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Susannah Rowe; Catherine H. MacLean; Paul G. Shekelle

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Preventing Visual Loss From Chronic Eye Disease in Primary Care

Scientific Review

Susannah Rowe, MD, MPH

Catherine H. MacLean, MD, PhD

Paul G. Shekelle, MD, PhD

VISUAL DISABILITY IS COMMON IN the United States and can have profound consequences for function and quality of life. Most causes of visual impairment are readily diagnosed and at least 40% of blindness and visual impairment is treatable or preventable.^{1,2} Nevertheless, many people living in the United States, especially elderly persons³ and minorities,^{4,5} do not receive necessary eye care.⁶ As a consequence many of these individuals develop visual disability or blindness needlessly.² The problem of undiagnosed visual disorders is growing, with the number of blind and visually impaired elderly individuals expected to double in the next 3 decades.¹

Clinicians in primary care settings play a critical role in reducing visual disability by managing systemic disease with ocular consequences and ensuring that patients receive timely specialty eye care. They may be the only health care professionals to recognize the need for an eye examination because of a new-onset visual disability. They also may be uniquely aware of risk factors, such as diabetes mellitus (DM) or a family history of glaucoma. Clinicians can edu-

Context Vision loss is common in the United States and its prevalence increases with age. Visual disability significantly impacts quality of life and increases the risk of injury. Although at least 40% of blindness in the United States is either preventable or treatable with timely diagnosis and intervention, many people with vision loss are undiagnosed and untreated.

Objective To review the evidence regarding screening and management of eye disorders and visual disability among adults in the primary care setting.

Data Sources and Study Selection MEDLINE, HealthSTAR, EMBASE, The Cochrane Database of Systematic Reviews, and the National Guidelines Clearinghouse were searched for articles and practice guidelines about screening and management of eye diseases and vision loss among adults in the primary care setting using key words and free-text terms, such as *vision screening, glaucoma prevention and control*, from 1985 to 2003. References in these articles and those suggested by experts in eye care, vision loss, and vision screening were reviewed as well.

Data Extraction Articles were searched for the most clinically important information and emphasized randomized controlled trials where available.

Data Synthesis Most major guidelines recommend periodic referral of older adults to an eye care professional for comprehensive evaluation to detect eye diseases and visual disability. The value of routine screening for vision loss in the primary care setting has not been established. Timely identification and treatment of eye diseases can substantially reduce the incidence and prevalence of visual disability among older adults. Optimizing management of systemic diseases, such as diabetes, hypertension, and hyperlipidemia, significantly reduces the risk of related eye disorders.

Conclusions Primary care clinicians can play a vital role in preserving vision in their patients by managing systemic diseases that impact eye health and by ensuring that patients undergo periodic evaluations by eye care professionals and receive needed eye care.

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cate patients about their need for eye care services and can advocate for their patients in obtaining access to such care. In the context of this article, we define a clinician as a primary care physician, nurse practitioner, or other mid-level

practitioner who provides ongoing general medical care and serves as the primary contact between the patient and the health care system.

This review synthesizes current recommendations for primary care clini-

See also p 1497.

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Author Affiliations: Department of Ophthalmology, Boston University School of Medicine, Boston, Mass (Dr Rowe); RAND Health, Santa Monica, Calif (Drs MacLean and Shekelle); Department of Medicine, University of California, Los Angeles (Dr MacLean); and Department of Medicine, Greater Los

Angeles Veterans Affairs Health Care System, Los Angeles, Calif (Dr Shekelle).

Corresponding Author: Susannah Rowe, MD, MPH, Department of Ophthalmology, Boston University School of Medicine, Room L-907, 720 Harrison Ave, Boston, MA 02119 (srowe@bu.edu).

cians regarding preventing the most common causes of visual loss in adults and summarizes the evidence that supports these recommendations. The goal is to help clinicians develop an informed strategy for vision care in their clinical practice. This review does not deal with acute complaints, such as pain, redness, and new-onset blurred vision; these topics have been well covered in recent comprehensive reviews for the primary care clinician.⁷⁻⁹ Readers interested in the evaluation and management of red eye are also referred to standard texts and to an algorithm for triaging acute eye complaints available from the American Academy of Family Physicians (<http://familydoctor.org/flowcharts/505.html>).

METHODS

Data Sources

We performed a systematic review of the literature regarding the diagnosis and management of vision impairment in adults and concentrated on those aspects of care that are within the domain of a typical primary care practice. A content expert (S.R.) worked with experts in systematic reviews (P.G.S. and C.H.M.). In general, our procedures followed those recommended by the Cochrane collaboration. With the assistance of a reference librarian, we electronically searched MEDLINE, EMBASE, The Cochrane Database of Systematic Reviews, and HealthSTAR between 1985 and 2003 using key words and free-text terms (eg, *vision screening, glaucoma prevention and control*) to identify potentially relevant studies. We identified additional citations through reference lists and expert consultation. In addition to these strategies, we sought relevant clinical practice guidelines by searching the Internet, including Web sites for clinical societies and the database maintained by the National Guidelines Clearinghouse (<http://www.guidelines.gov>). Searches were updated periodically throughout the preparation of the manuscript.

Study Selection and Data Extraction

The content expert (S.R.) reviewed all citations with the inclusion criterion being that a study assessed the relationship between a specific health process and health outcomes in humans; studies were included regardless of the magnitude or direction of the reported effect. Those studies with the strongest possible research design for the question of interest (eg, the use of randomized controlled trials [RCTs] for questions of efficacy and prospective cohort studies for questions of risk and prognosis) earned the highest priority. If such studies were rare or absent, we reviewed articles using other study designs. We included prior systematic reviews and meta-analyses when relevant. The clinical practice guidelines yielded additional citations for original literature and the expert opinions summarized in the recommendations.

RESULTS

Major Causes of Visual Disability Among Adults

The major causes of visual disability among US adults are age-related or worsen with advanced age.¹ These causes include refractive error, cataract, diabetic retinopathy, glaucoma, and macular degeneration (TABLE 1).¹⁰⁻²⁴ The incidence of blindness and vision impairment increases with age, increasing especially rapidly in adults older than 75 years.¹ A population-based study of US adults identified subjective functional visual impairment in up to 7% of people aged 71 to 74 years, rapidly increasing to 39% of those adults 90 years or older.²⁵⁻²⁷ Using measured visual acuity as an outcome, the Beaver Dam Eye Study²⁸ found visual impairment with worse than 20/40 visual acuity among 5% of individuals aged 65 to 74 years and 21% of individuals 75 years or older.

Prevention and Management of Visual Impairment in Primary Care Control Glucose in Patients With DM.

There is abundant evidence that patients with DM have improved visual outcomes when serum glucose is well

controlled. Two RCTs and 2 decision analyses have addressed the effects of tight glycemic control in patients with type 2 DM, and 1 study has addressed this issue in patients with type 1 DM.

The Diabetes Control and Complications Trial established that tight glycemic control in patients with type 1 DM leads to significant reductions in the risk of early microvascular complications.²⁹ Another RCT, United Kingdom Prospective Diabetes Study 33 (UKPDS 33), extended these findings to patients with type 2 DM.³⁰ This RCT randomly assigned 3876 patients newly diagnosed with type 2 DM (median age, 54 years) to either tight glycemic control or to usual care. During 10 years of follow-up, hemoglobin (Hb)A_{1c} levels averaged 7.0% in the tight control group compared with 7.9% in the usual care group. The tight control group experienced a statistically significant 12% lower relative risk for any diabetes-related end point, which was mainly due to a reduction in the number of microvascular events (primarily photocoagulation for diabetic retinopathy).

The Kaplan-Meier method curves published with UKPDS 33 show that at least 2 to 3 years of tight glycemic control are needed before its benefits become apparent. However, this level of control was associated with an increase from 0.7% to about 1.5% in the annual incidence of major hypoglycemic episodes. These outcomes are in general agreement with a smaller RCT from Japan.³¹

The first of the decision analyses we identified used a Markov model to estimate the benefits of glycemic control on microvascular complications in type 2 DM.³² The results indicated that most of the benefit of glucose control was achieved by decreasing very elevated levels of HbA_{1c} to 9% and that comparatively little was achieved by further reducing the HbA_{1c} level from 9% to 7%.

The second decision analysis, using a different set of assumptions, concluded that tight control of noninsulin-dependent DM was far less cost-effective for patients who developed DM

at age 75 years (>\$200 000 per quality-adjusted life-year) compared with patients who developed DM before age 50 years (\$20 000 per quality-adjusted life-year).³³ This model also concluded that the cost per quality-adjusted life-year increased greatly for HbA_{1C} values of less than 9%.

Very high levels of blood glucose can have immediate visual consequences. Fluctuations in blood glucose levels can be associated with dynamic shifts in the refractive power of the eye, resulting in blurry vision that is theoretically correctable with new lenses.³⁴⁻³⁶ Although a change in glasses prescription might temporarily restore clear vision, this approach can be impractical and expensive because the refractive power of the lens often is not stable during these episodes and may not return to baseline for weeks following normalization of serum glucose.³⁴ Thus, glycemic control remains the mainstay of therapy for these patients.

Control Hypertension. *Hypertension in Patients With DM.* In patients with

type 2 DM, the risk of diabetic retinopathy is strongly associated with higher blood pressure.^{10,37} Recent data indicate that tight control of hypertension reduces the risk of diabetic retinopathy, as well as all other major diabetes outcomes. In UKPDS 38, 1148 patients with hypertension and type 2 DM (mean age, 56 years; mean blood pressure, 160/94 mm Hg) were randomly assigned to either tight control of blood pressure (<150/85 mm Hg) or less tight control (<180/105 mm Hg).³⁸ Despite relatively small differences in mean blood pressures (144/82 mm Hg vs 154/87 mm Hg), the outcomes between the 2 groups began to diverge between 2 and 3 years after initiation of therapy, and were pronounced by 5 years. After 9 years of follow-up, the treatment group had a 34% reduced risk of retinopathy worsened by 2 steps (worsening by 2 steps often heralds the need for laser photocoagulation treatment) (99% confidence interval [CI], 11%-50%; $P < .001$). Patients who were treated had a 47% reduced risk of sig-

nificant deterioration in visual acuity (loss of 3 lines on a standard eye chart from 20/30 to 20/70) (95% CI, 7%-70%; $P = .004$).³⁸

The UKPDS 38 further showed that the greater the reduction in blood pressure, the greater the reduction in microvascular complications, such as retinopathy. In fact, for each 10-mm Hg decrease in mean systolic blood pressure, there was a 13% reduction in the risk of microvascular complications, such as diabetic retinopathy (95% CI, 10%-16%; $P < .001$).³⁷ Within this study, there was no threshold of systolic blood pressure below which this benefit began to wane.

These data suggest that the previously recommended blood pressure target of 140/90 mm Hg among middle-aged patients with type 2 DM may be inappropriately lenient. However, although evidence exists that lower blood pressure is better, the appropriate target for optimal blood pressure in older persons with DM has not been evaluated in randomized trials.

Table 1. Most Common Causes of Blindness and Visual Impairment in Adults: Features and Recommended Follow-up*

Condition	Prevalence	Important Risk and/or Modifying Factors (Definitive or Likely)	Common Signs	Common Symptoms	Treatment	Minimum Frequency of Examinations With Eye Care Professional†
Refractive error‡	25%-35% of adults aged 40-80 y ¹⁷	Heredity ^{18,23}	Defocus correctable with refractive lenses	Blurry vision without glasses or contacts	Glasses, contacts, refractive surgery	As needed for decreased vision or visual function ¹⁷
Cataract	About 17% of adults aged >40 y (not all symptomatic) ¹	Age, ¹⁹ race, ¹⁹ heredity, ¹⁹ UV exposure, ¹² smoking, ¹² corticosteroid use ²⁰	Opacification of the crystalline lens	Blur, glare, haze	Surgery when symptomatic	As needed for decreased visual acuity or function ¹⁶
Diabetic retinopathy	2.5% of US individuals aged ≥18 y ¹	Hyperglycemia, ¹⁰ worse with hypertension ¹⁰	Retinal edema, hemorrhages, exudates	Asymptomatic, gradual vision loss, or sudden vision loss	Glycemic and hypertensive control Laser	Yearly (see Table 3 for other recommendations) ¹³
Primary open-angle glaucoma	Black patients aged >40 y: 1.2%-11.3% ^{21,24} ; white patients aged >40 y: 0.9%-2.1% ^{21,24}	African descent, age, family history, high intraocular pressure ²²	Optic nerve cupping, visual field changes	Asymptomatic initially; peripheral, then central visual field loss with progression	Pressure-lowering treatments: medications, laser, surgery	Yearly ¹⁴
Age-related macular degeneration	Late (symptomatic): 1.6 million US individuals aged >50 y ¹	Age, race, cigarette smoking, ¹¹ heredity ¹⁵ Other possible factors (data are less conclusive) ¹⁵ : hypertension, atherosclerosis, low levels of antioxidants, dietary fat (especially saturated), UV light	Macular retinal changes	Early: asymptomatic Late: central vision loss (gradual or sudden)	Laser treatment, photodynamic therapy	Yearly ¹⁵

*Resource: American Academy of Ophthalmology Referred Practice Patterns Series.¹³⁻¹⁷

†In the absence of new signs or symptoms.

‡Estimates do not include presbyopia.

Hypertension in Other Patients. Control of hypertension can be expected to benefit the visual health of patients without DM as well, although this has not been studied directly in RCTs. Prolonged hypertension leads to decreased vision from hypertensive retinopathy^{39,40} and has been implicated in central retinal artery and vein occlusions,⁴¹⁻⁴³ ischemic optic neuropathy,^{39,40,44,45} and macular degeneration.⁴⁶ The optimal threshold for blood pressure control in patients without DM also has not been established.

Control Hyperlipidemia, Especially in Patients With DM. *Diabetes Mellitus.* Although there is a lack of experimental evidence supporting lipid-lowering interventions aimed at diabetic vision loss, most observational studies suggest an association between elevated serum lipid levels and diabetic retinopathy.⁴⁷⁻⁵² The Early Treatment Diabetic Retinopathy Study evaluated the relationship between elevated serum lipids and decreased visual acuity in 2709 patients at a baseline examination and after 5 years.⁵³ After controlling for age, baseline HbA_{1c}, and retinopathy severity, baseline serum cholesterol of more than 240 mg/dL (6.22 mmol/L) increased the risk of significant visual loss by 50% when compared with serum cholesterol of less than 200 mg/dL (5.18 mmol/L) (odds ratio [OR], 1.5; 95% CI, 1.1-2.1; *P*<.001). These results are in general agreement with the World Health Organization's multicenter study on the determinants of visual impairment in patients with DM.^{54,55} Nevertheless, other studies have failed to confirm this association.^{56,57} Randomized controlled trials are currently under way to assess the effect of lipid-lowering medications on the incidence and progression of diabetic retinopathy.⁴⁸

Age-Related Macular Degeneration. Observational case-control studies have suggested a link between self-reported dietary intake of certain fats (vegetable, monounsaturated, and polyunsaturated fats and linoleic acid) and increased risk for advanced age-related macular degeneration (AMD).⁵⁸ The Nurses'

Health Study and the Health Professionals Follow-up Study showed similar findings for high intakes of fat, including linoleic acid.⁵⁹ Other studies show links between AMD and saturated fat and cholesterol.⁶⁰ However, these findings were not replicated in the Third National Health and Nutrition Examination Survey, which found no such association.⁶¹ One possible explanation for this disparity may be that the National Health and Nutrition Examination Survey defined AMD based on a single photograph through an undilated pupil as opposed to a more comprehensive examination as in the Age-Related Eye Disease Study.⁴² Because no cause and effect have yet been established for these links, expert guidelines have not included recommendations regarding dietary fat intake in patients with AMD.

Other Eye Diseases. Hyperlipidemia and lipid-related atherosclerotic disease have been implicated as risk factors in a variety of ophthalmic diseases, including retinal artery and vein occlusions, ischemic optic neuropathy, cataract, and even dry eye.^{41,62-68}

Advocate Smoking Cessation. *Age-Related Macular Degeneration.* Cigarette smoking is one of the few known modifiable risk factors for AMD,^{11,46} with a well-documented dose-response curve.⁶⁹ In the Beaver Dam Eye Study, women who smoked at the time of the study had an OR of AMD-related retinal findings (large soft drusen) of 2.20 (95% CI, 1.04-4.66) compared with women who never smoked.⁷⁰ The OR for male smokers was 3.21 (95% CI, 1.09-9.45).⁶⁹

Cataract. Associations between cataract formation and smoking appear in multiple observational studies.^{12,71,72} Evidence suggests that smoking cessation may reduce the likelihood of cataract formation.^{71,73} However, this benefit may not accrue, at least measurably, for many years following cessation.⁷²

Diabetic Retinopathy. Smoking is linked to incidence and progression of diabetic retinopathy in multiple studies.^{10,47} The effect may be dose-related.⁷⁴ Smoking cessation is gener-

ally encouraged by diabetic retinopathy experts.^{13,47,75}

Thyroid Eye Disease. Smoking significantly increases the risk for Graves ophthalmopathy⁷⁶⁻⁸⁰ and worsens the condition among those who already have it.⁷⁸ In 1 case-control study among 450 patients with Graves disease, the odds of developing ophthalmopathy was 7.7 (95% CI, 4.3-13.7) for smokers relative to nonsmokers.⁸¹ There is some evidence that these effects are longstanding and may be irreversible.⁷⁶

Assess the Ocular Effects of Systemic Medications. Many systemic medications are associated with ocular symptoms, complications, or both. TABLE 2 summarizes the most common culprits, including their signs and symptoms, and strategies to address each.

Consider the Role of Antioxidants and Protection Against UV Light. Patients who have been diagnosed by an eye care professional with specific types of macular degeneration may benefit from taking certain antioxidants. Recently released data from the Age-Related Eye Disease Study indicate that a daily high-dose antioxidant supplement reduces the chance of further vision loss for selected patients with macular degeneration.⁸⁴ In this RCT, 3640 patients who had intermediate macular degeneration in 1 or both eyes, and those with advanced AMD or AMD-related vision loss in 1 eye only, showed a 6% reduction in absolute risk of vision loss over 6.3 years (23% vs 29%; OR, 0.73; 99% CI, 0.54-0.99). Vision loss was defined as at least a doubling of the visual angle, equivalent to a change from 20/20 to 20/40 or worse, or a change from 20/50 to 20/100 or worse. Based on data in this study, we estimated that 11 patients would need to be treated for 5 years for 1 patient to benefit from high-dose antioxidants. No benefit was detected for patients with early AMD in this time frame, although the study was not powered to detect small benefits. The study dosages were vitamin C (500 mg), vitamin E (400 IU), beta carotene (15 mg), zinc (80 mg as zinc oxide), and copper (2 mg as cupric oxide). (Cop-

Table 2. Common Systemic Medications With Ocular Adverse Effects*

Medication	Risk Factors	Symptoms and Signs	Treatment and Referral	Prognosis
Amiodarone	All patients, or <10% are symptomatic	Halos, blurred vision, corneal changes, optic neuropathy	Discontinue medication and refer to ophthalmologist for visual changes	Generally reversible with discontinuation of medication
Anticholinergics	Younger patients who are still able to accommodate (usually those persons aged <50 y) Patients with narrow-angle glaucoma or anatomic narrow angles (angle-closure glaucoma)	Blurry near vision from loss of accommodation, better with reading glasses Angle-closure glaucoma (rare)	Warn patients aged <50 years about difficulty focusing at near, and about possible need for reading glasses Refer emergently to ophthalmologist for acute vision loss, eye redness or pain, cloudy cornea No need to screen for narrow angles unless patient is aware of history of narrow angles or of narrow-angle glaucoma	Accommodative insufficiency: generally reversible with discontinuation Angle-closure glaucoma: usually long-term damage can be minimized with appropriate emergent laser treatment by ophthalmologist (within hours)
Cisplatin	Women aged >50 y receiving 200 mg/m ² per day	Decreased central vision and color vision Optic disc edema, retrobulbar neuritis Cortical blindness	Discontinue medication and refer to ophthalmologist for visual changes Check visual acuity and color vision regularly	Variable
Corticosteroids	Cataracts: 25% develop cataracts after 1 y receiving dose equivalent to prednisone, 15 mg/d Glaucoma from increased intraocular pressure can develop at any dose of systemic or inhaled steroids after 3 wk People with glaucoma or high risk for glaucoma (family history, race) may have greater chance of elevated intraocular pressure	Cataracts: glare, reduced visual acuity, halos Glaucoma: loss of peripheral vision (usually asymptomatic until advanced damage has occurred)	If long-term systemic steroids anticipated: Check visual acuity and visual symptoms periodically Check intraocular pressure every 6 mo (by eye care professional) Consider comprehensive eye evaluation and consultation with ophthalmologist to assess risk factors for glaucoma and to develop appropriate follow-up schedule	Cataract: symptoms generally stabilize after withdrawing medication and improve with cataract extraction Intraocular pressure usually stabilizes after withdrawing medication Glaucomatous damage: irreversible
Digoxin	25% of patients whose digoxin levels are in moderately toxic range Can occur with levels in normal range	Xanthopsia (yellowish orange vision) Snowy, flickering vision	Maintain dose in therapeutic range	Usually resolves when dose restored to therapeutic range
Ethambutol or isoniazid	Ethambutol: daily doses >15 mg/d Isoniazid: maintenance dose >5 mg/kg Lower doses in renal failure or when combining both drugs	Loss of color vision, visual acuity, visual field	Discontinue medication and refer to ophthalmologist for visual changes Baseline ophthalmologic examination prior to initiation Test visual acuity every 6 mo	Reversible if detected early Usually stabilizes with discontinuation of drug
Hydroxychloroquine and chloroquine ⁸³	Hydroxychloroquine dose >6.5 mg/kg per day Chloroquine dose >3 mg/kg per day ≥5 y use Overweight habitus Renal or hepatic disease Retinal disease Age >60 y	Loss of color vision, visual field, visual acuity "Bull's eye retinopathy": characteristic ring-like atrophy around fovea	Baseline ophthalmologic examination before initiation If any risk factors, yearly examination If aged 40-50 y with no risk factors: examination every 2-4 y	Visual deficits generally irreversible but stabilize with discontinuation of drug
Niacin	Male sex	Decreased visual acuity Maculopathy	Discontinue medication and refer to ophthalmologist for visual changes	

(continued)

per should be taken with zinc because high-dose zinc is associated with copper deficiency.⁸⁵) No statistically significant serious adverse effects from nutritional supplements were reported. However, the study noted that smok-

ers and ex-smokers should not use beta carotene, because previous studies have suggested an association between beta carotene use and lung cancer in smokers.^{86,87} There are limited data to support or refute the use of antioxidants and

to prevent or treat visual loss other than that from AMD as described above.

Protection against UV light has long been recommended by eye care professionals.¹⁶ Even low levels of exposure to UV light confer a measurable increase

Table 2. Common Systemic Medications With Ocular Adverse Effects* (cont)

Medication	Risk factors	Symptoms and Signs	Treatment and Referral	Prognosis
Phenytoin and carbamazepine	Serum levels in moderately toxic range	Nystagmus (can occur at upper-normal therapeutic levels) Diplopia Blurred vision	Adjust dosage downward if possible	Usually resolves when dose restored to therapeutic range
Tamoxifen citrate	Usually only with high doses (cumulative dose of >100 g or maintenance dose of 120 mg twice daily) Has been reported with normal doses (daily doses as small as 20 mg/d) after a total cumulative dose of 7 g	Decreased visual acuity Cystoid macular edema Perimacular retinal deposits	Baseline ophthalmologic examination before initiation if high doses anticipated Test visual acuity every 6 mo Discontinue or reduce dosage of medication and refer to ophthalmologist for visual changes	Vision generally returns to normal range within months Retinal deposits are usually permanent
Thioridazine	Maintenance dose >800 mg/d	Brownish discoloration of vision Reduced visual acuity Constricted peripheral visual fields Decreased night vision Pigmentary retinopathy	Baseline ophthalmologic examination before initiation Test visual acuity every 6 mo Describe possible symptoms to patient Advise to immediately report any visual changes Discontinue medication immediately and refer to ophthalmologist for visual changes	Visual deficits are irreversible Deficits may be progressive even after discontinuation of drug
Vincristine	Reported after mean total dose of 17.7 mg during 10-wk period	Ptosis Diplopia Abduction deficits	Discontinue medication if possible Assess eyelids and ophthalmic motility if diplopia, ptosis noted Consider referral to ophthalmologist for symptoms	90% Resolves Resolution occurs an average of 11 wk after discontinuation

*Resource: *The Physician's Guide to Eye Care*.⁸²

in the risk of certain types of cataract.⁸⁸⁻⁹¹ A recent comprehensive literature review concluded that there is sufficient evidence of increased risk of cataract with exposure to UV light to justify public health messages advocating simple measures such as sunglasses to decrease ocular exposure.⁹² However, few data unequivocally support protection against UV light in preventing or treating visual loss other than cataract.

Eye Care for Patients With DM

A systematic review performed for the American College of Physicians concluded that both screening for retinopathy and subsequent treatment are clearly beneficial for patients with DM.⁹³ Decision analytic models have concluded that screening for diabetic retinopathy is highly cost-effective and even cost-saving when payments for disability due to blindness are included, although the cost-effectiveness of screening decreases with increasing age.^{94,95}

There is widespread agreement among most major authorities that patients with

adult-onset DM should undergo dilated retinal evaluation at least every 2 years and that patients with poorly controlled DM need yearly examinations.^{75,93,96-100} Most major authorities recommend annual retinal examinations for all patients with adult-onset DM regardless of how successful their disease has been controlled.^{75,93,96-100} TABLE 3 summarizes specific recommendations by major authorities.

Recommendations for annual examinations are based in part on the finding that 5% to 10% of patients with no retinopathy will progress to retinopathy within 1 year.¹⁰⁴⁻¹⁰⁶ However, some authorities believe that patients with well-controlled DM may not require retinal examinations as frequently. In the Wisconsin Epidemiologic Study of Diabetic Retinopathy,^{104,105} a large prospective study of 1990 predominantly white patients, the subset of patients with type 2 DM with no retinopathy on skilled reading of standard 7-field stereoscopic color fundus photographs, no gross proteinuria, and glycemic con-

trol within 2 standard deviations of the nondiabetic population, generally did not require follow-up retinal examinations for 4 years. These data suggest that for selected low-risk patients who have excellent glucose control (as measured by HbA_{1c} <8.0%), and healthy eye examinations (as determined by gold standard methods), the interval between retinal evaluations may extend to 2 years with little increased morbidity. A recent cost-utility analysis highlights the potential cost-effectiveness of this strategy⁹⁵; the National Committee for Quality Assurance and Veterans Affairs acknowledge these findings in their current diabetes quality measures for Health Employer Data and Information Set (HEDIS)¹⁰⁷ and Veterans Affairs performance measures. Nevertheless, many experts express concern that a 2-year target would increase the rate of needless blindness, because gold standard evaluations such as those performed by the Wisconsin Epidemiologic Study of Diabetic Retinopathy may not be representative of the screening techniques avail-

able to most patients, and because preventable blindness occurs due to poor compliance even when the goal is annual screening.⁹⁹

Most major guidelines concur that diabetic retinopathy screening should be performed by an eye care professional who is knowledgeable regarding diabetic retinopathy or by stereoscopic fundus photography.^{75,93,96-100} Studies have reported that either ophthalmologists or diabetologists are more sensitive at detecting early diabetic retinopathy than are general internists or family physicians.¹⁰⁸ Although 7-field dilated stereoscopic fundus photography remains the gold standard for detection of diabetic retinopathy, clinical examination by a skilled practitioner is more sensitive in detecting certain features of the disease.^{75,109}

There is evidence and professional consensus that a dilated pupil is necessary to ensure optimal examination of the retina.^{13,75} In 2 studies, retinal examination through undilated pupils failed to correctly classify the presence and severity of retinopathy 50% of the time compared with the standard 7-field stereo photographs.^{110,111} In contrast, examination through a dilated pupil correlated with photographs approximately 80% of the time.

There is increasing evidence that some systems of retinal photoscreening may have comparable sensitivity and specificity to dilated retinal examination in the detection of treatable diabetic eye disease,¹¹²⁻¹¹⁴ although experts have not reached consensus on this point.^{13,75}

Screening Adult Patients for Vision Disorders

We did not identify any published RCTs that assessed the effect of routine visual screening on visual outcomes, although a recent Cochrane Database of Systematic Reviews (updated in 2003) found no convincing evidence for community-based screening of older people by asking questions about subjective visual impairment.¹¹⁵ All 5 studies included in this review were multicomponent assessments, which used self-reported measures of visual impairment based on a limited number of questions, both as screening tools and as outcome measures. There were no qualifying studies that assessed the value of testing visual acuity, performing or referring for an eye examination, using a formally validated qual-

Table 3. Summary of Recommendations for Periodic Vision Evaluation in Adults With DM

Organization	Document Title, Most Recent Update	Population	Frequency	Examination
American Association of Clinical Endocrinologists/ American College of Endocrinology	<i>Diabetes Guidelines</i> , ¹⁰¹ 2002	Patients with DM	At diagnosis of DM and yearly thereafter	Dilated examination performed by person skilled in management of diabetic retinopathy only
American Diabetes Association	<i>Clinical Practice Recommendations</i> , ⁷⁵ 2002	Patients with DM diagnosed after 30 y	At diagnosis, then yearly	Comprehensive examination by ophthalmologist or optometrist with experience managing diabetic retinopathy Or 7-Standard field stereoscopic 30° fundus photography through a dilated pupil
American Academy of Ophthalmology	<i>Preferred Practice Patterns: Diabetic Retinopathy</i> , ¹³ 2003	Patients with DM	At diagnosis, then yearly	Comprehensive examination, including dilated retinal examination
American Optometric Association	<i>Care of the Patient With Diabetes Mellitus</i> , ⁹⁶ 2002	Patients with DM	At diagnosis, then at least yearly	Comprehensive examination, including dilated retinal examination
The National Committee for Quality Assurance, American Medical Association, and the Joint Commission on Accreditation of Healthcare Organizations	<i>Common Measures for Diabetes Care Consensus Statements: Diabetes Quality Improvement Project Initial Measure Set</i> (final version), 2001	Low-risk patients with DM* High-risk patients with DM	Every 2 y At diagnosis and annually	Dilated eye examination
Veterans Administration	<i>The Management of Diabetes Mellitus in the Primary Care Setting</i> , ⁹⁸ 1999	Low-risk patients with DM† Patients with DM	Every 2 y Annually	Not specified Not specified
Canadian Task Force on the Periodic Health Examination	<i>Screening for Visual Problems Among Elderly Patients</i> , ¹⁰² 1995	Adults aged >64 y	During periodic health examination	Funduscopy or retinal photography
International Diabetes Center	<i>Type 2 Diabetes Practice Guidelines</i> , ¹⁰³ 2001	Patients with type 2 DM	Yearly	Dilated eye examination

Abbreviation: DM, diabetes mellitus.

*Low-risk patients are defined as meeting any 2 of the following 3 conditions: the patient is not taking insulin, the patient has an HbA_{1c} of less than 8.0% (the most recent test result within the reporting period will be used), and the patient did not have any evidence of retinopathy on the previous year's examination.

†Low-risk patients are defined as having type 2 DM with HbA_{1c} of less than 8.0% and treated with oral agents.

ity of life instrument as a screening tool, or combining several of these modalities. Hence, there are no RCTs that have evaluated routine visual screening as it would be performed as part of typical care by a primary care practitioner.

Although there is lack of evidence from RCTs supporting vision screening, nearly every major clinical authority recommends a periodic vision evaluation of asymptomatic adults, particularly in older populations (TABLE 4).^{102,116-122} However, there is no consensus as to who should perform the evaluation or its optimal content or timing. Most recommendations reflect consensus of expert opinion rather than evidence-based analysis. Some authorities simply recommend periodic screening tests such as visual acuity, which can be performed by primary care practitioners or other health care clinicians.^{102,116,117,120} Other authorities, rec-

ognizing that specialized ophthalmic testing is essential to detect most major causes of visual loss, such as glaucoma, macular degeneration, and diabetic retinopathy, recommend comprehensive examinations by eye care specialists, with interim screening tests as needed.^{118,119,121,122} Depending on the recommendation, primary care clinicians have several options: vision screening older patients themselves during the periodic health examination, referring older patients for annual complete eye examinations, or combining these strategies.

Most guidelines recommend increasingly frequent evaluations with advancing age. The rationale for a shorter interval is that increasing age is associated with a higher incidence of eye disease.² Recommendations for persons with DM, persons with known eye disease, and persons at risk for glaucoma

are more stringent than for low-risk patients (Tables 1, 3, and 4).

COMMENT

Visual impairment is common and debilitating, especially in elderly persons. Many patients suffer needlessly from preventable or treatable visual disorders. Primary care physicians have unique opportunities to help prevent visual impairment and blindness through patient education, medical therapy, and specialty referral. They can play a critical role by educating patients about the importance of treatment and prevention of eye diseases, by optimizing systemic treatment for illnesses, such as diabetes and hypertension, and by recognizing the need for specialty referral when there is visual impairment or risk factors for common eye diseases.

The value of routine screening for vision impairments has yet to be proven

Table 4. Summary of Recommendations for Periodic Vision Evaluation of Asymptomatic Adults Without Diabetes Mellitus or Known Eye Disease

Organization	Document Title, Most Recent Update	Population	Frequency	Test
US Preventive Services Task Force	<i>Guide to Clinical Preventive Services, 2nd Edition: Screening for Visual Impairment</i> , ¹¹⁶ 1996	Patients aged ≥ 65 y Black patients aged >40 y White patients aged >65 y Those with family history of glaucoma may benefit	Routine (frequency left to physician's discretion) According to clinical discretion	Snellen Visual Acuity; selected questions may be helpful Referral to eye specialist for glaucoma evaluation
Canadian Task Force on the Periodic Health Examination	<i>Screening for Visual Problems Among Elderly Patients</i> , ¹⁰² 1995	Adults aged >64 y	During periodic health examination	Snellen Visual Acuity
American Academy of Family Physicians	<i>Summary of AAFP Policy Recommendations for Periodic Health Examination Revision 5.1</i> , ¹¹⁷ 2001	Elderly patients	Not specified	Snellen Visual Acuity
National Eye Institute	<i>National Eye Institute Statement: Vision Screening in Adults</i> , ¹¹⁸ 1998	Adults aged >59 y Black patients aged >40 y Patients with visual acuity worse than 20/30	Every 2 y	Comprehensive eye examination by eye care professional
American Optometric Association	<i>Comprehensive Adult Eye and Vision Examination</i> , ¹¹⁹ 1997	Older patients	Yearly	Comprehensive eye examination
American Academy of Ophthalmology	<i>Comprehensive Adult Medical Eye Evaluation</i> , ¹²² 2000	All people aged >64 y Black patients aged >40 y People aged >40 y with family history of glaucoma	Every 1-2 y Every 2-4 y Every 2-4 y	Comprehensive eye examination
American College of Obstetricians and Gynecologists		Women aged >64 y	Yearly or as appropriate	Visual Acuity Test
Institute for Clinical Systems Improvement	<i>Health Care Guideline: Preventive Services for Adults</i> , ¹²⁰ 2001	All people aged >74 y	Every 1-2 y	Objective Visual Acuity Testing
Veterans Administration	<i>Screening for Glaucoma in the Primary Care Setting</i> , ¹²¹ 2000	Adults aged >65 y or black race or family history of glaucoma ≥ 2 of above risk factors	Every 2 y Yearly	Optic nerve examination, visual field test, and intraocular pressure measurement

in clinical trials. Nevertheless, a strong indirect argument can be made favoring periodic vision evaluations, especially in elderly persons. Although some version of periodic vision evaluation is recommended by all major clinical authorities, the appropriate role for vision screening in the primary care setting has not been rigorously assessed. Visual acuity measurement is a component of every major vision screening guideline and can be performed in the primary care setting. However, many causes of vision impairment can be diagnosed only by persons with specialty ophthalmic knowledge and equipment, and most treatments require specialty skills to deliver. Thus, effective collaboration between primary care clinicians and eye care professionals has the greatest potential to improve eye care and enhance patients' vision and quality of life.

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