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GERIATRIC OPHTHALMOLOGY

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As the United States shifts toward an older population, the specialty of ophthalmology will be impacted disproportionately, since many common eye disorders occur with increasing frequency and severity with older age. This chapter updates the chapter on geriatric ophthalmology in *New Frontiers in Geriatrics Research* by evaluating the more recent literature on the eye care of older persons. [1] Research addressing agenda items that were proposed in *New Frontiers* is described in the section Progress in Geriatric Ophthalmology; research suggesting the need for additions to the research agenda is described in the section New Horizons in Geriatric Ophthalmology at the end of the chapter. The Key Questions for geriatric ophthalmology highlighted in *New Frontiers* are unchanged:

Ophth KQ1: **Does visual improvement or stabilization, including low-vision rehabilitation, reduce the severity, incidence, and prevalence of depression, dementia, delirium, falls, driving accidents, loss of function or quality of life, and hospital complications in the elderly population?**

Ophth KQ2: **What is the best timing for and what are the best methods for intervention in visual loss in the elderly person, and what are the best outcome measures for documenting success?**

Ophth KQ3: **What are the risk factors for functional vision impairment in the elderly person, and what screening intervals and methods and what instruments for measuring visual function would be best for identifying an older person's risks for such impairment?**

METHODS

Articles on geriatric ophthalmology from 2000 to 2005 were reviewed systematically. Two searches of the National Library of Medicine's PubMed database were conducted in June and July 2005. Three topics (search 1) were searched as major medical subject headings (MeSH): *ophthalmology, ophthalmologic surgical procedures*, and *vision, low*. These headings were combined with the following MeSH terms denoting advanced age: *age, geriatric assessment, aged, 80 and over, frail, elderly, longevity*, and *geriatrics*. The limits placed on all searches were as follows: aged 65+ years, English language, humans, and the years 2000–2005. A second search of the National Library of Medicine database was performed in June 2005 using the topic *ophthalmology* combined with the following terms denoting advanced age: *65 or older*, *aged*, and *geriatric*. Limits placed on this search were English language, core clinical journals, and the years 2000–2005.

The first search strategy yielded 71 articles in ophthalmology, 3054 articles in ophthalmologic surgical procedures, and 125 articles in low vision. The second search yielded 83 articles. The senior writer (AGL) reviewed the titles and abstracts in the search

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results for relevance, type of study, and application to the research agenda. Case reports, editorials, and letters to the editor were included only if they added significant new information. The lists of eligible articles were also reviewed by the senior writer for articles that might have been missed by the searches. Finally, additional articles were obtained by using the PubMed search term *visual loss* combined with *dementia*, *depression*, *hearing loss*, *functional impairment*, and *falls*, limiting results to English language only, abstracted items, and years 2000–2005.

PROGRESS IN GERIATRIC OPHTHALMOLOGY

ASSESSING VISUAL LOSS IN AGE

Scope of the Problem

See *New Frontiers*, p. 178.

Although the emphasis of *New Frontiers* was on the increasing prevalence of vision loss in the United States (see p. 178), the problem is in fact occurring globally as a consequence of the large increase in the numbers of elderly persons throughout the world. [2–8] Some of the vision loss associated with aging is irreversible (eg, late age-related macular degeneration [ARMD]), but much of it is treatable, and the impact of some conditions on vision (eg, glaucoma) can be reduced through preventive efforts. In a striking finding, one cross-sectional population-based study of nearly 5000 elderly persons in Australia found uncorrected refractive error to be the most common cause of bilateral visual impairment. [6] Supporting this finding that uncorrected refractive error is a significant problem in older populations is a report from England in which vision was found to improve with pinhole (indicating likely improvement with eyeglasses) in 21% of those studied (persons aged 65 years or older and without mental impairment). These researchers also reported that visual impairment is very common in the oldest persons, with over 35% of the population aged 85 or older being visually impaired. [9] Another study from England found that among persons aged 75 years or older attending general health clinics, 13% were visually impaired (visual acuity less than 20/60). Over 25% of this impairment improved with pinhole. [3] In a separate report on older community-dwelling residents in the United States, Munoz et al found that over half of those with bilateral visual impairment had treatable or preventable disorders. [4]

Since most major eye diseases occur with much greater frequency among older adults, the rates of visual impairment will increase as the population ages and people live longer. A recent meta-analysis using data from most of the major US population-based eye disease prevalence studies conducted in the past 20 years reported that 937,000 (0.78%) Americans older than age 40 years are blind and 2.4 million (1.98%) have low vision (using the US definitions). Among white Americans the leading cause of blindness was ARMD, but for black Americans the leading causes were cataract and glaucoma. Although persons aged 80 years and older make up 7.7% of the US population 40 years and older, they account for 69% of the blindness. Again, because of the aging of the population and not an increase in the incidence or age-specific prevalence of eye disease, it is estimated that the number of blind persons in the United States will increase 70%, to 1.6 million by

2020 (using the criterion of visual acuity of 6/60 or worse). The number of older adults with visual impairment will increase from 7 million at present to 11.2 million in 2020, and possibly as high as 15 million in 2030. [10]

Much has been published about eye diseases among whites and blacks in Western countries, but data have only recently been published on the prevalence of eye disease among Hispanics, and data continues to be refined for Asian populations. Rodriguez et al reported that Hispanics in Arizona have higher rates of vision impairment than non-Hispanic whites, and that primary open-angle glaucoma (POAG) is the leading cause of blindness in this population. [5] A strong association of visual impairment with age was confirmed in a Japanese population, where 1.8% of those aged 40 to 79 years were found to be visually impaired. This study also reported that myopia is an independent risk factor for visual impairment, as is lower education level. [11] Myopia associated with retinal detachment, myopic retinal degeneration, glaucoma, and cataract was not as recognized previously to be such an important factor. [12,13] The association of myopia with visual impairment raises the possibility that the prevalence of low vision may increase in the coming decades in countries where myopia rates appear to be increasing (such as China and other parts of Asia).

Among Chinese persons in Hong Kong, 35% of persons aged 60 years or older had visual impairment in at least one eye, with a substantial proportion improving with pinhole. Bilateral blindness was present in 1.1%, but this decreased to 0.5% with pinhole. [14] Chinese in Taiwan were found to have similar rates of blindness (0.6%); the investigators examined only slightly over half of those eligible, so the true prevalence rate for the population may be higher or lower. The leading causes of visual impairment were found to be cataract (41.7%), myopic degeneration (12.5%), and ARMD (10.4%). [15] Such a high proportion of visual impairment caused by myopic degeneration has not been reported previously in European-derived populations, was not seen in the Hong Kong study, and awaits confirmation in other Asian populations.

A large population-based study in south India reported higher rates of visual impairment than those seen in more developed countries, with 52% of persons aged 60 to 69 years and 71% of persons aged 70 years or older visually impaired, using as the standard vision worse than 6/18 in the eye with better vision. Once again, refractive error accounted for a high proportion of this vision loss (nearly 10%), and cataract was responsible for about 25%. Cataract was a common cause of visual impairment even in persons in their 50s. [2]

Measures and Levels of Visual Loss

See *New Frontiers*, pp. 178–179.

Measuring Impact of Loss on Visual Function

See *New Frontiers*, p. 179.

Measuring Impact of Loss on Functional Ability

See *New Frontiers*, pp. 179–180.

Ophth 1 (Level B): **Future research in the treatment of ocular disease in the older person or rehabilitation for older persons with low vision**

should, wherever possible, make use of tools for assessing functional outcomes.

New Research Addressing This Question: One challenge in ophthalmic research is determining how diseases and interventions to prevent or cure them affect quality of life (QOL). QOL instruments are becoming an increasingly accepted outcome measure in ophthalmologic research; at least 29 different visual function rating scale questionnaires were documented in a review conducted in 2001. [16] Probably the most widely used and validated visual function assessment tool is the National Eye Institute Visual Function Questionnaire (NEI-VFQ), which asks 51 questions in 11 domains of visual function. [17] More recently, the NEI-VFQ 25, a reduced version, was demonstrated to work well in evaluating the impact of a wide variety of eye diseases. [18] The Age-Related Eye Disease Study (AREDS), a large clinical trial assessing the benefit of supplementation with beta-carotene and vitamins A and E along with zinc for the prevention of late ARMD and cataract, administered the NEI-VFQ 25 to 4077 participants and reported moderate to high internal consistency of NEI VFQ subscales. [19] Low NEI-VFQ 25 scores were associated with the presence of cataract or macular degeneration or reduced visual acuity. The NEI-VFQ 25 was also found in the AREDS study to be responsive to the progression of ARMD—that is, changes in scores indicated losses of function. Mean changes over the median of more than 3 years of follow-up ranged from 11 to 25 points for the subscales for general vision, near and distance activities, social functioning, mental health, role difficulties, dependency, and driving. The NEI-VFQ 25 was not found to be responsive to lens opacity progression. However, when lens opacity progressed in the eye with the best vision, the researchers found moderate responsiveness in the color vision (effect size = 0.62) and driving (effect size = 0.66) subscales. The progression of some participants to advanced ARMD with visual acuity loss contributed significantly to the variation in the mean difference in NEI-VFQ 25 scores over the course of the study. The authors concluded that changes in the NEI-VFQ 25 overall and subscale scores of 10 points or more indicate clinically significant changes in visual function resulting from ARMD. Given these findings, interventional studies of ARMD and loss of visual acuity might well include the NEI-VFQ 25 as an outcome measure. [20]

Others have also used the NEI-VFQ in studies of ARMD, diabetic retinopathy, optic neuritis, glaucoma, uveitis, and low vision. [19,21–23] The authors of one study [23] cautioned that adjustment of the NEI-VFQ scores for general health may be advisable and that using the adjustments from the physical and mental components of the Medical Outcomes Study Short Form 36-item health survey (SF-36) summary scores might be useful.

Work has continued on QOL measures among older persons. Some researchers have attempted to better define utility measures for visual impairment. Sharma et al cross-sectionally studied 239 patients with a variety of ocular disorders. [24] In contrast to previous reports that found patients to be unwilling to trade time for better vision, [25] the average patient in Sharma's study was willing to trade 2.8 years of every 10 remaining years of life to obtain perfect vision in both eyes. The authors concluded that utility values for vision loss from these patients were strongly associated with visual acuity and could be estimated mathematically. [24] Brown et al demonstrated good test-retest reliability for utility analysis in 115 patients with ophthalmic disease. [26]

Although studies have found only weak associations between measures of general health and visual status, [27] Tsai et al found visual impairment among older Chinese resi-

dents of Taiwan to be associated with significantly lower SF-36 physical and social functioning scores. In addition, the authors reported lower QOL for those with visual impairment and found that the use of eye care services is associated with a higher QOL. [28]

In a study of longitudinal household survey data, Sloan et al found that a self-reported decline from excellent or good vision to fair or poor near and distance vision has statistically significant effects on several limitations of instrumental activities of daily living (IADLs) and some activities of daily living (ADLs). The largest effects were for driving (odds ratio [OR] for no limitation: 0.55, $P = .003$), managing money (OR: 0.61, $P < .001$), and preparing hot meals (OR: 0.61, $P < .001$). Onset of fair to poor near vision increases the likelihood of onset of at least one IADL limitation (OR for no limitation: 0.71, $P < .01$) and ADL limitation (OR: 0.74, $P = .003$). Incident legal blindness results in a 78% increase in IADL limitation (OR for no limitation: 0.22, $P < .001$). The effects of vision declines on cognition and depressive symptoms were found to be statistically significant but small. Furthermore, self-reported declines in vision increase the probability of nursing home residence. The authors argued that visual impairment leads to important declines in function among older persons, concluding that preventing vision loss might improve their functioning. [29]

In a study of QOL measures in patients with low vision, Stelmack reported that the Veterans Affairs Low-Vision Visual Functioning Questionnaire has good psychometric properties, concluding that the instrument is valid and reliable for measuring the visual abilities of low-vision patients across many diverse clinical settings. [30]

Modification of This Question in Light of New Research: We are encouraged by the development of and increasing use of functional outcomes assessments in the evaluation and treatment of ocular disease in older persons, and we recommend continued use of these tools in the assessment of rehabilitation for older persons with low vision.

VISUAL LOSS AND SPECIFIC GERIATRIC CONDITIONS

See the section New Horizons in Geriatric Ophthalmology at the end of the chapter for added agenda items under new topics regarding the impacts of visual loss.

Visual Loss and Falls

See *New Frontiers*, pp. 180–181. For a new agenda item, see the subsection on visual loss and falls in New Horizons in Geriatric Ophthalamology at the end of the chapter.

***Ophth 2 (Level A)*: Elderly patients with visual impairment treated with low-vision rehabilitation or whose vision has improved following a specific intervention (eg, cataract surgery, refraction) should be compared with an untreated group or a treated group without visual improvement. The change in incidence of falls over time in the two groups should be prospectively studied.**

***Ophth 3 (Level B)*: Cross-sectional or prospective cohort studies should be performed to determine if certain ocular disorders are more or less likely to be associated with falls by elderly persons and whether multiple ocular disorders are synergistic or additive risk factors.**

***Ophth 4 (Level B)*: Time-series studies of correlations between level of visual function and likelihood of falls should be carried out in cohort studies.**

***Ophth 5 (Levels B, A)*: Prospective interventional studies are needed to establish whether interventions to reduce environmental hazards are cost-effective and practical. Prospective interventional randomized or nonrandomized studies should be performed to determine if the incidence of falls in older patients with visual impairment decreases among those for whom home safety improvements are performed.**

New Research Addressing These Questions: Vision plays an important part in stabilization of posture, and visual impairment may increase the risk for falls independently of environmental hazards. Lord and Menz assessed the impact on sway of contrast sensitivity, depth perception, stereopsis, and lower visual field in 156 older persons aged 63 to 90 years. They concluded that vision and in particular contrast sensitivity and stereopsis are important for posture control under challenging conditions (no effect was seen on a stable surface). [31] Lord and Dayhew found that wearers of multifocal glasses have impaired edge-contrast sensitivity and depth perception, and that the use of multifocal eyeglasses substantially increases the risk of a fall. Furthermore, the population-attributable risk of falls in this cohort was found to be 35% for those wearing multifocal eyeglasses. [32] The same authors also performed a prospective cohort study (N = 156 community-dwelling elderly persons) and reported that impaired vision is an important and independent risk factor for falls, with depth perception and distant-edge-contrast sensitivity being particularly important for maintaining balance as well as detecting and avoiding environmental hazards. [33] This study demonstrates that parameters of visual function other than visual acuity and visual field may be important in the study and prevention of falls and fractures in visually impaired older adults.

De Boer et al examined contrast sensitivity in 1509 older men and women and prospectively (3 years) evaluated the cohort for falls and fractures, finding that visual impairment is an independent risk factor for falls and fractures. [34] In the Blue Mountains Eye Study, a prospective population-based study of eye disease conducted in Australia, the 2-year risk of fractures in patients with visual acuity loss, the visual field deficits, and the presence of posterior subcapsular cataracts were found to be significantly higher than in persons without these findings at baseline. [35]

In order to assess more accurately how the visual system affects balance, Buckley et al studied the impact of visual impairment on the mechanics of landing during stepping down by elderly patients (N = 12) and concluded that correcting common visual problems might be an important intervention strategy for elderly persons negotiating stairs. [36] A separate study reported that stair negotiation appears to be an important hazard for older persons. [37]

In a randomized controlled trial from New Zealand, Campbell et al assessed the efficacy and cost-effectiveness of a home safety program and a home exercise program to reduce falls and injuries in community-dwelling older people with low vision (391 women and men aged 75 years or older with visual acuity of 6/24 or worse). Participants received a home safety assessment and modification program delivered by an occupational therapist (n = 100), an exercise program prescribed at home by a physiotherapist plus vitamin D supplementation (n = 97), both interventions (n = 98), or social visits (n = 96). The main outcome measure was the number of falls and injuries resulting from falls. These authors found fewer falls occurring in the group randomized to the home safety program but not in

the exercise program—incidence rate ratios 0.59 (95% confidence interval [CI]: 0.42 to 0.83) and 1.15 (0.82 to 1.61), respectively. [38]

In another prospective cohort study assessing the impact of vision on likelihood of falling, women with declines in visual acuity over 4 to 6 years were found to have significantly greater odds of experiencing frequent falling during the subsequent year. Odds ratios after adjustment for baseline acuity and other confounders were 2.08 (95% CI: 1.39 to 3.12) for loss of 1 to 5 letters, 1.85 (95% CI: 1.16 to 2.95) for loss of 6 to 10 letters, 2.51 (95% CI: 1.39 to 4.52) for loss of 11 to 15 letters, and 2.08 (95% CI: 1.01 to 4.30) for loss of $>$ 15 letters. This study lends further support to the conclusion that loss of vision among elderly women increases the risk of frequent falls and that prevention or correction of visual loss may help reduce the number of future falls. [39] Yet another study of falls risk assessed 1285 persons over 65 years of age and found previous falls, visual impairment, urinary incontinence, and the use of benzodiazepines to be the strongest predictors of fall risk. [40] In support of these findings from multiple studies reported here, one systematic review reported that visual intervention strategies to improve visual function and prevent falls in older people are warranted. [41]

Modification of These Questions in Light of New Research: No change in these agenda items is recommended, but the addition of one new item is proposed. See the section New Horizons in Geriatric Ophthalmology at the end of the chapter.

Visual Loss and Hearing Loss

See *New Frontiers*, p. 182.

> ***Ophth 6 (Level B)***: **Research is needed to quantify the effect of multisensory loss in elderly patients (eg, hearing and vision) on functional outcomes. Observational cohort studies should be performed to determine which ocular disorders (eg, age-related macular degeneration, cataract, glaucoma) are more likely to be associated with hearing loss and whether or not these ocular disorders have an additive or synergistic effect on functional outcome.**
>
> ***Ophth 7 (Level A)***: **Prospective, focused cohort studies with appropriate comparison groups or nonrandomized controlled trials of interventions for multisensory loss, including visual or hearing rehabilitation, should be performed to test for improved functional outcomes.**

New Research Addressing These Questions: In a large cohort study of risk factors for cognitive and functional decline, visual impairment alone was found to be associated with declines in both, but combined hearing and visual loss was found to be associated with the greatest likelihood of cognitive and functional decline. [42] These and other authors emphasized again the need for studies regarding whether treatment of both vision and hearing impairment can decrease these declines. [43,44] Wallhagen et al also found that vision and hearing loss self-reported by patients have strong independent effects on disability, physical functioning, mental health, and social function 1 year after initial evaluation. [45]

Modification of These Questions in Light of New Research: The more recent research adds to our knowledge of the synergistic negative effects of the comorbidities, but further research is still needed to determine the efficacy and impact of any low-vision or other

rehabilitation interventions that might improve functional outcomes in the older patient with vision and hearing loss.

Visual Loss and Depression

See *New Frontiers*, p. 182.

***Ophth 8 (Level B)*: Research is needed to establish what types and what level of visual impairment might be associated with clinical depression in elderly patients. Observational cohort studies should be performed to determine the interaction of visual impairment and depression on the health-related quality of life or other studies of function in older persons.**

***Ophth 9 (Level B)*: Interventional studies of the evaluation and treatment of depression in older patients with visual impairment should be performed to determine the best timing for intervention.**

***Ophth 10 (Level A)*: Interventional studies of the effect in elderly patients of specific treatments of visual loss on depression should be performed to determine if improvement in the vision-related depression might lead to improved health-related quality of life and overall functioning.**

New Research Addressing These Questions: Galaria et al reported on the development of a shorter version of the Geriatric Depression Scale (GDS) for visually impaired older patients (N = 70). [46] Horowitz et al conducted a descriptive study of the effects of specific vision rehabilitation services (eg, low-vision clinical services, skills training, counseling, optical device use, and adaptive device use) on depression among 95 older adults with age-related vision impairments. Hierarchical regression analyses indicated that low-vision clinical services, counseling, and the use of optical devices, in separate models, each significantly contributed to a decline in depression (after controlling for age, health status, vision status, functional disability, and baseline depression). The authors concluded that vision rehabilitation interventions impact both physical and psychological functioning, and they underscored the need for future controlled research on rehabilitation service models that address mental health issues. [47]

Brody et al assessed the effectiveness of a self-management program (ie, health education and enhancement of problem-solving skills) on mood and function in 231 community-dwelling cognitively intact patients with vision loss from ARMD. Patients were randomly assigned to a 12-hour self-management program, a series of 12 hours of tape-recorded health lectures, or to a waiting list. The primary outcome measured was emotional distress. The secondary outcomes measured were self-reported function, social support, outlook on life, and self-confidence to handle ARMD-specific challenges in daily life. Clinical depression was determined with the Structured Clinical Interview of *The Diagnostic and Statistical Manual of Mental Disorders*, Axis I (4th edition, research version). The self-management group showed significant improvement in measures of mood and function in comparison with the control patients, and the changes were found to be significantly greater for those who were depressed than for those who were not. Decreases in emotional distress were found to be associated with increases in self-efficacy, and improvements in function were found to be associated with increases in self-efficacy and

the perception of social support. The authors concluded that the ARMD self-management program effectively enhances well-being in older persons with poor eyesight and ARMD, particularly those with initial depression. [48]

Modification of These Questions in Light of New Research: The recent research on visual loss and depression continues to add to our knowledge of the impact of the comorbidities of vision loss and depression. Further work is still needed to determine if interventional strategies aimed at both comorbidities might improve functional outcomes for elderly persons.

Visual Loss and Dementia

See *New Frontiers*, p. 183.

> ***Ophth 11 (Level B)*: Observational cohort studies should be performed to determine if there is any association between type or severity of visual loss and the major causes of dementia (eg, Alzheimer's disease, multi-infarct dementia).**
>
> ***Ophth 12 (Level B)*: Large population studies should be performed to determine if dementia and visual loss are associated in elderly persons and if the association is independent of other important variables (eg, age could explain the entire association).**
>
> ***Ophth 13 (Level A)*: If an association between dementia and visual loss is found (Ophth 12), especially a severity-related one, then interventional studies should be performed to determine if improvement or stabilization of vision might reduce the incidence or severity of dementia in older persons.**
>
> ***Ophth 14 (Level A)*: In elderly patients with visual loss and dementia, the type and timing of specific interventions should be compared to determine the most effective for improving visual function that leads to improved health-related quality of life or overall functioning.**

New Research Addressing These Questions: Reyes-Ortiz et al found that over 2 years the scores of the blind version of the Mini–Mental State Examination (MMSE-blind) declined more among older Hispanics with near-vision impairment than among those with normal near vision. Distance vision and hearing impairment were not found to be associated with cognitive decline. On average, the MMSE-blind scores of the Hispanic subjects decreased 0.62 points over 2 years and decreased 0.13 points more per year than the scores of normal near-vision subjects. [49] In a population-based study of 2087 very old adults, Anstey et al reported an association between memory loss over 2 years with vision impairment but did not see an association with hearing. [50] Sloan et al also reported on a large cohort followed over nearly a decade and reported small but significant associations of self-reported vision decline with declines in cognition and increases in depressive symptoms. [29]

Modification of These Questions in Light of New Research: The recent studies of visual impairment and cognitive impairment confirm the association and negative impact of these comorbidities, but further research is necessary to determine the efficacy of interventions that might improve functional outcome in older persons.

Visual Loss and Overall Function

See *New Frontiers*, p. 184.

> ***Ophth 15 (Level B)***: **Single-time observational or time-series observational studies should be performed in elderly patients to determine the relationship between loss of independence or decreases in measures of overall function and the type (eg, cataract, glaucoma), timing of onset (eg, early or late), and severity of loss of vision.**

New Research Addressing This Question: No new research addressing this question has come to light since the publication of *New Frontiers.*

Modification of This Question in Light of New Research: This item should remain unchanged on the research agenda, as findings from research addressing this question will contribute to improved ophthalmologic care of older adults.

> ***Ophth 16 (Level A)***: **Interventional studies should be performed to determine whether stabilization or improvement in vision or visual function (eg, with low-vision rehabilitation) in elderly patients leads to increased independence and improved overall functioning.**

New Research Addressing This Question: No new research addressing this question has come to light since the publication of *New Frontiers.*

Modification of This Question in Light of New Research: This item should remain unchanged on the research agenda, as findings from research addressing this question will contribute to improved ophthalmologic care of older adults.

Visual Loss and Driving Impairment

See *New Frontiers*, pp. 184–185.

> ***Ophth 17 (Level B)***: **Single-time or time-series observational studies are needed to determine if mandatory vision screening of elderly drivers appears beneficial in decreasing or preventing traffic accidents.**

New Research Addressing This Question: No new research addressing this question has come to light since the publication of *New Frontiers.*

Modification of This Question in Light of New Research: This item should remain unchanged on the research agenda, as findings from research addressing this question will contribute to improved ophthalmologic care of older adults.

> ***Ophth 18 (Level A)***: **Interventional cohort studies should be performed to determine whether improvement in vision decreases the frequency and severity of traffic accidents by elderly drivers.**

New Research Addressing This Question: No new research addressing this question has come to light since the publication of *New Frontiers.*

Modification of This Question in Light of New Research: This item should remain unchanged on the research agenda, as findings from research addressing this question will contribute to improved ophthalmologic care of older adults.

***Ophth 19 (Level B)*: Single-time or cross-sectional observational studies of a suitable cohort are needed to determine whether there is a relationship between the older person's driving performance and the type, severity, and onset of loss of vision.**

New Research Addressing This Question: No new research addressing this question has come to light since the publication of *New Frontiers.*

Modification of This Question in Light of New Research: This item should remain unchanged on the research agenda, as findings from research addressing this question will contribute to improved ophthalmologic care of older adults.

***Ophth 20 (Level B)*: Observational cohort studies should be performed to determine the interaction between visual loss and other comorbidities or risk factors for unsafe driving such as physical impairments, decreased hearing, and decreased cognition.**

New Research Addressing This Question: No new research addressing this question has come to light since the publication of *New Frontiers.*

Modification of This Question in Light of New Research: This item should remain unchanged on the research agenda, as findings from research addressing this question will contribute to improved ophthalmologic care of older adults.

***Ophth 21 (Level A)*: Interventional studies of treatments to improve vision or stabilize vision loss in older patients with visual impairment should be performed to determine whether improvement in vision decreases the frequency and severity of traffic accidents among elderly drivers.**

New Research Addressing This Question: No new research addressing this question has come to light since the publication of *New Frontiers.*

Modification of This Question in Light of New Research: This item should remain unchanged on the research agenda, as findings from research addressing this question will contribute to improved ophthalmologic care of older adults.

Visual Loss and Hospitalization

See *New Frontiers,* p. 186.

***Ophth 22 (Level B)*: Single-time or time-series observational studies are needed to establish the relationship in elderly patients of the type and severity of visual loss to the length of hospital stay and to the incidence and severity of in-hospital comorbidities (eg, delirium and depression).**

New Research Addressing This Question: No new research addressing this question has come to light since the publication of *New Frontiers.*

Modification of This Question in Light of New Research: This item should remain unchanged on the research agenda, as findings from research addressing this question will contribute to improved ophthalmologic care of older adults.

Ophth 23 (Level A): **Interventional studies of treatments to improve or stabilize vision prior to or during hospitalization should be performed to determine if such treatments decrease the length of hospital stay or reduce the incidence or severity of delirium in hospitalized elderly patients.**

New Research Addressing This Question: A retrospective study of the charts of 93 inpatients (half of whom had suffered strokes) who were referred to a low-vision rehabilitation clinic found that on average the visual acuity was moderately impaired and that this interfered with activities of daily living. A high proportion of those referred were believed to benefit from new eyeglasses correction or vision aids. [51]

Modification of Question in Light of New Research: This study does not provide insight into assessment of vision among the hospitalized older patients. Research as described in Ophth 23 is still needed.

COMPREHENSIVE EYE EVALUATION AND SCREENING

See *New Frontiers*, pp. 186–187.

Ophth 24 (Level B): **Prospective observational studies are needed to validate the current recommendations for visual screening and to establish the most cost-effective and reliable means for detecting treatable pathology in elderly persons. Prospective cost-effectiveness studies of vision screening of elderly populations at risk are needed to establish the efficacy of such programs. Prospective observational studies should define the leading approaches to screening (eg, Snellen testing, J-scale, visual function scales, comprehensive examinations), and comparative studies should be performed to determine cost-effectiveness, validity, reliability, and feasibility.**

New Research Addressing This Question: No new research addressing this question has come to light since the publication of *New Frontiers.*

Modification of This Question in Light of New Research: This item should remain unchanged on the research agenda, as findings from research addressing this question will contribute to improved ophthalmologic care of older adults.

Ophth 25 (Level A): **Interventional studies should be performed in elderly persons to compare no screening with different screening methods, measuring efficacy on the basis of visual and functional outcome.**

New Research Addressing This Question: No new research addressing this question has come to light since the publication of *New Frontiers.*

Modification of This Question in Light of New Research: This item should remain unchanged on the research agenda, as findings from research addressing this question will contribute to improved ophthalmologic care of older adults.

IMPORTANT EYE DISORDERS IN GERIATRIC POPULATIONS

Cataract

See *New Frontiers*, pp. 187–189.

***Ophth 26 (Level A)*: Interventional studies with elderly patients are needed to determine if there are differences in the amount of functional improvement that are based on the timing of cataract surgery, the initial and final visual outcome, whether one or both eyes are operated on, and the age of the patient at the time of the surgery.**

***Ophth 27 (Level A)*: Meta-analyses of existing data from previously performed interventional studies and clinical trials of cataract extraction should be performed to provide age-specific and age-stratified data for the elderly age group and to identify any age-specific differences in functional outcome.**

New Research Addressing These Questions: Friedman et al found low vision to be highly prevalent among nursing home residents (37% worse than 20/40 in the better eye) and black Americans to be more likely to have one or two cataracts (a potentially treatable cause of vision loss). [52] In a Scandinavian population, Buch et al concluded that adequate implementation of cataract surgery can reduce visual impairment by 33.3%. [53] The benefits of cataract extraction on function were confirmed in one small study that reported improvement in cognitive function after cataract surgery in elderly Japanese patients (n = 20) who were compared with controls (n = 20). [54] Though not directly addressing the impact of cataract surgery on function, an observational prospective study in Sweden of cataract surgery in 757 patients aged 85 years or older reported overall good visual outcomes. [55]

Modification of These Questions in Light of New Research: Although these studies are important and helpful, we encourage further data mining of existing databases for age-stratified information.

Age-Related Macular Degeneration

See *New Frontiers*, pp. 189–190.

***Ophth 28 (Level A)*: Interventional studies are needed to define the efficacy, cost-effectiveness, and functional outcomes of specific treatments for age-related macular degeneration.**

***Ophth 29 (Level A)*: Interventional studies are needed to determine the differences made, if any, by the timing of the treatment of age-related macular degeneration, with results stratified by age of the patient or timing of onset.**

***Ophth 30 (Level A)*: Meta-analyses of existing data from interventional and clinical studies on age-related macular degeneration should be**

performed to provide age-specific and age-stratified data regarding type, timing of therapy, and visual and functional outcome.

***Ophth 31 (Level B)*: All interventional studies of age-related macular degeneration should include demonstration of improvement in function as well as in visual acuity.**

New Research Addressing These Questions: Significant impairment in vision-specific health-related QOL (using the NEI-VFQ 25) was reported by ARMD patients seen at a low-vision clinic who were treated with various low-vision techniques. [56] In an uncontrolled study, Khan et al concluded that the overall management of ARMD should include counseling, prescription of appropriate devices, and training. [57]

Modification of These Questions in Light of New Research: These recent studies do not impact the agenda items; studies addressing these questions are therefore still needed.

Glaucoma

See *New Frontiers*, pp. 190–191.

***Ophth 32 (Level A)*: Interventional studies are needed to determine if the type and timing of treatments of glaucoma alter efficacy and if efficacy in elderly patients improves functional outcome.**

***Ophth 33 (Level A)*: Interventional studies are needed to determine the cost-effectiveness and durability of stabilization or improvement of vision in elderly glaucoma patents.**

***Ophth 34 (Level A)*: Interventional studies should be performed to determine if preventive measures or screening for glaucoma in older persons is effective and improves functional outcome.**

***Ophth 35 (Level B)*: Observational studies are needed to determine if treatment efficacy and functional outcome for glaucoma therapy differ by age.**

***Ophth 36 (Level B)*: Meta-analyses of existing data from interventional and clinical studies on surgical and medical treatment for glaucoma should be performed to provide age-specific and age-stratified data on functional outcome.**

New Research Addressing This Question: Two major clinical trials published recently on glaucoma management tended to show higher risks for progression among older glaucoma patients. [58,59] However, interpreting these findings is complicated by the fact that glaucoma tends to be relatively slowly progressive, and shorter life expectancy may limit the impact of glaucoma in older persons. One report based on the case notes of glaucoma patients from a blind registry in Fife, Scotland, reported that poor adherence with treatment was noted in 26%, and that 24% were demented. The average age at registration was 78 years. [60]

Modification of These Questions in Light of New Research: Additional interventional studies demonstrating improvement in functional outcomes are still needed.

Diabetic Retinopathy

See *New Frontiers,* pp. 191–192.

> ***Ophth 37 (Level B)***: **Observational studies should be performed to determine the functional impact of diabetic retinopathy on the health-related quality of life of older diabetic patients.**
>
> ***Ophth 38 (Level A)***: **Interventional studies are needed to determine whether specific preventive strategies (eg, tight diabetic control measures or diabetic retinopathy screening programs) and treatment measures improve functional outcomes in older diabetic patients.**
>
> ***Ophth 39 (Level B)***: **Observational studies are needed to determine if the age of the patient, age at onset of diagnosis, and age at initiation of treatment are important factors in functional outcome in diabetic retinopathy.**
>
> ***Ophth 40 (Level A)***: **Meta-analyses of data from existing and future interventional studies on the treatment of diabetes, including diabetic control, laser treatment for proliferative diabetic retinopathy and diabetic macular edema, and surgical treatment, should be performed to provide age-specific and age-stratified data on functional outcome.**

New Research Addressing These Questions: No new research addressing these questions has come to light since the publication of *New Frontiers.*

Modification of These Questions in Light of New Research: These items should remain unchanged on the research agenda, as findings from research addressing them will contribute to improved ophthalmologic care of older adults.

LOW VISION

See *New Frontiers,* p. 193.

> ***Ophth 41 (Level A)***: **Interventional studies should be performed in elderly persons to determine if the types and visual outcome effectiveness of low-vision therapies are important factors in functional outcomes.**

New Research Addressing This Question: One group has initiated a randomized trial of visual impairment interventions for nursing home residents. The study proposes to determine the physical and social function of nursing home residents with and without visual loss to determine the impact of vision rehabilitation service versus usual care, and to determine the cost-effectiveness of the interventional program. [61] A separate study of 71 persons reported on the impact of an interdisciplinary low-vision service on the QOL of low-vision patients. The provision of low-vision services was found to lead to a significant reduction in anxiety about deterioration of vision, home safety, and coping with everyday life. These authors concluded that low-vision service resulted in improvements in many areas of vision-related QOL. [62] An observational study of new referrals to a low-vision clinic (N = 168) documented improvement in function after evaluation and treatment.

Before low-vision intervention, 77% were unable to read N8 newsprint, whereas following low-vision services, 88% were able to read N8 or smaller text. [63] In an institutionalized cohort of 284 older persons, de Winter et al reported a 31% prevalence of binocular low vision. [64]

One large randomized controlled clinical trial of 226 patients with ARMD compared extended low-vision rehabilitation (including home visits along with hospital-based low-vision treatment) and standard hospital-based treatment. No benefit of additional home visits was found in this study, and the authors caution clinicians of the need for testing of low-vision therapies before implementing them widely. [65]

The Agency for Healthcare Research and Quality issued a Technology Assessment report on vision rehabilitation for older persons with low vision or blindness. The aims of this extensive project included the following: first, to estimate the number of elderly persons with visual loss that might benefit from low-vision rehabilitation services, and second, to systematically review the evidence for the effectiveness of vision rehabilitation services. In assessing effectiveness, the authors considered outcomes, including disability and function, activities of daily living, psychosocial status, and quality of life. The report concluded that comprehensive vision rehabilitation programs benefit individuals, but that the evidence supporting this statement is weak because of poor methodology in the research. Other conclusions were that optic devices and visual aids improve reading performance, that the efficacy of orientation and mobility training has yet to be demonstrated by a well-designed study using validated instruments, and that no evidence-based recommendation could be made regarding adaptive techniques training or group intervention programs. [66]

Modification of This Question in Light of New Research: Although much of the work to date is promising, more research to demonstrate functional improvement is still needed.

NEW HORIZONS IN GERIATRIC OPHTHALMOLOGY

VISUAL LOSS AND FALLS

The following agenda item should be added to the research agenda to complement Ophth 5 as newer primary and secondary outcome assessments emerge for falls preventive measures; these assessments will be better than relying solely upon epidemiologic studies with falling as the primary outcome measure.

> ***Ophth 42 (Level B)***: **Interventional studies (eg, low-vision rehabilitation) to improve visual functioning in elderly patients should be performed to assess improvements in mechanics of gait, stair negotiation, posture, and balance to reduce falls risk.**

VISUAL LOSS AND MORTALITY

Prior studies have shown an association of visual loss with increased mortality. More recently, McCarty et al reported on predictors of mortality in the 5-year follow-up of the Melbourne Visual Impairment Project (VIP), a population-based study of 3271 persons

aged 40 years and older as of 1992, when the baseline study was done. Best corrected visual acuity lower than 6/12 was found to be associated with a significantly higher risk of mortality. [67]

***Ophth 43 (Levels B, A)*: Observational studies are recommended to determine the impact of visual loss on mortality in the elderly age group, and interventional studies might then follow, to demonstrate the reduction of mortality rates after specific visual interventions.**

VISUAL LOSS AND INSTITUTIONAL RESIDENCE

One study assessed the risk of institutionalization associated with visual impairment. Using national interview data, these authors concluded that visual handicap is associated with institutional admission. [68] In a large cohort study from Australia, older persons with visual impairment (both correctable and not correctable) were found to have about twice the rate of nursing home admission than those with good vision. [69] The study by Sloan et al also found self-reported declines in vision to be associated with increased probability of nursing home residence. [29]

***Ophth 44 (Levels B, A)*: Observational studies are recommended to determine the impact of visual loss on institutionalization in the elderly age group, and interventional studies might then follow, to demonstrate the reduction of institutionalization rates after specific visual interventions.**

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