For each 10 percent loss in visual field, individuals experienced 8 percent higher odds of falling, after adjustment for other factors. Peripheral visual field loss, in particular, was statistically significant. Visual field reduction is most likely related to the risk of falls through its effects on postural stability, the ability to maneuver around objects, and decreased ability to detect steps or changes in surfaces. Although visual field loss cannot be reversed, persons with such deficits may benefit from mobility training to navigate the environment more safely and reduce the risk of falling.<sup>205</sup> (Evidence Grade: B)

Impaired vision is an important and independent risk factor for falls. Strong association exists between depth perception and falls, and distance edge contrast sensitivity and visual acuity have also been linked to the risk of falls. Good visual acuity and distance edge contrast sensitivity have been shown to be important for detecting and avoiding hazards in the environment, especially when walking. The strong association between depth perception and falls suggests intact stereoacuity may be important for fall prevention.<sup>206</sup> (Evidence Grade: C)

The Los Angeles Latino Eye Study found that both central and peripheral visual impairment were associated with increased risk of falls and falls with injury, independent of age, gender and co-morbidities. Impairment in central vision

increased the risk of falls by 2.4 times and falls with injury by 2.8 times. Peripheral vision loss increased falls risk 1.4-fold for both outcomes. Patients may benefit from being counseled about the impact of central and peripheral vision loss on the increased risk of falls.<sup>207</sup> (Evidence Grade: B)

**Clinical note:** *Because medications can contribute to falls by inducing changes in vision and vision loss, it is important for clinicians to take a detailed medication history in patients who report subjective changes in vision or who have decreased visual acuity.*<sup>123</sup>

A combination of interventions, including exercise, and vision assessment and treatment, may help prevent injurious falls.<sup>208</sup> (Evidence Grade: B) Cost-effective measures such as ensuring their spectacle correction is current, or the use of cataract surgery when indicated, may also maximize vision and have an impact on preventing falls in older people.<sup>206</sup> (Evidence Grade: C) One study, however, found that correction of vision problems did not reduce the frequency of falls, although the reason was unclear.<sup>209</sup>

**EVIDENCE-BASED ACTION STATEMENT:** Older individuals ( $\geq 60$  years of age) with central and/or peripheral vision loss should be counseled by their eye doctor about the potential for an increased risk of falls.<sup>205-208</sup>

**Evidence Quality:** Grade B, Systematic Review, Cohort-Prospective Studies, Cohort-Retrospective Study.

**Level of Confidence:** Medium.

**Clinical Recommendation Level:** Recommendation. This recommendation should generally be followed but remain alert for new information.

**Evidence Statements:** In the Salisbury Eye Evaluation Study, visual field loss was reported to be the primary vision component that increases the risk of falls. For each 10 percent loss in visual field, individuals experienced 8 percent higher odds of falling, after adjustment for other factors. Peripheral visual field loss, in particular, was statistically significant. Visual field reduction is most likely related to the risk of falls through its effects on postural stability, the ability to maneuver around objects, and decreased ability to detect steps or changes in surfaces. Although visual field loss cannot be reversed, persons with such deficits may benefit from mobility training to navigate the environment more safely and reduce the risk of falling.<sup>205</sup> (Evidence Grade: B)

The Los Angeles Latino Eye Study found that both central and peripheral visual impairment were associated with increased risk of falls and falls with injury, independent of age, gender, and co-morbidities. Impairment in central vision increased the risk of falls by 2.4 times and falls with injury by 2.8 times. Peripheral vision loss increased falls risk 1.4-fold for both outcomes. Patients may benefit from being counseled about the impact of impaired vision on the increased risk of falls.<sup>207</sup> (Evidence Grade: B)

A combination of interventions, including exercise and vision assessment and treatment, may help prevent injurious falls.<sup>208</sup> (Evidence Grade: B)

Impaired vision is an important and independent risk factor for falls. Strong association exists between depth perception and falls, and distance edge contrast sensitivity and visual acuity have also been linked to the risk of falls. Good visual acuity and distance edge contrast sensitivity have been shown to be important for detecting and avoiding hazards in the environment, especially when walking. The strong association between depth perception and falls suggests intact stereoacuity may be important for fall prevention.<sup>206</sup> (Evidence Grade: C)

<p>Cost-effective measures such as ensuring patient's spectacle correction is current, or the use of cataract surgery, when indicated, may also maximize vision and have an impact on preventing falls in older people.<sup>206</sup> (Evidence Grade: C)</p>	
<p><b>Potential Benefits:</b> Patients with central and/or peripheral vision loss may benefit from fall prevention counseling and intervention when initially diagnosed.</p>	<p><b>Potential Risks/Harms:</b> None.</p>
<p><b>Benefits and Harms Assessment:</b> Benefits significantly outweigh harms.</p>	
<p><b>Potential Costs:</b> Direct cost of counseling as part of a comprehensive eye and vision examination.</p>	
<p><b>Value Judgments:</b> None.</p>	
<p><b>Role of Patient Preferences:</b> Moderate.</p>	
<p><b>Intentional Vagueness:</b> Specific type/form of counseling is not stated, as it is patient specific.</p>	
<p><b>Gaps in Evidence:</b> Research is needed to further evaluate the relationship between different forms of vision loss/impairment and falls.</p>	

### 3. Coordination and Frequency of Care

Eye and vision care provide for the evaluation, management, and coordination of a broad spectrum of integrated health care needs resulting in the diagnosis of a wide array of eye and vision anomalies, diseases, disorders, and related systemic conditions. The nature and severity of the problem(s) diagnosed determine the need for and frequency of additional services.

#### **a. Professional Collaboration and Communication**

Intraprofessional consultation may be needed for optometric services such as treatment and management of ocular disease, low vision or neurovision rehabilitation, vision therapy, and/or specialty contact lenses. Interprofessional consultation with an ophthalmologist may be necessary for ophthalmic surgery or other aspects of secondary or tertiary eye care.

The comprehensive adult eye and vision examination may also reveal systemic medical conditions or diseases for which the doctor of optometry may coordinate needed care. An interprofessional consultation can be implemented with the patient's primary care physician or another health care provider for further evaluation and treatment of systemic conditions or related health problems. Information shared with other health care providers offers a unique and important perspective, resulting in improved interdisciplinary care of the patient.

#### **b. Frequency of Care**

Individuals should receive periodic eye and vision examinations to detect and treat any eye disease in its early stages to prevent or minimize vision loss. These evaluations can also identify problems that may be affecting visual function and productivity at work, home, and in sports or leisure activities. In addition, the early signs and symptoms of systemic medical conditions, such as diabetes, hypertension, and hyperlipidemia, may be revealed during a

comprehensive eye and vision examination. Annual eye health and vision examinations are an important part of overall preventive healthcare and wellness practices.

The cost/benefit ratio of routine eye examinations may vary for those persons found to have normal eye examination results on initial examination; however, regular examinations are recommended for individuals who notice a change in vision, have systemic health problems with ocular complications (e.g., diabetes) and who have a family history of eye disease.<sup>210</sup> (Evidence Grade: B)

In patients with chronic eye conditions (e.g., glaucoma, retinal eye disease) nonadherence with scheduled follow-up visits can be prevalent. Factors such as incomplete understanding of the pathogenesis and treatment of the disease, difficulty getting time off from work, and having significant visual impairment may limit compliance with follow-up care. Interventions to improve patient education and office efficiency and to increase networking opportunities among patients with chronic eye conditions could help improve compliance with follow-up.<sup>211</sup> (Evidence Grade: D)

Many eye diseases can be asymptomatic in their earliest and most treatable stages. Detection of any eye disease in this early phase can be very beneficial to the patient for treatment options and treatment success. Some individuals believe that if they had an eye problem, they would have symptoms. If this misconception results in fewer eye examinations, it potentially may contribute to increased risk of vision loss due to later stage detection.<sup>212</sup> (Evidence Grade: D). Therefore, annual eye health and vision examinations can aid in the early detection and treatment of potentially vision-threatening conditions, such as diabetes. The American Public Health Association supports annual in-person comprehensive eye examinations for all individuals, regardless of diabetes status.<sup>213</sup>

**CONSENSUS-BASED ACTION STATEMENT:** Patients who will undergo or have undergone ocular surgery or other specialty care should be counseled by their eye doctor regarding their ongoing need for periodic comprehensive eye and vision examinations.

**Evidence Quality:** There is a lack of published research to support or refute the use of this recommendation.

**Benefits and Harms Assessment:** Implementation of this recommendation is likely to increase patient understanding of any diagnosed eye or vision problems and improve compliance with any recommended treatment. The benefits of this recommendation were established by expert consensus opinion.

Since the prevalence of ocular diseases and vision disorders tends to increase with age, the need for patient re-examination is potentially age dependent. In addition, the recommended frequency of a comprehensive eye and vision examination varies with an individual's ocular and medical history, occupation, and other related risk factors.

- 18 through 39 years of age

Vision problems in people under 40 years of age are largely due to refractive errors and eye injury.<sup>214</sup> More than half of all individuals treated for eye injuries are between 18 and 45 years of age and nearly 30 percent of those are 30 to 40 years old.<sup>215</sup> Lifestyle changes adopted during this period may adversely affect vision and eye health in later years.

The educational, vocational, and avocational visual requirements for individuals in this age group are substantial. Visual demands of the workplace bring about the need for regular eye care. The most frequent health complaints among workers who use computers are vision related. Studies indicate that a large percentage of people working at a computer have visual symptoms.<sup>216-219</sup> Other workers whose jobs involve extensive near viewing tasks may also experience similar problems. Clinicians should consider additional testing on these individuals and advise them on visual ergonomics to help prevent or reduce eyestrain.

The prevalence of ocular disease is relatively low for young adults; however, many eye diseases can initially develop without signs or symptoms. Therefore, having good visual acuity does not rule out their presence.<sup>27</sup> Glaucoma may begin to appear in this age group, particularly among African Americans. In addition, diabetes increasingly affects young adults and is a leading cause of blindness among Americans of working age. To ensure early detection of potentially sight-threatening vision disorders, and for young adults to maintain their visual efficiency and productivity, periodic examinations are needed.

**CONSENSUS-BASED ACTION STATEMENT:** Comprehensive eye and vision examinations are recommended annually for persons 18 through 39 years of age to optimize visual function, evaluate eye changes, and provide for the early detection of sight-threatening eye and systemic health conditions. Risk factors present may result in recommendations for more frequent evaluations.

**Evidence Quality:** There is a lack of published research to support or refute the use of this recommendation.

**Benefits and Harms Assessment:** Implementation of this recommendation is likely to result in earlier diagnosis of eye and vision problems and the prevention or reduction in vision loss in this age group. The benefits of this recommendation were established by expert consensus opinion.

- 40 through 64 years of age

The prevalence of refractive errors is related to age and varies with gender and race/ethnicity.<sup>98</sup> Changes in refractive error are not uncommon in persons 40 years or older.<sup>105</sup> Even low amounts of refractive error can cause significantly reduced vision, and if uncorrected, affect a person's independence, health-related quality of life, and well-being. A substantial portion of working age adults may have visually-significant undiagnosed refractive errors, and detection can be a major benefit in their personal and work lives and help to improve vision in later life.<sup>220</sup> (Evidence Grade: D) Near vision problems due to refractive errors are also significant causes of reduced vision among people of working age.<sup>221</sup>

The onset of presbyopia in this age group results in reduced ability to focus at near and intermediate distances. Uncorrected presbyopia can cause significant visual disability and have a negative impact on a person's quality of life. In most cases, presbyopia progresses gradually until individuals are unable to focus clearly at near for reading or other close activities without the aid of an optical correction. This progression continues in a predictable manner in this age group, necessitating periodic changes in the power of their near optical correction.

Uncorrected presbyopia has been poorly recognized as a cause for reduction in a person's health-related quality of life. This may be due to the perception that it affects individuals less significantly than eye disease or other eye conditions; however, reduced near vision due to uncorrected presbyopia matters just as much to quality of life as reduced distance visual acuity.<sup>222</sup>

Individuals in this age group are also at greater risk for eye diseases, including age-related macular degeneration, cataracts, diabetic retinopathy, and glaucoma. Since these diseases are often asymptomatic in the early treatable stages, regular eye examinations are an important means to prevent vision loss.<sup>223</sup> (Evidence Grade: D)

Having insurance for eye care services increases the chances of having better vision outcomes. A study of adults in eight states found that persons 40 to 65 years of age, with or without visual impairment, who had an eye exam in the prior year, generally had better vision, as indicated by their ability to recognize friends across the street and to read a newspaper or magazine.<sup>224</sup> (Evidence Grade: D) Early diagnosis and treatment of eye and vision problems may also reduce the cost burden of providing future care. These findings reinforce the benefits of an annual eye health and vision examination.

**CONSENSUS-BASED ACTION STATEMENT:** Comprehensive eye and vision examinations are recommended annually for persons 40 through 64 years of age to optimize visual function, evaluate eye changes and provide for the early detection of sight-threatening eye and systemic health conditions. Risk factors present may result in recommendations for more frequent evaluations.

**Evidence Quality:** There is a lack of published research to support or refute the use of this recommendation.

**Benefits and Harms Assessment:** Implementation of this recommendation is likely to result in earlier diagnosis of eye and vision problems and the prevention or reduction in vision loss in this age group. The benefits of this recommendation were established by expert consensus opinion.

- 65 years of age and older

The prevalence of visual impairment increases rapidly with age among all racial and ethnic groups.<sup>225</sup> The portion of adults reporting some form of visual impairment rises dramatically after age 65. In 2014, an estimated 28 million people aged ≥65 years in the United States reported some vision impairment defined as being blind or having severe difficulty with seeing, even with eyeglasses.<sup>204</sup> Vision loss in older adults can adversely affect their activities of daily living and hinder their ability to live independently in their community.

Persons aged 65 years and older who have regular eye examinations were found to experience less decline in vision and improved functional status.<sup>30</sup> (Evidence Grade: D) In addition, correction of refractive error improves vision-specific quality of life and aids in preserving independence in activities of daily living in persons over age 65.<sup>18</sup> (Evidence Grade: B) Those who have regular eye examinations may also have a lower probability of reduction in reading ability and of developing legal blindness or chronic vision impairment.<sup>226</sup>

In asymptomatic patients, routine comprehensive optometric eye examinations detect a significant number of new eye conditions and/or result in management changes. The number detected increases with age and assessment interval. As the assessment interval increases, the odds of having a significant change increase, especially in older individuals.<sup>223</sup> (Evidence Grade: D)

Failure to diagnose and treat vision problems in the elderly may contribute to cognitive decline and dementia.<sup>227-229</sup> Visual disturbances, including problems with contrast sensitivity, color perception, visuospatial orientation and pupillary reaction, can be among the first symptoms in persons with Alzheimer’s disease.<sup>39,229</sup> Early vision correction may reduce the severity of dementia and its associated functional decline.<sup>106</sup>

**EVIDENCE-BASED ACTION STATEMENT:** For persons 65 years of age or older, annual comprehensive eye and vision examinations are recommended to optimize visual function, evaluate eye changes and provide for the early detection of sight-threatening eye and systemic health conditions. Risk factors present may result in recommendations for more frequent evaluation.<sup>18,30,223</sup>

**Evidence Quality:** Grade C, Randomized Clinical Trial, Cross-Sectional Studies.

**Level of Confidence:** Medium.

**Clinical Recommendation Level:** Recommendation. This recommendation should generally be followed but remain alert for new information.

<p><b>Evidence Statements:</b> Correction of refractive errors improves vision-specific quality of life and aids in preserving independence in activities of daily living in persons over age 65.<sup>18</sup> (Evidence Grade: B)</p> <p>Persons aged 65 years and older who have regular eye examinations were found to experience less decline in vision and improved functional status.<sup>30</sup> (Evidence Grade: D)</p> <p>In asymptomatic patients, routine comprehensive optometric eye examinations detect a significant number of new eye conditions and/or result in management changes. The number detected increases with age and assessment interval. As the assessment interval increases, the odds of having a significant change increase, especially in older individuals.<sup>223</sup> (Evidence Grade: D)</p>	
<p><b>Potential Benefits:</b> Optimizing visual function and preventing and/or minimizing vision loss through early diagnosis, treatment and management of ocular health conditions.</p>	<p><b>Potential Risks/Harms:</b> Temporary discomfort and visual disturbances resulting from dilation, allergic responses to diagnostic pharmaceutical agents or other adverse effects.</p>
<p><b>Benefits and Harms Assessment:</b> Benefits significantly outweigh harms.</p>	
<p><b>Potential Costs:</b> Direct cost of testing.</p>	
<p><b>Value Judgments:</b> None.</p>	
<p><b>Role of Patient Preferences:</b> Moderate.</p>	
<p><b>Intentional Vagueness:</b> None.</p>	
<p><b>Gaps in Evidence:</b> Research is needed to determine the optimum frequency of eye examinations in persons 65 years or older to prevent vision loss and maintain visual function and eye health.</p>	

**c. At-risk Patients**

More frequent re-examinations may be recommended for certain patients at risk for vision loss, regardless of their age. Persons who notice vision changes, those at higher risk for the development of eye and vision problems, and individuals with a family history of eye disease need to have an eye examination more frequently than asymptomatic persons with no history of ocular or general health problems.<sup>210</sup> (Evidence Grade: B) Table 2 lists, in no particular order, factors that put persons at risk for the development of eye and vision problems.

**Table 2  
Risk Factors for the Development of Eye and Vision Problems**

Having a personal or family history of ocular disease.	Having functional vision in only one eye.
Belonging to certain racial and ethnic groups.	Wearing contact lenses.
Having systemic health conditions with potential ocular manifestations, (e.g., diabetes mellitus, hypertension, obesity, arteriosclerosis).	Undergoing eye surgery or experiencing previous eye injury.
Participating in occupations that are highly demanding visually or have a high potential of being hazardous to the eyes.	Having high or progressive refractive error.
Taking prescription or nonprescription drugs with ocular side effects.	Experiencing other progressive eye-related health concerns or conditions.

**CONSENSUS-BASED ACTION STATEMENT:** Adult patients should be advised by their eye doctor to seek eye care more frequently than the recommended re-examination interval, if new ocular, visual, or systemic health problems develop.

**Evidence Quality:** There is a lack of published research to support or refute the use of this recommendation.

**Benefits and Harms Assessment:** Implementation of this recommendation is likely to increase patient understanding of the need for and benefits of more frequent vision examination based on personal risk factors. The benefits of this recommendation were established by expert consensus opinion.

## C. CONCLUSION

Eye and vision disorders have broad implications in health care because of their potential for causing disability, suffering, and loss of productivity. Early detection and treatment of eye and vision disorders are essential to maintain full functional ability and to prevent or minimize the damage and consequent disabilities that may result from their neglect.

Many eye and vision disorders create no obvious symptoms; therefore, individuals are often unaware that problems exist. The comprehensive adult eye and vision examination performed in-person by an eye doctor provides the means to evaluate the function and health of the eyes and visual system and any ocular manifestations of systemic disease. It is an important part of preventive health care and serves as a key component in maintaining good vision and optimal eye health in adults.

Comprehensive eye and vision examinations provide the opportunity for early detection of eye health and visual performance problems. They also provide the opportunity for prevention of vision loss. This results in improved visual and overall function, as well as improved health-related quality of life for adults.

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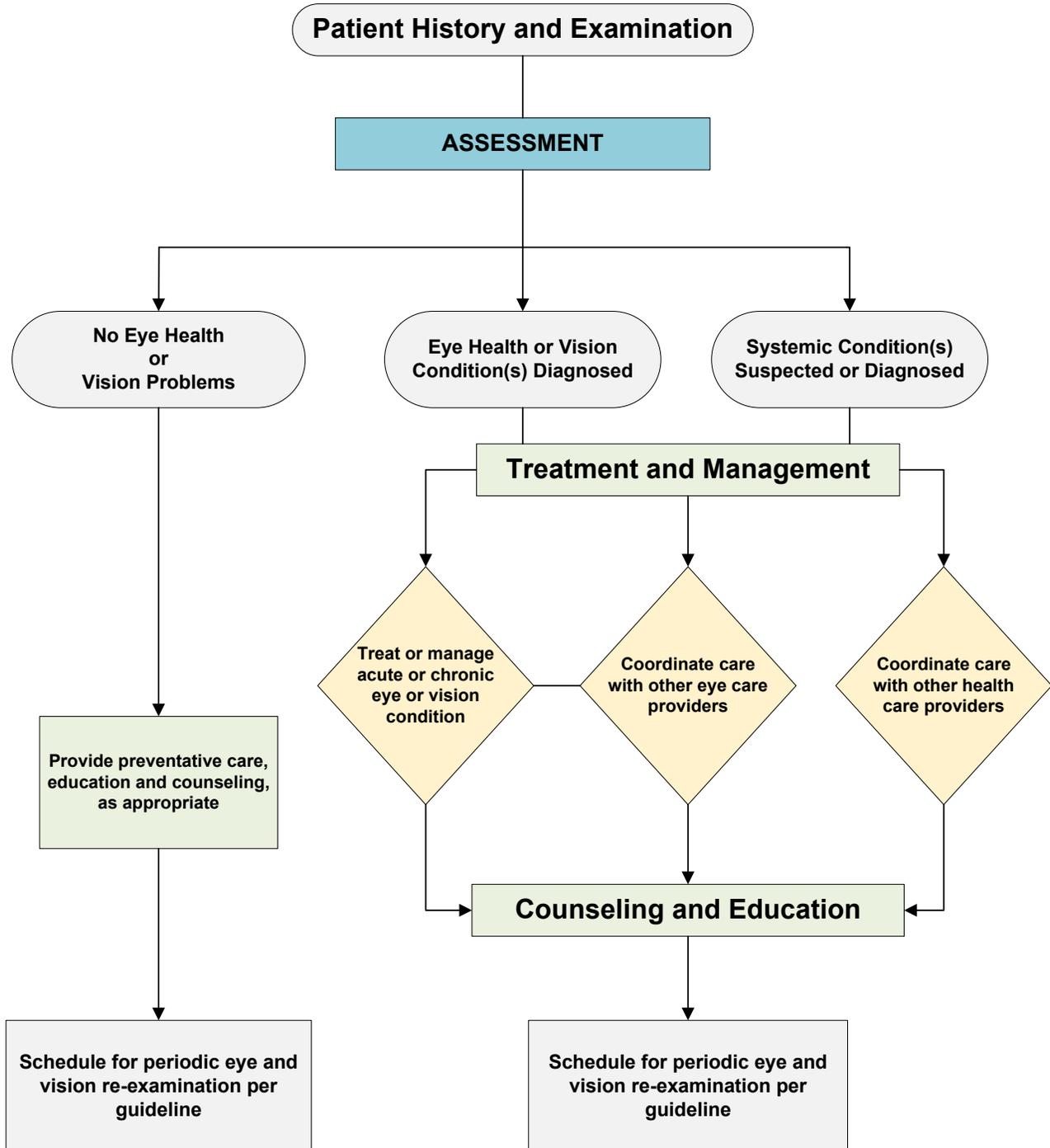
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V. APPENDICES

Appendix 1:  
Comprehensive Adult Eye and Vision  
Examination: A Flowchart



**Appendix 2:  
Potential Components of the Comprehensive Adult  
Eye and Vision Examination**

**A. Patient History**

1. Nature and history of presenting problem, including chief complaint
2. Visual and ocular history
3. General health history, which may include social history and review of systems
4. Family eye and medical histories
5. Medication usage and medication allergies
6. Vocational and avocational visual requirements
7. Name of, and contact information for, the patient's other health care providers

**B. Visual Acuity**

1. Distance visual acuity testing
2. Near visual acuity testing
3. Pinhole acuity testing
4. Visual acuity at identified vocational or avocational working distances

**C. Refraction**

1. Measurement of patient's most recent or habitual optical correction
2. Objective measurement of refractive status
3. Subjective measurement of refractive status
4. Cycloplegic refraction, if needed

**D. Ocular Motility, Binocular Vision, and Accommodation**

1. Evaluation of ocular alignment and motility
2. Assessment of heterophorias, vergence amplitude and facility
3. Testing for suppression
4. Measurement of accommodative amplitude and facility

**E. Ocular Examination and Systemic Health Assessment**

1. Observation of pupil size and pupillary responses
2. Evaluation of the ocular anterior segment and adnexa
3. Measurement of intraocular pressure
4. Evaluation of the ocular media
5. Evaluation of the ocular posterior segment
6. Visual field testing
7. Systemic health assessment

**F. Ancillary Testing (as needed)**

### **Appendix 3: Abbreviations/Acronyms**

AC/A –	Accommodative convergence/accommodation
ADA –	Americans with Disabilities Act
AHRQ –	Agency for Healthcare Research and Quality
AMD –	Age-related macular degeneration
ANSI –	American National Standards Institute
AOA –	American Optometric Association
CDC –	Centers for Disease Control and Prevention
COI –	Conflict of interest
CPG –	Clinical Practice Guideline
DED –	Dry eye disease
DR –	Diabetic retinopathy
EBO –	Evidence-based optometry
EHR –	Electronic health record
ETDRS –	Early Treatment Diabetic Retinopathy Study
GDG –	Guideline Development Group
GDRG –	Guideline Development Reading Group
IOM –	Institute of Medicine
IOP –	Intraocular pressure
NASEM –	National Academies of Sciences, Engineering and Medicine
NPC –	Near point of convergence
TDD –	Telecommunications devices for the deaf
UV –	Ultraviolet radiation

### **Appendix 4: Gaps in Research Evidence**

During the course of the development of this guideline, the Evidence-based Optometry Guideline Development Group identified the following gaps in evidence as potential areas for future research:

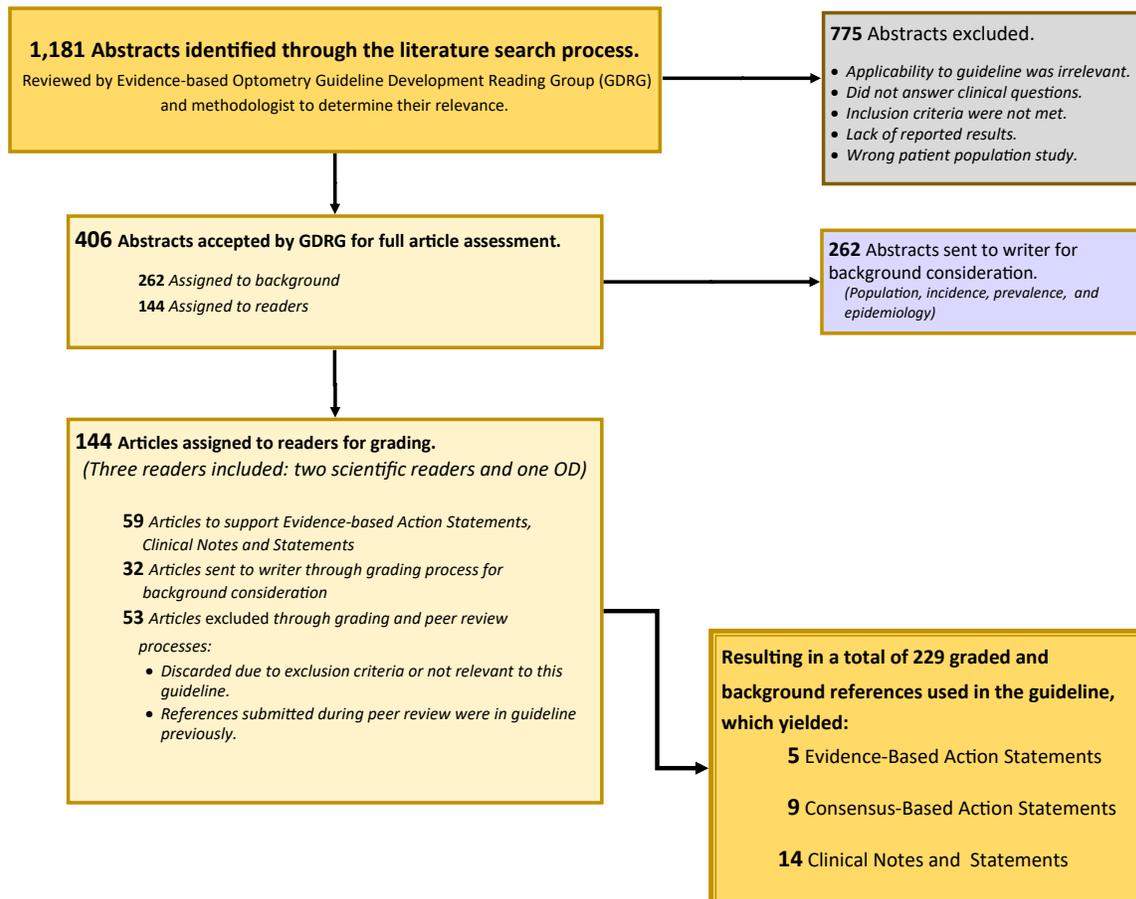
- Research to determine the optimum frequency for comprehensive eye and vision examinations in adults to prevent vision loss and maintain visual function and eye health.
- Research to identify the most effective methods of patient education.
- Research to further evaluate the relationship between different forms of vision loss/impairment and falls.

## VI. METHODOLOGY FOR GUIDELINE DEVELOPMENT

This guideline was developed by the AOA Evidence-based Optometry Guideline Development Group (GDG). Clinical questions to be addressed in the guideline were identified and refined during an initial meeting of the GDG and served as the basis for a search of the clinical and research literature.

An English language literature search for the years 2013 to 2020 was conducted by a trained researcher. If the search did not produce results, the search parameters were extended an additional 5 years, and subsequently 10 years, back. In addition, a review of selected earlier research publications was conducted based on previous versions of this guideline. The literature search was conducted using the following electronic databases:

- Centers for Disease Control and Prevention, National Center for Health Statistics
- Cochrane Library
- Google Scholar
- Ovid MEDLINE
- PubMed
- VisionCite
- Scopus



All references meeting the criteria were reviewed to determine their relevance to the clinical questions addressed in the guideline. They were assigned to three readers who independently reviewed and graded the quality of evidence and the clinical recommendations for each article, based on a previously defined system for grading quality.

During six articulation meetings of the Evidence-based Optometry Guideline Development Reading Group (GDRG), all evidence was reviewed and clinical recommendations were developed. Grading for the recommendations was based on the quality of the research and the benefits and risks of the procedure or therapy recommended. Where direct scientific evidence to support a recommendation was weak or lacking, a consensus of the GDRG members was required to approve a recommendation.

At the draft reading meeting of the Evidence-based Optometry Guideline Development Group (GDG), the guideline document was reviewed and edited and the completed draft was approved by the GDG by conference call. The approved draft of the guideline was then made available for peer and public review for 30 days for numerous stakeholders (individuals and organizations) to make comments. All suggested revisions were reviewed, and, if accepted by the GDG, incorporated into the final guideline.

Clinical recommendations in this guideline are evidence-based statements regarding patient care that are supported by the scientific literature or consensus of professional opinion when no quality evidence was discovered. The guideline will be periodically reviewed and updated as new scientific and clinical evidence becomes available.

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