

Screening for Primary Open-Angle Glaucoma

US Preventive Services Task Force Recommendation Statement

US Preventive Services Task Force

IMPORTANCE Glaucoma affects an estimated 2.7 million people in the US. It is the second-leading cause of irreversible blindness in the US and the leading cause of blindness in Black and Hispanic/Latino persons.

OBJECTIVE To update its 2013 recommendation, the US Preventive Services Task Force (USPSTF) commissioned a systematic review to evaluate the benefits and harms of screening for glaucoma in adults.

POPULATION Adults 40 years or older who present in primary care and do not have signs or symptoms of open-angle glaucoma.

EVIDENCE ASSESSMENT The USPSTF concludes that the evidence is insufficient to assess the balance of benefits and harms of screening for glaucoma in adults. The benefits and harms of screening for glaucoma in adults are uncertain. More research is needed.

RECOMMENDATION The USPSTF concludes that the current evidence is insufficient to assess the balance of benefits and harms of screening for primary open-angle glaucoma in adults. (I statement)

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Summary of Recommendation

Asymptomatic adults 40 years or older	The USPSTF concludes that the current evidence is insufficient to assess the balance of benefits and harms of screening for primary open-angle glaucoma in adults.	I
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USPSTF indicates US Preventive Services Task Force.

See the Summary of Recommendation Figure.

Importance

Glaucoma affects an estimated 2.7 million people in the US.¹ It is the second-leading cause of irreversible blindness in the US and the leading cause of blindness in Black and Hispanic/Latino persons.¹⁻³

the methods the USPSTF uses to determine the net benefit, see the USPSTF Procedure Manual.⁴

USPSTF Assessment of Magnitude of Net Benefit

The US Preventive Services Task Force (USPSTF) concludes that the **evidence is insufficient** to assess the balance of benefits and harms of screening for glaucoma in adults. The benefits and harms of screening for glaucoma in adults are uncertain. More research is needed.

See the **Table** for more information on the USPSTF recommendation rationale and assessment and the **eFigure** in the Supplement for information on the recommendation grade. See the **Figure** for a summary of the recommendation for clinicians. For more details on

Practice Considerations

Patient Population Under Consideration

This recommendation applies to adults 40 years or older who present in primary care settings and do not have signs or symptoms of open-angle glaucoma.

Definitions

Glaucoma is defined as a chronic progressive optic neuropathy characterized by thinning of the structural optic disc layer, retinal nerve fiber layer, or both, and its associated visual field loss.⁵ Although increased intraocular pressure (IOP) was previously considered an important part of the definition of this condition, it is now known that many persons with open-angle glaucoma do not have increased IOP and not all persons with increased IOP

Table. Summary of USPSTF Rationale

Rationale	Screening for glaucoma
Detection	<ul style="list-style-type: none"> • Adequate evidence that screening tests such as imaging (eg, optical coherence testing), tonometry, and visual field testing can identify open-angle glaucoma; however, these tests are not commonly administered in the primary care setting. • Inadequate evidence on the accuracy of risk assessment tools to identify patients at higher risk of open-angle glaucoma.
Benefits of early detection and intervention and treatment	<ul style="list-style-type: none"> • Inadequate direct evidence that screening for open-angle glaucoma in primary care improves intermediate outcomes (changes in the optic nerve, visual field, or intraocular pressure) or health outcomes such as reduced visual impairment, vision-related function, and quality of life. • Adequate evidence that treatment of open-angle glaucoma (ie, laser trabeculoplasty or medical therapy) improves intermediate outcomes (reduced intraocular pressure, visual field loss, or optic nerve damage). • Inadequate evidence that treatment of primary open-angle glaucoma improves health outcomes such as reduced visual impairment, vision-related function, and quality of life. • Limited evidence that improvements in intermediate outcomes lead to improvements in health outcomes.
Harms of early detection and intervention and treatment	<ul style="list-style-type: none"> • Inadequate evidence on the harms of screening for open-angle glaucoma. • Adequate evidence that the harms of treatment of open-angle glaucoma (laser trabeculoplasty or medical therapy) are small.
USPSTF assessment	The limitations of the direct evidence and indirect evidence prevent the USPSTF from developing an assessment of the overall net benefit; therefore, the USPSTF found the evidence insufficient to determine the balance of benefits and harms.

Abbreviation: USPSTF, US Preventive Services Task Force.

have or will develop glaucoma.^{2,4,5} Glaucoma is characterized as primary (idiopathic) or secondary (resulting from a known cause, such as trauma or inflammation) and as closed-angle or open-angle. “Open” refers to a visibly open anterior chamber angle (between the iris and the anterior sclera or peripheral cornea). Primary open-angle glaucoma (POAG) is the most common form of glaucoma and is the focus of this recommendation.⁶

The typical natural history of POAG is gradual loss of peripheral vision, central vision, or both, potentially progressing to blindness. Visual field loss is often detectable before visual acuity loss, which usually occurs later in patients with glaucoma. Rates of progression of POAG vary, although in most patients, significant visual impairment does not occur for years or 1 to 2 decades. Progression of glaucoma is typically measured by progression of visual field deficits and optic disc changes.⁷

Impaired visual acuity refers to decreased clarity or sharpness of vision. For the purposes of this recommendation, impaired visual acuity is defined as best corrected vision less than 20/40 (cutoff for many states for an unrestricted driver’s license). In the US, blindness is defined as best corrected vision less than 20/200 or a visual field of 20 degrees or less.^{1,8} Visual impairment refers to vision-related functional limitations and can occur for reasons other than visual acuity loss.

Suggestions for Practice Regarding the I Statement

Potential Preventable Burden

The prevalence of POAG in the US is estimated at about 2%.⁹ The onset is often in mid-late adulthood, and the number of persons with glaucoma increases with age (from 250 000 persons aged 40 to 49 years to 1.5 million persons 70 years or older).¹⁰ Risk factors for POAG include older age, family history, and Black or Hispanic/Latino race or ethnicity. Physical findings such as increased IOP, thinner central cornea, optic disc hemorrhage, large optic disc cup-to-disc ratio, and lower ocular perfusion pressure are also associated with increased risk of developing POAG.^{5,11,12} While the incidence of glaucoma-related blindness has decreased in recent years, the number of persons with glaucoma is projected to increase to an estimated 4.3 million in 2025.³ Glaucoma disproportion-

ately affects Black and Hispanic/Latino persons.¹¹⁻¹³ These disparities may be related to known disparities in access to health care and glaucoma management.⁷ Black persons have the highest prevalence of glaucoma, a higher rate of glaucoma progression and blindness, and earlier presentation of glaucoma symptoms.^{7,9,11-13}

Whether early glaucomatous changes will progress to visual impairment cannot be precisely predicted. Rates of progression of POAG vary, although in most patients, significant visual impairment does not occur during the first 10 years after diagnosis. Whether the rate of progression of glaucoma remains uniform throughout the disease course is also not known.⁷

Screening Tests

Diagnosis of open-angle glaucoma is based on a combination of tests showing degenerative changes in the optic disc, increased IOP, and defects in visual fields.¹⁴ Screening might include a smaller combination of tests, or a single test, to identify patients needing further, more comprehensive evaluation for glaucoma. Commonly used tests include tonometry (for IOP), ophthalmoscopy during the dilated eye examination (for evaluation of the optic nerve), perimetry (visual field test), gonioscopy (to measure the angle in the eye where the iris meets the cornea), and pachymetry (to measure the thickness of the cornea). Imaging tests such as optical coherence tomography (OCT) or spectral-domain OCT (which analyzes the spectrum of reflected light on the retina) and optic disc photography (to view the optic nerve head, retina, or both) can supplement the clinical examination. Given that increased IOP is no longer considered necessary or sufficient to diagnose glaucoma, the use of tonometry alone is inadequate to detect cases of open-angle glaucoma.⁷ With the exception of visual acuity testing, most tests (eg, OCT, Humphrey Visual Field Analyzer, and tonometry) require specialized equipment and are performed in an eye specialty setting. There are no tools currently available that reliably identify who may be at increased risk for glaucoma or for whom screening may be more beneficial. The USPSTF found no randomized clinical trials that assessed the benefits or harms of primary care referral to specialty eye services.

Figure. Clinician Summary: Screening for Primary Open-Angle Glaucoma

What does the USPSTF recommend?	For adults 40 years or older who do not have any symptoms of glaucoma: The USPSTF found that the evidence is insufficient to assess the balance of benefits and harms of screening for primary open-angle glaucoma in adults. Grade: I statement
To whom does this recommendation apply?	This recommendation applies to asymptomatic adults (40 years or older). It does not apply to adults who have reported signs and symptoms of vision loss or have been diagnosed with other types of glaucoma (ie, narrow- or closed-angle glaucoma and secondary open-angle glaucoma).
What's new?	This recommendation is consistent with the 2013 USPSTF statement on screening for glaucoma.
How to implement this recommendation?	<ul style="list-style-type: none"> • There is insufficient evidence to recommend for or against screening for primary open-angle glaucoma in the primary care setting in persons without symptoms of vision impairment. • Clinicians should use their clinical judgement to determine if screening is appropriate for individual patients.
What additional information should clinicians know about this recommendation?	<ul style="list-style-type: none"> • Glaucoma affects an estimated 2.7 million persons in the US. Its onset is mid-late adulthood, with prevalence increasing with age. • Glaucoma disproportionately affects Black and Hispanic/Latino persons; Black persons have the highest prevalence of glaucoma, a higher rate of glaucoma progression, and earlier presentation of glaucoma symptoms. • Several screening tests can identify open-angle glaucoma; however, these tests are not commonly administered in the primary care setting. Whether increased intraocular pressure or early glaucomatous changes will progress to visual impairment cannot be precisely predicted. • Treatment of early, screen-detected primary open-angle glaucoma often includes prescription eye drops or laser therapy and focuses on reducing intraocular pressure, visual field loss, and optic nerve damage. However, there is limited evidence about whether these changes lead to improvements in visual impairment, vision-related function, and quality of life.
Why is this recommendation and topic important?	Glaucoma is the second-leading cause of irreversible blindness in the US and the leading cause of blindness in Black and Hispanic/Latino persons.
What are other relevant USPSTF recommendations?	The USPSTF has a recommendation on screening for impaired visual acuity in older adults, which can be found on the USPSTF website (https://www.uspreventiveservicestaskforce.org/uspstf/).
Where to read the full recommendation statement?	Visit the USPSTF website (https://www.uspreventiveservicestaskforce.org/uspstf/) or the JAMA website (https://jamanetwork.com/collections/44068/united-states-preventive-services-task-force) to read the full recommendation statement. This includes more details on the rationale of the recommendation, including benefits and harms; supporting evidence; and recommendations of others.

The USPSTF recognizes that clinical decisions involve more considerations than evidence alone. Clinicians should understand the evidence but individualize decision-making to the specific patient or situation.

USPSTF indicates US Preventive Services Task Force.

Treatment of Open-Angle Glaucoma

The initial aim of primary treatment of POAG is reduction of IOP, even in persons without elevated IOP. Treatments include medication, laser therapy, and surgery. The American Academy of Ophthalmology recommends medications (most often prostaglandins) or laser trabeculoplasty as initial therapy in most patients.⁵ Surgery is usually reserved for patients with severe visual field loss at baseline or patients with advanced POAG who do not respond to medications or laser trabeculoplasty.⁷ Although the USPSTF found adequate evidence that treatment of glaucoma reduces intermediate outcomes such as IOP, visual field loss, and optic nerve changes, there was not enough evidence to conclude that these changes would lead to improvements in health outcomes such as visual impairment, vision-related function, and quality of life.

Potential Harms of Screening and Treatment

Because not all persons who are diagnosed with and treated for glaucoma progress to visual impairment, potential harms of screening tests include overdiagnosis and overtreatment. Potential harms

caused by treatment of glaucoma may include formation of cataracts resulting from surgery, eye irritation from topical medications, or both.¹⁵

Current Practice

Data on the frequency of glaucoma screening in primary care settings is unknown, although it is likely uncommon due to a lack of training and specialized equipment. The American Academy of Ophthalmology recommends a baseline comprehensive eye evaluation at age 40 years, with subsequent examinations based on age and risk factors.¹⁴ For glaucoma evaluation, the American Academy of Ophthalmology describes a number of components of the comprehensive eye examination, including visual acuity measurement, pupil examination, anterior segment examination, IOP measurement, gonioscopy, optic nerve and retinal nerve fiber layer examination, and fundus examination.⁵

Other Related USPSTF Recommendations

The USPSTF has a recommendation on screening for impaired visual acuity in older adults (I statement).

Update of Previous USPSTF Recommendation

In 2013, the USPSTF concluded that the evidence was insufficient to assess the balance of benefits and harms of screening for glaucoma in adults (I statement).¹⁵ This recommendation concurs with the previous I statement.

Supporting Evidence

Scope of Review

The USPSTF commissioned a systematic review to evaluate the benefits and harms of screening for glaucoma in adults.^{7,16} This review focuses on screening for POAG. Screening for and treatment of other types of glaucoma (ie, narrow- or closed-angle glaucoma and secondary open-angle glaucoma) are outside the scope of this review.

Accuracy of Screening Tests and Risk Assessment

Fifty-three studies (n = 65 464) examined the accuracy of screening tests to detect glaucoma. The largest groups of studies evaluated spectral-domain OCT (29 studies) and tonometry (17 studies), followed by visual fields (9 studies). Most studies evaluated more than 1 test of diagnostic accuracy and the reference standard varied by study, although in general was based on findings related to ophthalmic structure (eg, appearance of optic disc) as well as function (eg, visual fields).^{7,16}

Both spectral-domain OCT and the Humphrey Visual Field Analyzer (visual field test) were associated with acceptable accuracy. Retinal nerve fiber layer thickness on spectral-domain OCT was associated with a pooled sensitivity of 0.79 (95% CI, 0.75-0.83) and pooled specificity of 0.92 (95% CI, 0.87-0.96) for diagnosing glaucoma vs controls (15 studies; n = 4242).^{7,16} Ganglion cell complex thickness measurement using spectral-domain OCT was associated with a pooled sensitivity of 0.74 (95% CI, 0.68-0.80) and pooled specificity of 0.91 (95% CI, 0.80-0.96) for identifying individuals with glaucoma (9 studies; n = 1522). The Humphrey Visual Field Analyzer was associated with a pooled sensitivity of 0.87 (95% CI, 0.69-0.95) and pooled specificity of 0.82 (95% CI, 0.66-0.92), based on 6 studies (n = 11 244). Thirteen studies were included in the pooled analysis evaluating the accuracy of tonometry. Tonometry was associated with a high specificity (0.94 [95% CI, 0.90-0.96]) but lower sensitivity (0.48 [95% CI, 0.31-0.66]) for diagnosing glaucoma.^{7,16} Evidence on other screening tests (ophthalmoscopy, optic disc photography, pachymetry, telemedicine, and afferent pupillary defect) was limited.

One study (n = 145) evaluated the accuracy of a risk assessment instrument for identifying persons with glaucoma. Several risk factors were assessed (including age, race, and family history of diabetes or glaucoma), but the study reported low sensitivity (0.20 [95% CI, 0.03-0.56]). Additionally, the highest weight was assigned to previous glaucoma diagnosis, limiting its applicability to asymptomatic populations.^{7,16}

Benefits of Early Detection and Treatment

One trial of frail elderly persons (n = 616; mean age, 81 years) studied the effects of screening on health outcomes. This study com-

pared screening by an optometrist that included components relevant for glaucoma diagnosis (ie, visual acuity testing, IOP measurement, direct ophthalmoscopy, and visual field testing) with no screening. At 1 year, there were no differences in vision parameters (mean distance visual acuity or mean near visual acuity) or vision-related quality of life.^{7,16}

While treatment of POAG was found to improve IOP, there was limited evidence that treatment improved health outcomes such as reduced visual impairment, vision-related function, and quality of life or evidence that improvements in intermediate outcomes leads to improvements in health outcomes.

Sixteen trials (n = 3706) studied the benefits of treatment of glaucoma vs placebo or no treatment. Topical medical treatment was associated with greater reduction in IOP (mean difference, -3.14 mm Hg [95% CI, -4.19 to -2.08]; $I^2 = 95\%$; 16 studies) and decreased risk of glaucoma progression at 24 to 120 months (relative risk [RR], 0.68 [95% CI, 0.49-0.96]; $I^2 = 53\%$; 7 trials; n = 3771; absolute risk difference, -4.8%). However, evidence on the effects of medical therapy on quality of life was very limited, with 1 trial (n = 461) reporting no differences between latanoprost and placebo in general or vision-related quality of life.^{7,16} Because self-perceived vision changes occur very late in the disease course, this finding may be the result of the relatively short duration of the studies.

Four trials (n = 957) compared the effectiveness of laser trabeculoplasty vs medical therapy or no therapy.^{7,16} The largest trial (Laser in Glaucoma and Ocular Hypertension Trial [LiGHT]; n = 718) found that laser trabeculoplasty and medical therapy were associated with similar effects on IOP, visual acuity, visual fields, general quality of life, and glaucoma-specific quality of life and function at 3 years after enrollment.^{7,16} Three smaller trials reported results consistent with LiGHT for IOP at 4 to 12 months and 5 years; however, the trials did not evaluate other ocular and health outcomes.^{7,16}

Harms of Screening and Treatment

One trial (n = 616) reported on the harms of screening for open-angle glaucoma in frail elderly persons (mean age, 81 years). The trial intervention was vision screening by an optometrist and involved multiple components, including tests specific for glaucoma (tonometry, direct ophthalmoscopy, and visual field assessment). It found that screening (vs no screening) was associated with an increased incidence of falls (incidence rate ratio, 1.57 [95% CI, 1.20-2.05]) and an increased risk of 1 or more falls (RR, 1.31 [95% CI, 1.13-1.50]) and 2 or more falls (RR, 1.24 [95% CI, 0.99-1.54]). Screening was also associated with increased risk of fracture, although the difference was not statistically significant.^{7,16} The reason for the increase in falls was unclear.

Eight trials of medical therapy vs placebo or no treatment reported harms. There were no significant differences in risk of serious adverse events (RR, 1.14 [95% CI, 0.60-1.99]; $I^2 = 32\%$; 3 trials; n = 3140), withdrawal due to adverse events (RR, 2.40 [95% CI, 0.71-19.32]; $I^2 = 0\%$; 5 trials; n = 648), or any adverse event (RR, 1.56 [95% CI, 0.59-4.03]; $I^2 = 82\%$; 2 trials; n = 1538).^{7,16} Two trials found that treatment was associated with increased risk of ocular adverse events (primarily itching, irritation, tearing, dryness, or taste issues) vs placebo in 1 trial of various treatments and in 1 trial of dorzolamide.^{7,16}

The LiGHT trial found no difference between laser trabeculoplasty and medical therapy in patients experiencing both adverse

and serious adverse events. Evidence on harms from 3 smaller trials was limited.^{7,16}

How Does Evidence Fit With Biological Understanding?

The exact cause of POAG is not known. Diagnosis of glaucoma is usually based on several tests that, when combined, evaluate the structure and function of the optic nerve and measure IOP. Persons with POAG may not have increased IOP, and increased IOP may not result in nerve damage and visual impairment. Many persons with glaucoma do not have symptoms. However, once vision loss occurs—usually slow loss of side vision or peripheral vision—the optic nerve is already damaged. When damage is severe enough, loss of vision impairs function and quality of life. Treatments that reduce IOP prevent the decline in the structure and function of the optic nerve caused by glaucoma, thus slowing the worsening of visual field loss.

There is limited evidence, however, that improvements in intermediate outcomes (IOP, visual fields, visual acuity, or optic nerve damage) after treatment of open-angle glaucoma improve visual impairment, vision-related function, or quality of life. Additionally, the slowly progressive nature of glaucoma makes it difficult to evaluate the effectiveness of treatments, especially in preventing or slowing clinically noticeable loss of vision, and screening may lead to detection and treatment of many persons who will remain asymptomatic throughout their life (known as overdiagnosis and overtreatment).

Response to Public Comment

A draft version of this recommendation statement was posted for public comment on the USPSTF website from October 26 to November 22, 2021. Comments sought clarification on why the USPSTF found insufficient evidence to recommend screening given the USPSTF assessment that there are accurate screening tools and effective treatment for glaucoma. While the USPSTF found adequate evidence that screening tests can identify POAG, these screening tests are not commonly found in primary care settings. Additionally, it found limited evidence that treatment of POAG directly improves health outcomes (such as visual impairment, vision-related function, or quality of life) or that changes in intermediate outcomes (such as changes in the optic nerve or IOP) result in improved health outcomes. Because there was not a clear linkage, it was unclear if changes in intermediate outcomes translate into tangible health outcomes for patients.

Several comments noted the higher prevalence of glaucoma in Black and Hispanic/Latino persons and questioned why the USPSTF did not recommend screening in these higher-risk groups. The USPSTF recognizes that glaucoma disproportionately affects Black and Hispanic/Latino persons; however, it did not find adequate evi-

dence on screening in these higher-risk groups. Additionally, there was a lack of evidence on ways to help identify persons at increased risk who could benefit from screening. The USPSTF is calling for more studies that target higher-risk populations (vs screening all adults). Additionally, the USPSTF wishes to clarify that its I statement is a recommendation neither for nor against screening. Clinicians should continue to use their clinical judgment to determine if screening is appropriate for individual patients.

Research Needs and Gaps

More studies are needed that address the following areas.

- Trials are needed that include larger numbers of Black and Hispanic/Latino persons reporting on the effects of screening and treatment of POAG.
- Screening trials are needed that assess referral to an eye care specialist and use contemporary screening and diagnostic modalities (eg, spectral-domain OCT or swept-source OCT), are of sufficient duration, and include vision-related outcomes (visual impairment, vision-related function, quality of life, and other patient-reported outcomes). These types of studies could provide direct evidence on effects of screening.
- Research is needed on the accuracy of risk assessment tools both for early identification of persons at increased risk of glaucoma and to inform screening strategies.
- Research is needed to better understand the long-term effects of treatment on visual impairment, vision-related function, and quality of life and to verify that benefits of treatment are retained in persons diagnosed with POAG using newer imaging methods such as OCT.

Recommendations of Others

The American Academy of Ophthalmology and the American Optometric Association recommend a baseline comprehensive eye evaluation at age 40 years.^{17,18} For persons without risk factors for ocular disease, the American Academy of Ophthalmology also recommends examinations every 2 to 4 years for persons aged 40 to 54 years, every 1 to 3 years for persons aged 55 to 64 years, and every 1 to 2 years for persons 65 years or older. For persons at higher risk for ocular disease, the American Academy of Ophthalmology recommends that decisions regarding when to initiate eye evaluations and the frequency of periodic examinations be based on the risks but does not provide specific guidance. The American Academy of Family Physicians supports the USPSTF 2013 recommendation on glaucoma screening.¹⁹

ARTICLE INFORMATION

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