

Chronic Disease and Medical Innovation in an Aging Nation

The Silver Book[®]: Vision Loss



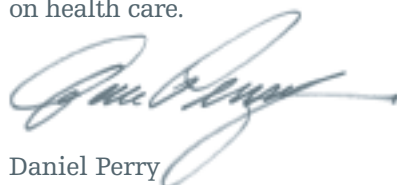
Preface

Americans are living longer than ever before. Unfortunately that longevity is not always experienced by Americans in good health. Eighty percent of Americans age 65 and older have at least one chronic health condition. These conditions impose a huge burden on individuals, families, and the nation's economy. People with chronic ailments account for 83% of all health care spending; and with Baby Boomers beginning to qualify for Medicare in less than five years, health care policymakers are searching for ways to curb spending.

In order to promote national policies that look to investments in innovation rather than short-term cost-cutting and health care rationing, the Alliance for Aging Research publishes *The Silver Book®: Chronic Disease and Medical Innovation in an Aging Nation*. *The Silver Book* is an almanac of compelling statistics that spotlight the mounting burden of chronic diseases, and the promise of innovation in mitigating that burden. While much of this information is buried in dense reports and diverse technical studies, *The Silver Book* extracts key findings and provides essential information in a single, easy-to-use, and well-referenced resource.

The first volume of *The Silver Book* was launched in 2006 and has quickly become a trusted resource for health policy practitioners. We are particularly pleased to partner with the National Alliance for Eye and Vision Research (NAEVR) in 2007, to make available a new volume of *The Silver Book* dedicated to eye diseases—*The Silver Book: Vision Loss*. The data address age-related macular degeneration (AMD), diabetic retinopathy, and glaucoma—which along with cataract are the eye diseases that disproportionately affect older Americans. **(Information pertaining specifically to the older population is noted in silver type)**. All sources are cited so that users may easily integrate them into presentations and work, and return to the original sources for additional information. All data are also available on-line at www.silverbook.org, where the data are searchable and frequently updated.

More than 38 million Americans age 40 and older are blind, visually impaired, or have an age-related eye disease. The annual economic costs of adult vision loss exceed \$51 billion—a huge share of the \$68 billion annual cost of all vision impairment and eye disease. With innovation in vision research bringing hope for major advances and breakthroughs, it is critical to ensure that support for research and incentives for innovation remain a bedrock of good public policy. By bringing this rich information resource to bear on that policy, the Alliance for Aging Research and NAEVR hope to enrich the national debate on health care.



Daniel Perry
Executive Director
Alliance for Aging Research



Advancing Science. Enhancing Lives.

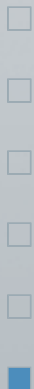
Introduction

Cost of Vision Loss

Innovative Medical Research

Conclusion

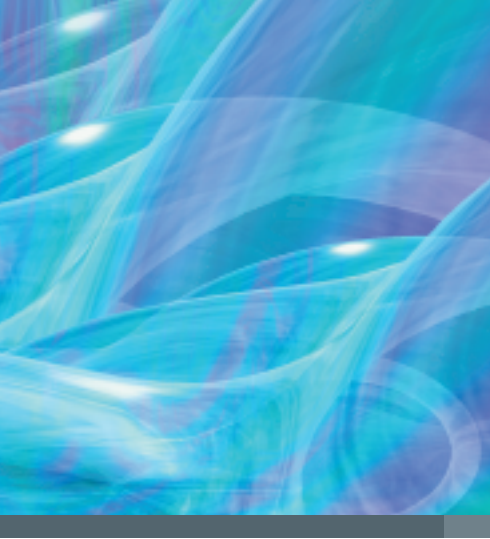
References



Chronic Disease and Medical Innovation in an Aging Nation

The Silver Book[®]: Vision Loss

Preface	1
Introduction	3
Cost of Vision Loss: The Human and Economic Burden	4
Prevalence and Incidence of Vision Loss	5
Vision Loss	5
Age-Related Macular Degeneration	5
Diabetic Retinopathy	5
Glaucoma	5
Age—A Major Risk Factor	6
Vision Loss	6
Age-Related Macular Degeneration	7
Diabetic Retinopathy	7
Glaucoma	8
The Burden of Vision Loss	9
The Human Burden	9
Vision Loss	9
Age-Related Macular Degeneration	10
Diabetic Retinopathy	10
Glaucoma	11
The Economic Burden	11
Vision Loss	11
Age-Related Macular Degeneration	13
Diabetic Retinopathy	13
Glaucoma	14
The Future Cost of Vision Loss	14
Vision Loss	14
Age-Related Macular Degeneration	14
Diabetic Retinopathy	14
Glaucoma	14
Innovative Medical Research: Investing in Science	15
The Human Value	16
Age-Related Macular Degeneration	16
Diabetic Retinopathy	16
Glaucoma	17
The Economic Value	17
The Future Value	17
Conclusion	18
References	19



Introduction

NAEVR is pleased to have partnered with the Alliance for Aging Research to produce the first volume of *The Silver Book* dedicated to age-related eye disease—*The Silver Book: Vision Loss*. Vision loss can be an enormous burden, and in public opinion polls over the past 40 years Americans have consistently identified fear of vision loss as second only to fear of cancer. The National Eye Institute (NEI), within the National Institutes of Health (NIH), estimates that the annual cost impact of vision loss and eye disease is \$68 billion.

-
-
-
-
-
-

Eye disease and vision impairment are increasing not only because of the aging of the population, but also due to their disproportionate incidence in fast-growing minority populations and the increased incidence of chronic diseases for which vision loss is often a co-morbidity, such as diabetes. In fact, current cost estimates may not fully quantify the growing impact of direct healthcare costs, lost productivity, reduced independence, diminished quality of life, increased depression, and accelerated mortality associated with vision loss.

Fortunately, vision research is resulting in new tests and imaging technologies to diagnose eye disease, as well as treatments and therapies that not only stabilize vision loss but restore it or ultimately prevent the onset of disease. *The Silver Book: Vision Loss* focuses on the incidence and costs of AMD, diabetic retinopathy, and glaucoma—the age-related eye diseases that could be enormously affected by ongoing research and innovation. Cataract, the fourth of the major aging eye diseases, is now routinely treated in the United States through outpatient surgery that is proven to restore lost vision. These treatments have already been found to be cost-effective, and while further research could form the basis of new therapies to delay or prevent the onset of a cataract, existing innovations have already proven their value.

While the data of *The Silver Book: Vision Loss* illustrate both the cost of eye disease and the value of medical innovation, the published literature on the current and future costs for AMD do not yet reflect the impact on the new generation of Food and Drug Administration (FDA)-approved ophthalmic drugs to treat AMD. The cost of these drugs is estimated by the American Academy of Ophthalmology to be one billion dollars a year; and although it has yet to be quantified, the concomitant value could be equally, if not more, significant. Since these therapies are also being studied in clinical trials within the NEI-funded Diabetic Retinopathy Clinical Research Network, the same caution applies to the data for diabetic retinopathy.

The pace of vision research is accelerating, resulting in dramatic advances to benefit patients. Readers are encouraged to refer to the on-line version at www.silverbook.org to access the latest data resulting from this innovation.

Stephen J. Ryan, MD
President, Board of Directors
National Alliance for Eye and Vision Research



NAEVR
National Alliance For
Eye And Vision Research
Serving as Friends of the National Eye Institute



-
-
-
-
-

The Human and Economic Burden

Cost of Vision Loss

■ **V**ision specialists are making history with promising research that could lead to prevention and reversal of vision loss and blindness for millions of Americans. But the toll of vision loss in the U.S. is still enormous and paid in both human and economic terms. Every 7 minutes someone in the United States becomes blind or visually impaired. Vision loss often brings functional limitations, dependency, depression, high medical bills, and an increased risk of mortality.

■ Vision loss is costly both to individuals and to the overall U.S. economy. People with impaired or lost vision visit their doctors more, take additional medications and supplements, and need extra help with activities of daily living. Chronic eye diseases and vision impairment are responsible for consuming a huge share of health care resources—costing the U.S. an estimated \$68 billion annually.

■ Because vision loss tends to strike later in life, it disproportionately impacts older people. Nearly one-quarter of people age 80 and older are either blind or vision impaired. With the aging of our population, the burden of vision loss will undoubtedly increase. The number of Americans with blindness, low vision, or an age-related eye disease is expected to grow by nearly one-third—to some 50 million people—by 2020. While cost estimates are scarce, there will surely be a proportional increase in economic costs unless research and innovation provide some relief.

There could be an even greater economic toll in terms of future national productivity. With the nation's largest generational cohort approaching traditional retirement age, the nation will need and value older workers. Vision loss poses a serious challenge to those who would otherwise remain in the workforce beyond age 65. Already, vision loss and blindness account for \$8 billion in lost productivity annually. In a nation urgently needing to encourage and support older workers, vision loss is going to become an even larger challenge for individuals and for America.



Prevalence and Incidence of Vision Loss

Vision Loss

- More than 38 million Americans age 40 and older are estimated to experience blindness, low vision, or an age-related eye disease.

Eye Disease Prevalence Research Group 2004, *Blindness*

- Age-related eye diseases affect more than 35 million Americans age 40 and older. The most common eye diseases in that age group are macular degeneration, glaucoma, diabetic retinopathy, and cataract.

Eye Disease Prevalence Research Group 2004, *Blindness*

- Low vision or blindness affects 1 in 28 Americans over the age of 40—3.3 million Americans.

Congdon et al. 2004, *Causes and Prevalence of Visual Impairment Among Adults in the United States*

- An estimated 2.4 million Americans over the age of 40 have low vision.

Congdon et al. 2004, *Causes and Prevalence of Visual Impairment Among Adults in the United States*

- An estimated 1 million Americans over the age of 40 are legally blind.

Congdon et al. 2004, *Causes and Prevalence of Visual Impairment Among Adults in the United States*

- Every 7 minutes, someone in the United States becomes blind or visually impaired.

American Foundation for the Blind, *Blindness Statistics*

Age-Related Macular Degeneration

- An estimated 1.75 million Americans age 40 and older have advanced age-related macular degeneration (AMD). Another 7.3 million are at substantial risk for vision loss from AMD.

Friedman et al. 2004, *Prevalence of Age-Related Macular Degeneration in the United States*

- Every year, 200,000 Americans develop advanced age-related macular degeneration (AMD).

National Alliance for Eye and Vision Research, *Vision Impairment and Eye Disease is a Major Public Health Problem*

Diabetic Retinopathy

- An estimated 4.1 million Americans age 40 and older have diabetic retinopathy.

Kempen et al. 2004, *The Prevalence of Diabetic Retinopathy Among Adults in the United States*

- Nearly all patients with type 1 diabetes, and greater than 60% of patients with type 2, develop retinopathy within the first two decades of the disease.

Fong et al. 2004, *Retinopathy in Diabetes*

- 1 in 12 diabetics age 40 and older has advanced diabetic retinopathy that threatens their vision.

Kempen et al. 2004, *The Prevalence of Diabetic Retinopathy Among Adults in the United States*

- Close to 50% of participants in the NEI-sponsored Los Angeles Latino Eye Study (LALES) who had diabetes, also had diabetic retinopathy.

Varma et al. 2004, *Prevalence of Diabetic Retinopathy in Adult Latinos*

- Around 1 in 5 individuals with diabetes in the NEI-sponsored Los Angeles Latino Eye Study (LALES) was newly diagnosed during the study. Of those who were newly diagnosed, 23% were found to have diabetic retinopathy.

Varma et al. 2004, *Prevalence of Diabetic Retinopathy in Adult Latinos*

Glaucoma

- An estimated 2.2 million Americans age 40 and older have glaucoma—1.9% of the 40 and older population.

Friedman et al. 2004, *Prevalence of Open-Angle Glaucoma Among Adults in the United States*

- Glaucoma is almost 3 times more common in African Americans than in whites.

Friedman et al. 2004, *Prevalence of Open-Angle Glaucoma Among Adults in the United States*

- Around 50% of those with glaucoma are not aware that they have the disease.

Friedman et al. 2004, *Prevalence of Open-Angle Glaucoma Among Adults in the United States*

- Of the study participants in the Los Angeles Latino Eye Study (LALES) who had open-angle glaucoma, 75% were previously undiagnosed.

Varma et al. 2004, *Prevalence of Open-Angle Glaucoma and Ocular Hypertension in Latinos*

Age—A Major Risk Factor

Vision Loss

- More than 2.1 million Americans age 80 and older have low vision or are blind—23.7% of the 80 and older population.

Congdon et al. 2004, *Causes and Prevalence of Visual Impairment Among Adults in the United States*

- More than 1.5 million Americans age 80 and older have low vision—16.7% of the 80 and older population.

Congdon et al. 2004, *Causes and Prevalence of Visual Impairment Among Adults in the United States*

- Around 648,000 Americans age 80 and older are blind—7% of the 80 and older population.

Congdon et al. 2004, *Causes and Prevalence of Visual Impairment Among Adults in the United States*

- 6.5 million Americans over the age of 65 have severe visual impairment that threatens to limit their mobility, independence, and quality of life.

American Foundation for the Blind, *Aging and Vision Loss Fact Sheet*

- Americans age 80 and older have the highest rates of blindness. They are also the fastest growing segment of our population.

Congdon et al. 2004, *Causes and Prevalence of Visual Impairment Among Adults in the United States*

- In one study, individuals age 80 and older made up 8% of the population, yet accounted for 69% of cases of blindness.

Congdon et al. 2004, *Causes and Prevalence of Visual Impairment Among Adults in the United States*

- 1 in 9 people over the age of 65 experiences serious vision loss. That number increases to 1 in 4 for individuals over 85.

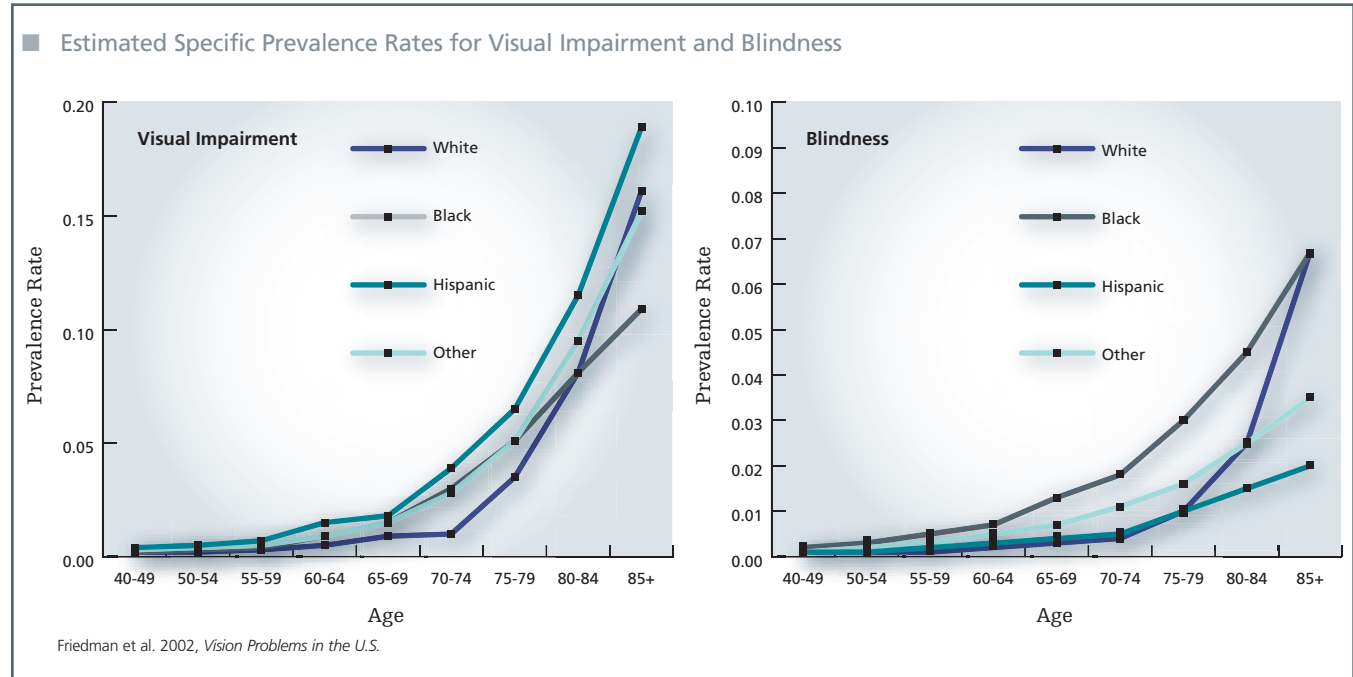
Vision Loss Resources, *Frequently Asked Questions*

- 16.8% of the non-institutionalized adults 65 years and older have some trouble seeing, even with glasses or contacts. That number increases to 19.9% in adults 75 years and older.

Centers for Disease Control and Prevention 2006, *Health*

- A longitudinal study that followed Medicare patients found that after 9 years, almost 50% of survivors had developed glaucoma, cataract, or macular degeneration.

Lee et al. 2003, *Longitudinal Prevalence of Major Eye Diseases*

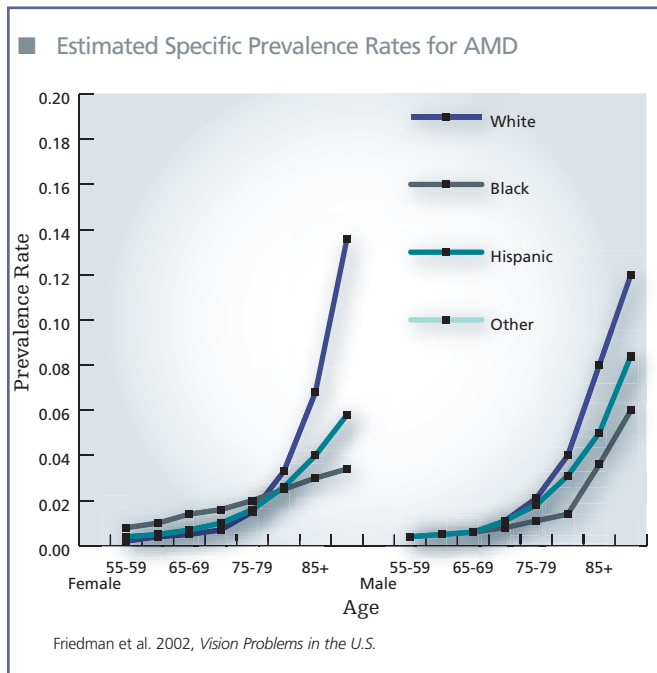




Age-Related Macular Degeneration

- More than 1 in 10 Americans over the age of 80 has advanced age-related macular degeneration (AMD)—1.08 million Americans 80 and older.

Friedman et al. 2004, *Prevalence of Age-Related Macular Degeneration in the United States*



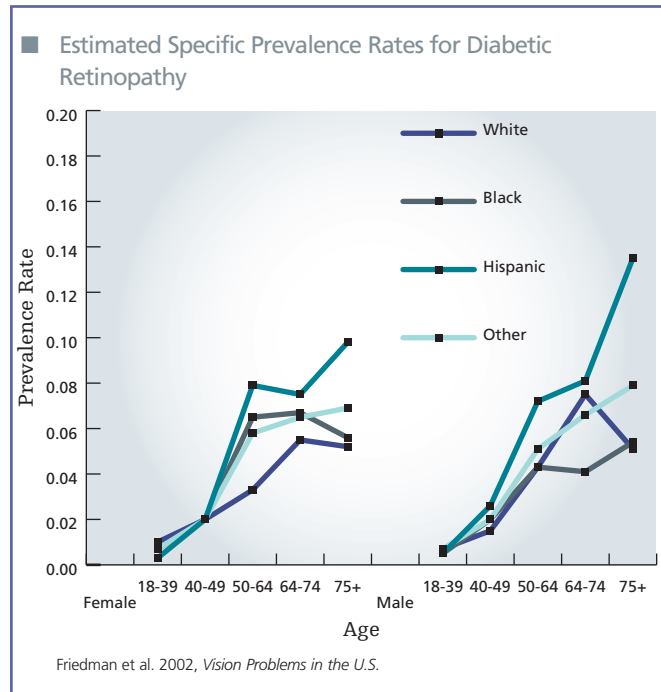
- The risk of getting age-related macular degeneration (AMD) increases from 2% for those ages 50-59, to nearly 30% for those over the age of 75.

National Eye Institute, *Age-Related Macular Degeneration*

Diabetic Retinopathy

- Around 824,000 Americans age 74 and older have diabetic retinopathy—5% of the 74 and older population.

Kempen et al. 2004, *The Prevalence of Diabetic Retinopathy Among Adults in the United States*

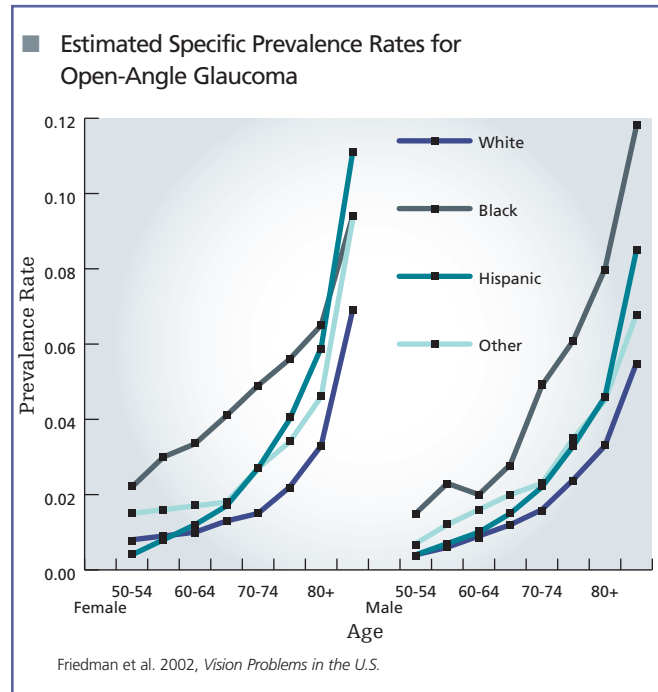


-
-
-
-
-
-

Glaucoma

- Around 711,000 Americans age 80 and older have glaucoma—7.7% of the 80 and older population.

Friedman et al. 2004, *Prevalence of Open-Angle Glaucoma Among Adults in the United States*



- Glaucoma affects 1 in 200 people age 50 and younger. That rate increases to 1 in 10 for individuals over the age of 80.

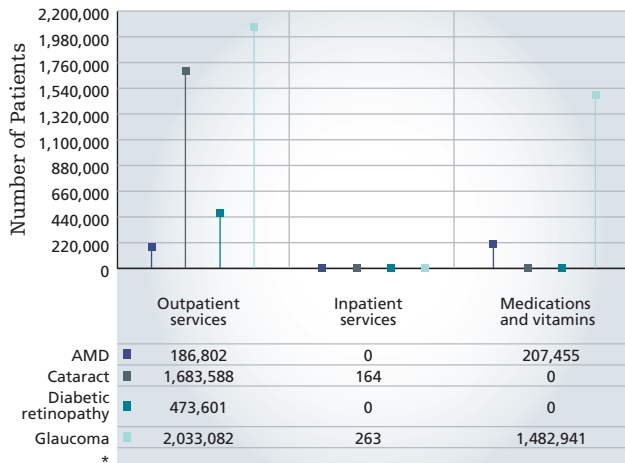
Prevent Blindness America, *The Glaucoma Learning Center*

The Burden of Vision Loss

The Human Burden

Vision Loss

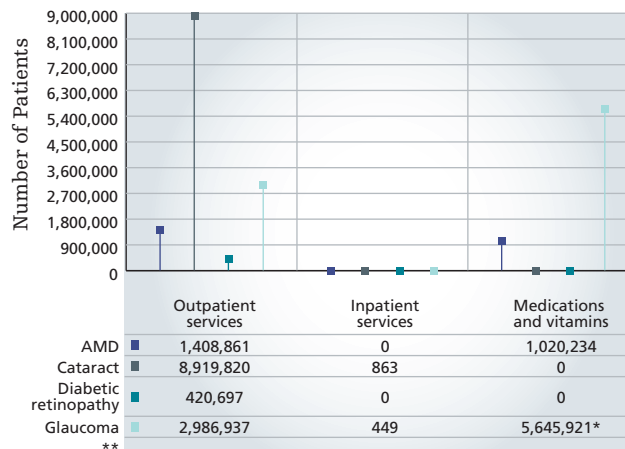
Number of Patients Aged 40 to 64 Using Medical Services, Medications and Vitamins



Prevent Blindness America 2007, *The Economic Impact of Vision Problems*

* Note that data on refractive error from the original graph has been removed.

Number of Patients Aged 65 and Older Using Medical Services, Medications and Vitamins



Prevent Blindness America 2007, *The Economic Impact of Vision Problems*

* The number for glaucoma medications represents the number of prescriptions for glaucoma medications and not the number of patients.

**Note that data on refractive error from the original graph has been removed.

- For assistance getting around, more than 100,000 visually impaired Americans use long white canes, and more than 7,000 use guide dogs.

American Foundation for the Blind, *Blindness Statistics*

- Vision conditions or problems cause activity limitations in 8.3% of Americans age 85 and older.

Centers for Disease Control and Prevention 2006, *Health*

- Vision loss is a leading cause of falls in the elderly. One study found that visual field loss was associated with a 6-fold risk of frequent falls.

Ramratten et al. 2001, *Prevalence and Causes of Visual Field Loss in the Elderly*

- An association with vision loss and vehicular crashes has been shown in older adult drivers.

Sims et al. 2000, *Exploratory Study of Incident Vehicle Crashes Among Older Drivers*

- The ability to recognize faces declines with age and requires, on average, being 5 feet closer to the face with every decade after the age of 60.

Lott et al. 2005, *Face Recognition in the Elderly*

- While only 4.3% of the 65 and older population lives in nursing homes, 16% of those who are visually impaired and 40% of those who are blind reside in nursing homes.

Rein et al. 2006, *The Economic Burden of Major Adult Visual Disorders in the United States*

- An estimated 424,801 more visually impaired and blind individuals live in nursing homes than would be expected if they had normal vision.

Rein et al. 2006, *The Economic Burden of Major Adult Visual Disorders in the United States*

- The data from the NEI-sponsored Age-Related Eye Disease Study (AREDS) found that persons with vision worse than 20/40 OU (*oculus unitas*, meaning "in both eyes") were more likely to be cognitively impaired than those with a visual acuity of 20/40 OU or better.

Clemons et al. 2006, *Cognitive Impairment in the Age-Related Eye Disease Study*

- In a study of new applicants for recent vision loss rehabilitative services, 7% had current major depression and 26.9% met the criteria for subthreshold depression.

Horowitz et al. 2005, *Major and Subthreshold Depression Among Older Adults Seeking Vision Rehabilitation Services*



- Progression of vision loss from normal to blind is associated with more than 1.5-fold increased odds of depression and injury, and 2.5- to 3-fold increased odds of utilization of skilled nursing facilities and long term care.

Javitt et al. 2007, *Association between Vision Loss and Higher Medical Care Costs in Medicare Beneficiaries*

- Based on estimates from 1997 data, around 115,583 visually impaired and 74,133 blind individuals who did not work, would have worked if they had been fully sighted.

Rein et al. 2006, *The Economic Burden of Major Adult Visual Disorders in the United States*

- The total annual loss for the 3.7 million people in the U.S. who are visually impaired or blind is estimated at more than 209,200 quality-adjusted life-years.

Frick et al. 2007, *Economic Impact of Visual Impairment and Blindness in the United States*

- Even mild visual impairment doubles the risk of mortality over a 5-year period.

McCarty et al. 2001, *Vision Impairment Predicts 5 Year Mortality*

Age-Related Macular Degeneration

- Age-related macular degeneration (AMD) is the leading cause of irreversible vision loss in people over the age of 65.

National Eye Institute 2006, *Progress in Eye and Vision Research*

- Age-related macular degeneration (AMD) is the leading cause of blindness among white Americans—accounting for 54% of cases of blindness.

Congdon et al. 2004, *Causes and Prevalence of Visual Impairment Among Adults in the United States*

- One-third of age-related macular degeneration (AMD) patients suffer from clinical depression.

National Alliance for Eye and Vision Research 2005, *The National Eye Institute (NEI) Responds to the Growing Public Health Problem of Age-Related Eye Disease*

- One study reported emotional distress scores in age-related macular degeneration (AMD) patients comparable to scores of individuals with serious illnesses such as melanoma and HIV.

Mitchell and Bradley 2006, *Quality of Life in Age-Related Macular Degeneration*

- Compared to elderly persons without visual impairment, elderly patients with macular degeneration are 8 times more likely to report difficulty shopping, 13 times more likely to have difficulty managing finances, 4 times more likely to have difficulty preparing meals, 12 times more likely to have problems making phone calls, and 9 times more likely to have problems with light housework.

Williams et al. 1998, *The Psychosocial Impact of Macular Degeneration*

- Visual loss from subfoveal choroidal neovascularization, a characteristic of wet age-related macular degeneration (AMD), was found to have a profound impact on how patients felt about their health-related quality of life.

Bass et al. 2004, *Patients' Perceptions of the Value of Current Vision*

- Individuals with early-stage age-related macular degeneration (AMD) are almost 2 times more likely to have a stroke than those who do not have the eye disease.

Wong et al. 2006, *Age-Related Macular Degeneration and Risk for Stroke*

- Various studies found between 13% and 24% of age-related macular degeneration (AMD) patients had experienced visual hallucinations.

Mitchell and Bradley 2006, *Quality of Life in Age-Related Macular Degeneration*

- In 2001, an estimated 1.4 million age-related macular degeneration (AMD) patients visited physicians or hospitals for treatment of their disease.

Rein et al. 2006, *The Economic Burden of Major Adult Visual Disorders in the United States*

Diabetic Retinopathy

- Diabetic retinopathy is the most frequent cause of new blindness in individuals ages 20 to 74.

Fong et al. 2003, *Diabetic Retinopathy*

- In 2001, approximately 420,000 diabetic retinopathy patients visited physicians or hospitals for treatment of their disease.

Rein et al. 2006, *The Economic Burden of Major Adult Visual Disorders in the United States*

- Diabetic retinopathy often causes vision loss and blindness during working age years, resulting in more disability and person-years of vision lost than other eye diseases.

Kempen et al. 2004, *The Prevalence of Diabetic Retinopathy Among Adults in the United States*



Glaucoma

- Glaucoma is one of the leading causes of blindness among age-related eye diseases in Hispanic persons—accounting for 28.6% of cases of blindness.

Congdon et al. 2004, *Causes and Prevalence of Visual Impairment Among Adults in the United States*

- Approximately 120,000 people have gone blind because of glaucoma—9-12% of all cases of blindness in the U.S.

Glaucoma Research Foundation, *Glaucoma Facts and Stats*

- A study of glaucoma patients found that compared with control subjects, they were over 3 times more likely to have fallen in the previous year, over 6 times more likely to have been involved in 1 or more motor vehicle collisions in the previous five years, and more likely to have been at fault in the collision.

Haymes et al. 2007, *Risk of Falls and Motor Vehicle Collisions in Glaucoma*

- In 2001, approximately 5.6 million prescriptions were filled for glaucoma patients.

Rein et al. 2006, *The Economic Burden of Major Adult Visual Disorders in the United States*

- In 2001, approximately 2.9 million glaucoma patients visited physicians or hospitals for treatment of their disease.

Rein et al. 2006, *The Economic Burden of Major Adult Visual Disorders in the United States*

- In one NEI-sponsored study, trabeculectomy, a surgical procedure to relieve pressure in the eyes of glaucoma patients where other treatments have not been effective, was found to increase the risk of cataract formation by 78%.

The AGIS Investigators 2001, *The Advanced Glaucoma Intervention Study*

The Economic Burden

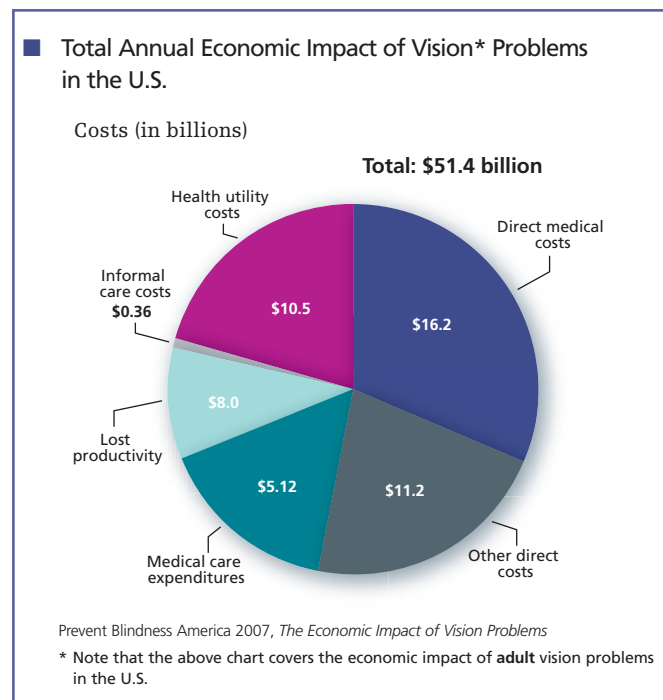
Vision Loss

- The annual cost associated with all eye disease and vision impairment in the U.S. is estimated at \$68 billion—\$48.7 billion in direct costs and \$18.9 billion in indirect costs. These estimates are based on inflationary adjustments from 1981 data.

National Eye Institute 2003, *Updating the Hu 1981 Estimates of the Economic Costs of Visual Disorders and Disabilities*

- The annual cost of adult vision problems in the U.S. is around \$51.4 billion.

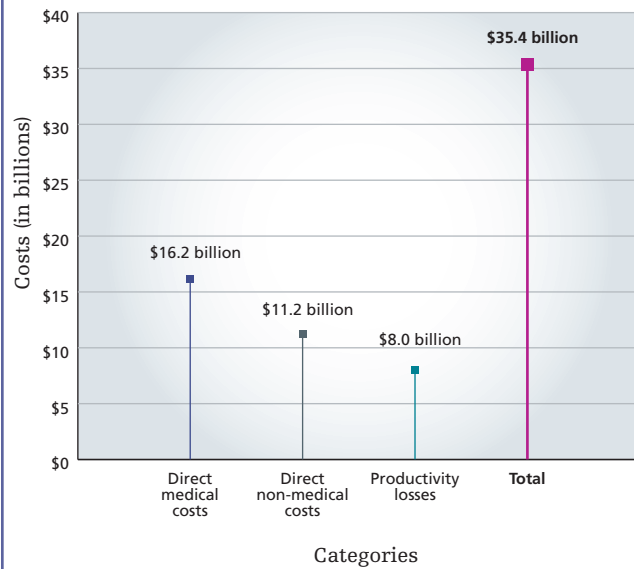
Prevent Blindness America 2007, *The Economic Impact of Vision Problems*



- The annual burden to the U.S. economy of age-related macular degeneration (AMD), cataract, diabetic retinopathy, glaucoma, refractive errors, visual impairment, and blindness in adults age 40 and older is estimated at \$35.4 billion—\$16.2 billion in direct medical costs, \$11.2 billion in other direct costs, and \$8 billion in lost productivity.

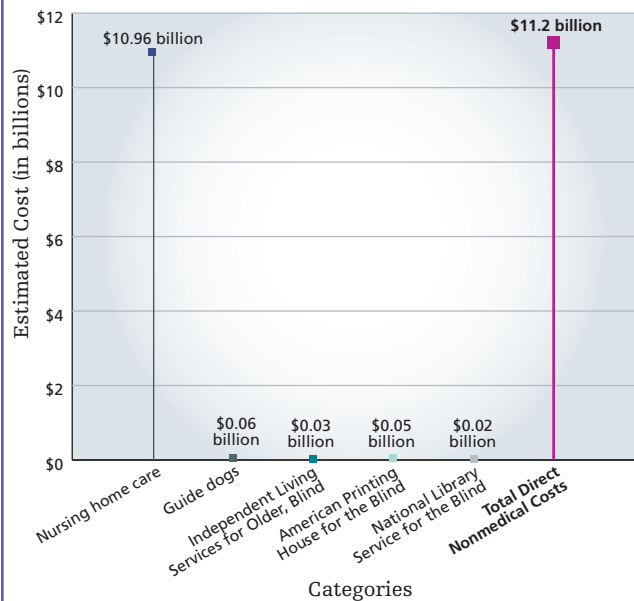
Rein et al. 2006, *The Economic Burden of Major Adult Visual Disorders in the United States*

■ Annual Total Burden to the U.S. Economy of AMD, Cataract, Diabetic Retinopathy, Glaucoma, Refractive Errors, Visual Impairment and Blindness



Rein et al. 2006, *The Economic Burden of Major Adult Visual Disorders in the United States*

■ Estimated Direct Nonmedical Costs for People Who Are Visually Impaired or Blind



Rein et al. 2006, *The Economic Burden of Major Adult Visual Disorders in the United States*

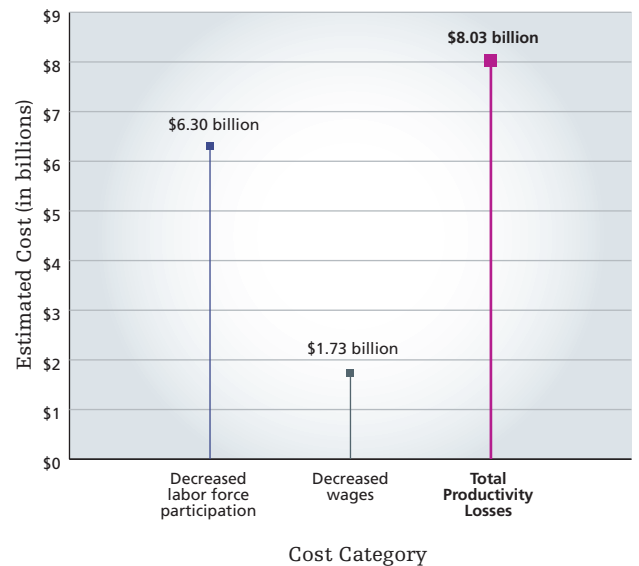
- Close to \$11 billion of the \$11.2 billion in direct nonmedical costs for adults with visual disorders goes to nursing home care.

Rein et al. 2006, *The Economic Burden of Major Adult Visual Disorders in the United States*

- Visual impairment and blindness account for \$8 billion in lost productivity annually.

Rein et al. 2006, *The Economic Burden of Major Adult Visual Disorders in the United States*

■ Estimated Cost of Reduced Labor Force Participation by People Who are Visually Impaired or Blind



Rein et al. 2006, *The Economic Burden of Major Adult Visual Disorders in the United States*

- The excess economic burden of visual impairment and blindness of individuals age 40 and older on the individual, caregivers, and other health care payers is an estimated \$5.48 billion annually—\$5.12 billion in additional medical care expenditures and \$360 million in informal care costs.

Frick et al. 2007, *Economic Impact of Visual Impairment and Blindness in the United States*

- Visual impairment and blindness cause an annual health utility loss of approximately \$10.5 billion. This figure measures lost quality of life when a disease has little or no short-term impact on mortality.

Frick et al. 2007, *Economic Impact of Visual Impairment and Blindness in the United States*



- An individual who is visually impaired or blind accumulates nearly \$1,479 in vision-related expenses each year—not including health utility or QALY losses. At this rate, after 8 years an individual would accumulate \$10,000 in excess expenditures.

Frick et al. 2007, *Economic Impact of Visual Impairment and Blindness in the United States*

- The annual governmental budgetary impact of major adult visual disorders is estimated at \$13.7 billion.

Rein et al. 2006, *The Economic Burden of Major Adult Visual Disorders in the United States*

- Visual impairment (compared to no visual impairment) is associated with more than \$1,000 in excess annual medical expenses per person.

Frick et al. 2007, *Economic Impact of Visual Impairment and Blindness in the United States*

- Blindness (compared to no visual impairment) is associated with more than \$2,000 in excess annual medical expenses per person.

Frick et al. 2007, *Economic Impact of Visual Impairment and Blindness in the United States*

- Medicare beneficiaries with vision loss incur significantly higher costs than individuals with normal vision. Approximately 90% of the higher annual costs are non-eye related medical costs—\$2,193 for those with moderate loss, \$3,301 for those with severe loss, and \$4,443 for those who are blind. Extrapolating to the entire Medicare population, blindness and vision loss are associated with \$2.14 billion in non-eye related costs (in 2003 dollars).

Javitt et al. 2007, *Association between Vision Loss and Higher Medical Care Costs in Medicare Beneficiaries*

- The excess yearly nursing home cost for those with vision loss, beyond the expected cost for those with normal vision, is \$450 for those with moderate vision loss, \$1,225 for those with severe vision loss, and \$3,275 for those with blindness.

Javitt et al. 2007, *Association between Vision Loss and Higher Medical Care Costs in Medicare Beneficiaries*

- Around \$62 million a year is spent on guide dogs for individuals 40 years and older with visual impairment (in 2004 dollars).

Rein et al. 2006, *The Economic Burden of Major Adult Visual Disorders in the United States*

- Over 50% of Americans have vision problems or impairments and 40% fear that they can't afford adequate treatment.

Aflac 2005, *Aflac Survey Reveals Disparities in Americans' Perceptions of Vision Health*

Age-Related Macular Degeneration

Note that age-related macular degeneration (AMD) cost estimates are through 2004, prior to the Food and Drug Administration (FDA) approval of the new generation of ophthalmic drugs to treat AMD. Studies quantifying the cost of these new treatments—which the American Academy of Ophthalmology estimates at one billion dollars a year—as well as the concomitant benefits which could be equally or more significant, had yet to be published at the time of press for *The Silver Book: Vision Loss*.

- The annual direct medical costs (including outpatient, inpatient, and prescription drug services) for Americans age 40 and older with age-related macular degeneration (AMD) is \$570 million.

Rein et al. 2006, *The Economic Burden of Major Adult Visual Disorders in the United States*

- The average cost in 2004 per age-related macular degeneration (AMD) patient age 40 to 64 using outpatient services was \$305. The average cost per patient 65 years and older was \$272.

Rein et al. 2006, *The Economic Burden of Major Adult Visual Disorders in the United States*

- The average cost in 2004 per age-related macular degeneration (AMD) patient age 40 to 64 using medications and vitamins was \$110. The average cost per patient 65 years and older was also \$110.

Rein et al. 2006, *The Economic Burden of Major Adult Visual Disorders in the United States*

Diabetic Retinopathy

Note that the new generation of FDA-approved ophthalmic drugs to treat AMD are currently in clinical trials for diabetic retinopathy. Studies quantifying the cost of these new treatments, as well as the value of their concomitant benefits—both of which are potentially significant—had yet to be published at the time of press for *The Silver Book: Vision Loss*.

- The annual direct medical costs (including outpatient, inpatient, and prescription drug services) for Americans age 40 and older with diabetic retinopathy is \$490 million.

Rein et al. 2006, *The Economic Burden of Major Adult Visual Disorders in the United States*

- The average cost in 2004 per diabetic retinopathy patient age 40 to 64 using outpatient services was \$629. The average cost per patient 65 years and older was \$463.

Rein et al. 2006, *The Economic Burden of Major Adult Visual Disorders in the United States*



Glaucoma

- The annual direct medical costs (including outpatient, inpatient, and prescription drug services) for Americans age 40 and older with glaucoma is \$2.86 billion.

Rein et al. 2006, *The Economic Burden of Major Adult Visual Disorders in the United States*

- The average cost in 2004 per glaucoma patient age 40 to 64 using outpatient services was \$276. The average cost per patient 54 years and older was \$254.

Rein et al. 2006, *The Economic Burden of Major Adult Visual Disorders in the United States*

- The average cost in 2004 per glaucoma patient age 40 to 64 using inpatient services was \$2,270. The average cost per patient 65 years and older was \$4,929.

Rein et al. 2006, *The Economic Burden of Major Adult Visual Disorders in the United States*

- The average cost in 2004 per glaucoma patient age 40 to 64 using medications and vitamins was \$806.

Rein et al. 2006, *The Economic Burden of Major Adult Visual Disorders in the United States*

- The average direct cost of glaucoma treatment ranges from \$623 per year for patients with early-stage glaucoma, to \$2,511 per year for end-stage patients. Medication costs make up the largest proportion of the total direct costs for all stages of the disease.

Lee et al. 2006, *A Multicenter, Retrospective Pilot Study of Resource Use and Costs Associated with Severity of Disease in Glaucoma*

The Future Cost of Vision Loss

Vision Loss

- Currently an estimated 38 million Americans suffer from blindness, low vision, or an age-related eye disease. That number is expected to grow to around 50 million by 2020.

Eye Disease Prevalence Research Group 2004, *Blindness*

- By 2020, the number of Americans age 40 and older who are blind or have low vision is projected to reach 5.5 million—growing from 3.3 million in 2004.

Congdon et al. 2004, *Causes and Prevalence of Visual Impairment Among Adults in the United States*

- By 2020, the number of Americans age 40 and older with low vision is projected to reach 3.9 million—growing from 2.4 million in 2004.

Congdon et al. 2004, *Causes and Prevalence of Visual Impairment Among Adults in the United States*

- By 2020, the number of Americans age 40 and older who are blind is projected to reach 1.6 million—growing 70% from 1 million in 2004.

Congdon et al. 2004, *Causes and Prevalence of Visual Impairment Among Adults in the United States*

Age-Related Macular Degeneration

- An estimated 1.75 million Americans currently have age-related macular degeneration (AMD). That number is expected to grow to 2.95 million by 2020.*

Friedman et al. 2004, *Prevalence of Age-Related Macular Degeneration in the United States*

*Note that an additional 7.3 million currently at substantial risk for AMD are not included in these projections.

- The cost of age-related macular degeneration (AMD) is projected to increase to \$845 million per year over the next 15 years, simply due to the growth in the number of older Americans.*

Rein et al. 2006, *The Economic Burden of Major Adult Visual Disorders in the United States*

*See note in AMD section on pg. 13 for qualifications to these data.

Diabetic Retinopathy

- An estimated 4.1 million Americans currently have diabetic retinopathy. That number is expected to grow to 7.2 million by 2020.

Kempen et al. 2004, *The Prevalence of Diabetic Retinopathy Among Adults in the United States*

Glaucoma

- An estimated 2.2 million Americans 40 and older currently have glaucoma. That number is expected to grow by 50% to 3.36 million by 2020.

Friedman et al. 2004, *Prevalence of Open-Angle Glaucoma Among Adults in the United States*



-
-
-
-
-

Investing in Science

Innovative Medical Research

■ **A**s the number and percentage of older Americans grows, the impact of vision loss on society and affected individuals will intensify. In the next 15 years, the number of Americans who are blind, or have low vision or an age-related eye disease could reach 50 million. With the aging of the Baby Boom generation, vision loss and blindness will become more pervasive and will affect an increasing proportion of the U.S. population.

■ The good news is that advances from innovation in medical research are already transforming vision care. New drugs are stabilizing vision loss and restoring vision in individuals with age-related macular degeneration; studies are revealing benefits to those taking carotenoids and other nutritional formulas; laser treatments are reducing blindness in people with diabetic retinopathy; and medications are delaying and preventing vision loss in many glaucoma patients.

Medical innovation has already proven its value in reducing the impact of vision loss on individuals, and in reducing and containing costs. Advances in cataract treatment are a dramatic case in point. Not only is cataract increasingly treatable through out-patient surgery, but new surgical techniques resulted in an estimated \$300 billion in benefits to Americans in 2003 alone.

Improvements in vision care often produce health gains that far outweigh the initial financial investments in research. As we enter a critical time in health care for older Americans, we must be sure to consider both the financial and human impact that medical innovation can have on vision loss. Short-sighted efforts to reduce spending too often target the initial expenses of investing in medical innovation while ignoring remarkable returns on investment.



-
-
-
-
-
-

The Human Value

Age-Related Macular Degeneration

“Retiree Luther W. takes nutritional supplements with the hope of keeping his AMD from progressing. When he’s fishing, he wears sunglasses to block the harmful ultraviolet and blue rays of the sun. ‘When you’re younger and working hard, life goes by in a blur,’ he says. ‘Now, I want to savor every detail.’ Research has led to new treatments to help preserve vision in patients with AMD.”

Research to Prevent Blindness, *Macular Degeneration*

- A new FDA-approved ophthalmic drug that treats wet age-related macular degeneration (AMD)—pegaptanib sodium (Macugen)—reduced vision loss in 70% of clinical trial patients.

Gragoudas et al. 2004, *Pegaptanib for Neovascular Age-Related Macular Degeneration*

- A new FDA-approved ophthalmic drug that treats wet age-related macular degeneration (AMD)—ranibizumab (Lucentis)—maintained vision in 95% of clinical trial participants and improved vision by 15 or more letters in approximately 25% to 34% of trial participants.

Rosenfeld et al. 2006, *Ranibizumab for Neovascular Age-Related Macular Degeneration*

- The NEI-sponsored Age-Related Eye Disease Study (AREDS) found that individuals at high risk of developing advanced stages of age-related macular degeneration (AMD) lowered their risk of disease progression by about 25% when treated with the AREDS nutritional formula (daily, high-dose combination of vitamins C, E, beta-carotene, and zinc).

Age-Related Eye Disease Study Research Group 2001, *AREDS report no. 8*

- A study on the impact of diet on age-related macular degeneration (AMD) found that those who took the highest amounts of carotenoids, such as lutein and zeaxanthin, had a 43% lower risk of age-related macular degeneration than those who took the least amounts.

Seddon et al. 1994, *Dietary Carotenoids, Vitamins A, C, and E, and Advanced Age-Related Macular Degeneration*

Diabetic Retinopathy

“Judith L. didn’t know she had diabetes until signs of diabetic retinopathy were discovered at her annual eye exam. The ophthalmologist referred her back to her regular doctor for treatment of her diabetes and to a retina specialist for laser treatments for her macular edema, to help seal the leaking blood vessels. She’s also begun intraocular steroid injections to improve the results. Judith no longer drives at night and has trouble reading, but says she’s better off than her father who also had diabetic eye problems. ‘I want the next generation to be even luckier,’ she says.”

Research to Prevent Blindness, *Diabetic Retinopathy*

- Laser treatment and vitrectomy reduce blindness in patients with severe diabetic retinopathy by 90%.

National Institutes of Health, *Diabetic Retinopathy*

- Timely treatment and follow-up care can reduce the risk of blindness in individuals with proliferative retinopathy by 95%.

National Eye Institute, *Diabetic Retinopathy*

- Intensive glucose control (3 or more daily insulin injections or continuous subcutaneous insulin infusion) reduced the mean risk of retinopathy by 76% in type 1 diabetes patients who had not developed retinopathy.

Fong et al. 2003, *Diabetic Retinopathy*

- Intensive glucose control (3 or more daily insulin injections or continuous subcutaneous insulin infusion) reduced the mean risk of retinopathy progression by 54% in type 1 diabetes patients with minimal-to-moderate retinopathy.

Fong et al. 2003, *Diabetic Retinopathy*

- After 9 years of tight blood pressure control, patients with type 2 diabetes had a 34% reduction in retinopathy progression and a 47% reduction in risk of visual acuity deterioration by three lines, when they had a 10/5 mmHg reduction in blood pressure.

Turner et al. 1998, *Tight Blood Pressure Control and Risk of Macrovascular and Microvascular Complications in Type 2 Diabetes*



- Screening and treatment for diabetic retinopathy in type 2 diabetes patients produces annual savings of 53,986 person-years of sight.

Javitt et al. 1994, *Preventive Eye Care in People With Diabetes is Cost-Saving to the Federal Government*

- Current treatments for proliferative diabetic retinopathy have reduced the rate of blindness within 5 years from 50% to less than 5%.

National Eye Institute, *Early Treatment Diabetic Retinopathy Study*

Glaucoma

“Five of my nine brothers and sisters had glaucoma,’ says 81-year-old Jean R. who for 20 years has depended on eye drops to decrease pressure inside her eyes. Jean is supporting research for genetic tests for glaucoma. ‘I want my children and grandchildren to know their risk for glaucoma,’ she says, ‘and then be able to prevent it.’ With science advancing in this direction, she could have her wish.”

Research to Prevent Blindness, *Glaucoma*

- The NEI-sponsored Ocular Hypertension Treatment Study (OHTS) found that lowering intraocular pressure (IOP) by at least 20% produced a 50% protective benefit for individuals who had an elevated IOP but no optic disc or visual field deterioration.

Kass et al. 2002, *The Ocular Hypertension Treatment Study*

- Prescription eye drops could delay or prevent half of glaucoma cases in African Americans.

Higginbotham, et al. 2004, *The Ocular Hypertension Treatment Study*

The Economic Value

- Treatments that have been found to delay or prevent diabetic retinopathy save the U.S. \$1.6 billion annually.

National Institutes of Health, *Diabetic Retinopathy*

- The cost-effectiveness of detection and treatment of eye disease in diabetics is \$3,190 per quality adjusted life year (QALY).

Javitt and Aiello 1996, *Cost-Effectiveness of Detecting and Treating Diabetic Retinopathy*

- Screening and treatment of diabetic retinopathy in type 2 diabetes patients produces annual savings of \$247.9 million to the federal budget—in 1994 dollars.

Javitt et al. 1994, *Preventive Eye Care in People With Diabetes is Cost-Saving to the Federal Government*

The Future Value

- Of the 8 million older Americans at high risk of developing advanced age-related macular degeneration (AMD), 1.3 million will develop advanced AMD within 5 years. However, the NEI-sponsored Age-Related Eye Disease Study (AREDS) nutritional formula could help 300,000 of those 1.3 million avoid the severe vision loss of advanced AMD over a 5-year period.

Bressler et al. 2003, *Potential Public Health Impact of Age-Related Eye Disease Study Results*

- Screening and treatment for eye disease in all type 2 diabetes patients would result in an estimated net savings of over \$472.1 million—in 1994 dollars.

Javitt et al. 1994, *Preventive Eye Care in People With Diabetes is Cost-Saving to the Federal Government*

- Screening and treatment for eye disease in all type 2 diabetes patients would result in an estimated net savings of 94,304 person-years of sight.

Javitt et al. 1994, *Preventive Eye Care in People With Diabetes is Cost-Saving to the Federal Government*

- Because the resource use and direct cost of glaucoma treatment and management increases as the disease severity worsens—from an average \$623 per early-stage patient to \$2,511 per late-stage patient—a glaucoma treatment that delays the disease progression could significantly reduce its economic burden.

Lee et al. 2006, *A Multicenter, Retrospective Pilot Study of Resource Use and Costs Associated with Severity of Disease in Glaucoma*



-
-
-
-
-

Conclusion

- **T**he *Silver Book®: Vision Loss* volume outlines the growing burden of vision loss in America and makes a strong case for the value of innovation in reducing that burden. In addition to other important data, this volume captures current economic assessments of the burden of age-related eye disease and vision loss. However, relatively few economic projections or estimates currently address the *future* value or cost of innovations. Additionally, eye and vision health research is advancing with remarkable speed. Even statistics as current as 2004 do not reflect the impact of recent FDA approvals of new drugs for AMD or the same drugs which are being tested against diabetic retinopathy. We challenge health researchers and economists to fill in these gaps in our statistical profile of vision loss. Once the data detailing the cost and benefits of new therapies for vision health are available, they will be included in future pages of *The Silver Book Online*—at www.silverbook.org/visionloss.
- We fully expect *The Silver Book: Vision Loss* to join the original *Silver Book* as an important tool for encouraging policy decisions that invest in medical research and innovation. The U.S. and our ever increasing numbers of older Americans face unprecedented challenges including eye disease and vision loss that will impact some 50 million Americans by 2020.

Sound public policy should strive for cost containment strategies that also provide for high quality health care that is patient-centered, values driven, knowledge intense, innovation rich, and prevention oriented. We must seriously consider how our long-range plans for research aim for ultimate reduction of both the economic and human burdens imposed by vision loss. Historically, investments that produce new medical innovations have paid for themselves many times over through decreased medical expenses and increased productivity. Medical innovation will be essential to containing the costs of health care as the Baby Boom generation ages. Research and discovery, properly applied to health care and prevention, will be needed to avoid an unacceptable toll due to eye disease and vision loss.

References

Aflac. 2005. *Aflac Survey Reveals Disparities in Americans' Perceptions of Vision Health*. www.aflac.com/us/en/aboutaflac/PressReleaseStory.aspx?rid=717509.

Age-Related Eye Disease Study Research Group. 2001. A Randomized, Placebo-Controlled, Clinical Trial of High-Dose Supplementation with Vitamins C and E, Beta Carotene, and Zinc for Age-Related Macular Degeneration and Vision Loss: AREDS report no. 8. *Arch Ophthalmol* 119(10):1417-36.

The AGIS Investigators. 2001. The Advanced Glaucoma Intervention Study, 9: Risk of cataract formation after trabeculectomy. *Arch Ophthalmol* 119(12):1771-9.

American Foundation for the Blind. *Aging and Vision Loss Fact Sheet*. www.afb.org/seniorsite.asp?SectionID=68&TopicID=320&DocumentID=3374.

American Foundation for the Blind. *Blindness Statistics*. www.afb.org/Section.asp?SectionID=15.

Bass, Eric B., Marta J. Marsh, Carol M. Mangione, Neil M. Bressler, Ashley L. Childs, Li Ming Dong, Barbara S. Hawkins, Harris A. Jaffee, and Paiva H. Miskala; for the Submacular Surgery Trials Research Group. 2004. Patients' Perceptions of the Value of Current Vision: Assessment of preference values among patients with subfoveal choroidal neovascularization—The Submacular Surgery Trials Vision Preference Value Scale: SST report no. 6. *Arch Ophthalmol* 122(12):1856-67.

Bressler, Neil M., Susan B. Bressler, Nathan G. Congdon, Frederick L. Ferris III, David S. Friedman, Ronald Klein, Anne S. Lindblad, Roy C. Milton, and Johanna M. Seddon; for the Age-Related Eye Disease Study (AREDS) Research Group. 2003. Potential Public Health Impact of Age-Related Eye Disease Study Results: AREDS report no. 11. *Arch Ophthalmol* 121(11):1621-4.

Centers for Disease Control and Prevention. 2006. *Health: United States, 2006: With chartbook on trends in the health of Americans*. Atlanta: GA. Centers for Disease Control and Prevention.

Clemons, Traci E., Molly W. Rankin, and Wendy L. McBee; for the Age-Related Eye Disease Study (AREDS) Research Group. 2006. Cognitive Impairment in the Age-Related Eye Disease Study: AREDS report no. 16. *Arch Ophthalmol* 124(4):537-43.

Congdon, Nathan G., Benita J. O'Colmain, Caroline C.W. Klaver, Ronald Klein, Beatriz Muñoz, David S. Friedman, John Kempen, Hugh R. Taylor, Paul Mitchell, and Leslie Hyman; for the Eye Disease Prevalence Research Group. 2004. Causes and Prevalence of Visual Impairment Among Adults in the United States. *Arch Ophthalmol* 122(4):477-85.

Eye Disease Prevalence Research Group. 2004. Blindness. *Arch Ophthalmol* 122(4):437-676.

Fong, Donald S., Lloyd Aiello, Thomas W. Gardner, George L. King, George Blankenship, Jerry D. Cavallerano, Frederick L. Ferris, and Ronald Klein; for the American Diabetes Association. 2004. Retinopathy in Diabetes. *Diabetes Care* 27:S84-7.

Fong, Donald S., Lloyd Aiello, Thomas W. Gardner, George L. King, George Blankenship, Jerry D. Cavallerano, Frederick L. Ferris, and Ronald Klein. 2003. Diabetic Retinopathy. *Diabetes Care* 26:S99-102.

Frick, Kevin D., Emily W. Gower, John H. Kempen, and Jennifer L. Wolff. 2007. Economic Impact of Visual Impairment and Blindness in the United States. *Arch Ophthalmol* 125(4):544-50.

Friedman, David S., Benita J. O'Colmain, Beatriz Muñoz, Sandra C. Tomany, Catherine A. McCarty, Paulus T.V.M. de John, Barbara Nemesure, Paul Mitchell, John Kempen, and Nathan G. Congdon; for the Eye Disease Prevalence Research Group. 2004. Prevalence of Age-Related Macular Degeneration in the United States. *Arch Ophthalmol* 122(4):564-72.

Friedman, David S., Nathan G. Congdon, John Kempen, and James M. Tielsch. 2002. *Vision Problems in the U.S.: Prevalence of adult vision impairment and age-related eye disease in America*. Chicago, IL: Prevent Blindness America.

Friedman, David S., Roger C.W. Wolfs, Benita J. O'Colmain, Barbara E. Klein, Hugh R. Taylor, Sheila West, M. Cristina Leske, Paul Mitchell, Nathan G. Congdon, and John Kempen; for the Eye Disease Prevalence Research Group. 2004. Prevalence of Open-Angle Glaucoma Among Adults in the United States. *Arch Ophthalmol* 122(4):532-8.

Glaucoma Research Foundation. Glaucoma Facts and Stats. www.glaucoma.org/learn/glaucoma_facts.html.

Gragoudas, Evangelos S., Anthony P. Adamis, Emmett T. Cunningham, Matthew Feinsod, David R. Guyer; for the VEGF Inhibition Study in Ocular Neovascularization Clinical Trial Group. Pegaptanib for Neovascular Age-Related Macular Degeneration. 2004. *NEJM* 351(27):2805-16.

Haymes, Sharon A., Raymond P. LeBlanc, Marcelo T. Nicolela, Lorraine A. Chiasson, and Balwantray C. Chauhan. 2007. Risk of Falls and Motor Vehicle Collisions in Glaucoma. *IOVS* 48(3):1149-55.

Higginbotham, Eve J., Mae O. Gordon, Julie A. Beiser, Michael V. Drake, G. Richard Bennett, M. Roy Wilson, and Michael A. Kass; for the Ocular Hypertension Treatment Study Group. 2004. The Ocular Hypertension Treatment Study: Topical medication delays or prevents primary open-angle glaucoma in African American individuals. *Arch Ophthalmol* 122(6):813-20.

Horowitz, Amy, Joann P. Reinhardt, and Gary J. Kennedy. 2005. Major and Subthreshold Depression Among Older Adults Seeking Vision Rehabilitation Services. *Am J Geriatric Psychiatry* 13(3):180-7.

Javitt, Jonathan C. and Lloyd Paul Aiello. 1996. Cost-Effectiveness of Detecting and Treating Diabetic Retinopathy. *Annals of Internal Medicine* 124(1):164-9.

Javitt, Jonathan C., Lloyd Paul Aiello, Yen-Pin Chiang, Frederick L. Ferris, J.K. Canner, and S. Greenfield. 1994. Preventive Eye Care in People With Diabetes is Cost-Saving to the Federal Government: Implications for health care reform. *Diabetes Care* 17(8):909-17.

Javitt, Jonathan C., Zhiyuan Zhou, and Richard J. Wilke. 2007. Association Between Vision Loss and Higher Medical Care Costs in Medicare Beneficiaries: Costs are greater for those with progressive vision loss. *Ophthalmol* 114(2):238-45.

Kass, Michael A., Dale K. Heuer, Eve J. Higginbotham, Chris A. Johnson, John L. Keltner, J. Philip Miller, Richard K. Parrish, M. Roy Wilson, Mae O. Gordon; for the Ocular Hypertension Treatment Study Group. 2002. The Ocular Hypertension Treatment Study: A randomized trial determines that topical ocular hypotensive medication delays or prevents the onset of primary open-angle glaucoma. *Arch Ophthalmol* 120(6):701-13.

Kempen, John H., Benita J. O'Colmain, M. Cristina Leske, Steven M. Haffner, Ronald Klein, Scott E. Moss, Hugh R. Taylor, Richard F. Hamman; for the Eye Disease Prevalence Research Group. 2004. The Prevalence of Diabetic Retinopathy Among Adults in the United States. *Arch Ophthalmol* 122(4):552-63.

Lee, Paul P., John G. Walt, John L. Doyle, Sameer V. Kotak, Stacy J. Evans, Donald L. Budenz, Philip P. Chen, Anne L. Coleman, Robert M. Feldman, Henry D. Jampel, L. Jay Katz, Richard P. Mills, Jonathan S. Myers, Robert J. Noecker, Jody R. Piltz-Seymour, Robert R. Ritch, Paul N. Schacknow, Janet B. Serle, and Gary L. Trick. 2006. A Multicenter, Retrospective Pilot Study of Resource Use and Costs Associated with Severity of Disease in Glaucoma. *Arch Ophthalmol* 124(1):12-9.

Lee, Paul P., Zachary W. Feldman, Jan Ostermann, Derek S. Brown, and Frank A. Sloan. 2003. Longitudinal Prevalence of Major Eye Diseases. *Arch Ophthalmol* 121(9):1303-10.

Lott, Lori A., Gunilla Haegerstrom-Portney, Marilyn E. Schneck, and John A. Brabyn. 2005. Face Recognition in the Elderly. *Optom Vis Sci* 82(10):874-81.

McCarty, Catherine A., Mukesh B. Nanjan, and Hugh R. Taylor. 2001. Vision Impairment Predicts 5 Year Mortality. *Br J Ophthalmol* 85:322-6.

Mitchell, Jan and Clare Bradley. 2006. *Quality of Life in Age-Related Macular Degeneration: A review of the literature*. Royal Holloway: University of London.

National Alliance for Eye and Vision Research (NAEVR). 2005. *The National Eye Institute (NEI) Responds to the Growing Public Health Problem of Age-Related Eye Disease*. www.eyeresearch.org/eye_fact_center.html.

National Alliance for Eye and Vision Research (NAEVR). *Vision Impairment and Eye Disease is a Major Public Health Problem*. www.eyeresearch.org/resources/Vision_Impairment_factsheet.html.

National Eye Institute. 2006. *Progress in Eye and Vision Research: 1999-2006*. Washington, D.C.: U.S. Department of Health and Human Services.

National Eye Institute. 2003. *Updating the Hu 1981 Estimates of the Economic Costs of Visual Disorders and Disabilities*. www.nei.nih.gov/eyedata/hu_estimates.asp.

National Eye Institute. *Age-Related Macular Degeneration*. www.nei.nih.gov/health/maculardegen/armd_facts.asp#2b.

National Eye Institute. *Diabetic Retinopathy*. www.nei.nih.gov/health/diabetic/retinopathy/asp.

National Eye Institute. *Early Treatment Diabetic Retinopathy Study*. www.nei.nih.gov/neitrials/viewStudyWeb.aspx?id=53.

National Institutes of Health. *Diabetic Retinopathy: Fact sheet*. www.nih.gov/about/researchresultsforthepublic/index.htm.

Prevent Blindness America. 2007. *The Economic Impact of Vision Problems: The toll of major adult eye disorders, visual impairment and blindness on the U.S. economy*. Chicago, IL: Prevent Blindness America.

Prevent Blindness America. *The Glaucoma Learning Center*. www.preventblindness.org/glaucoma/glaucoma_who.htm.

Ramrattan, Raan, Roger C.W. Wolfs, Songhomitra Panda-Jonas, Jost B. Jonas, Douwe Bakker, Huibert A. Pols, Albert Hofman, and Paulus T.V.M. de Jong. 2001. Prevalence and Causes of Visual Field Loss in the Elderly and Associations with Impairment in Daily Functioning. *Arch Ophthalmol* 119(12):1788-94.

Rein, David B., Ping Zhang, Kathleen E. Wirth, Paul P. Lee, Thomas J. Hoerger, Nancy McCall, Ronald Klein, James M. Tielsch, Sandeep Vijan, and Jinan Saaddine. 2006. The Economic Burden of Major Adult Visual Disorders in the United States. *Arch Ophthalmol* 124(12):1754-60.

Research to Prevent Blindness. *Diabetic Retinopathy*. www.rpbusa.org/dr.php.

Research to Prevent Blindness. *Glaucoma*. www.rpbusa.org/glaucoma.php.

Research to Prevent Blindness. *Macular Degeneration*. www.rpbusa.org/amd.php.

Rosenfeld, Philip J., David M. Brown, Jeffrey S. Heier, David S. Boyer, Peter K. Kaiser, Carol Y. Chung, Robert Y. Kim; for the MARINA Study Group. 2006. Ranibizumab for Neovascular Age-Related Macular Degeneration. *NEJM* 355(14):1419-31.

Seddon, Johanna M., Umed A. Ajani, Robert D. Sperduto, Rita Hiller, Norman Blair, Thomas C. Burton, Marilyn D. Farber, Evangelos S. Gragoudas, Julia Haller, Dayton D. Miller, et al. 1994. Dietary Carotenoids, Vitamins A, C, and E, and Advanced Age-Related Macular Degeneration. Eye Disease Case-Control Study Group. *JAMA* 272(18):1413-20.

Sims, Richard V., Gerald McGwin, Richard M. Allman, Karlene Ball, and Cynthia Owsley. 2000. Exploratory Study of Incident Vehicle Crashes Among Older Drivers. *J Gerontology* 55(1):M22-7.

Turner, Robert, Rury Holman, Irene Stratton, Carole Cull, Valeria Frighi, Susan Manley, David Matthews, Andrew Neil, Heather McElroy, Eva Kohner, Charles Fox, David Hadden, and David Wright; for the UK Prospective Diabetes Study Group. 1998. Tight Blood Pressure Control and Risk of Macrovascular and Microvascular Complications in Type 2 Diabetes: UKPDS 28. *BMJ* 317(7160):703-13.



Varma, Rohit, Mei Ying-Lai, Brian A. Francis, Betsy Bao-Thu Nguyen, Jennifer Deneen, M. Roy Wilson, and Stanley P. Azen. 2004. Prevalence of Open-Angle Glaucoma and Ocular Hypertension in Latinos: The Los Angeles Latino Eye Study. *Ophthalmol* 11(8):1439-48.



Varma, Rohit, Mina Torres, Fernando Peña, Ronald Klein, and Stanley P. Azen. 2004. Prevalence of Diabetic Retinopathy in Adult Latinos: The Los Angeles Latino Eye Study. *Ophthalmol* 111(7):1298-1306.



Vision Loss Resources. *Frequently Asked Questions*. www.visionlossresources.com/index.asp?Type=B_LIST&SEC={2074C6EE-BD47-45DB-A139-635C2513806A}.



Williams, Rebecca A., Barbara L. Brody, Ronald G. Thomas, Robert M. Kaplan, and Stuart I. Brown. 1998. The Psychosocial Impact of Macular Degeneration. *Arch Ophthalmol* 116(4):514-20.

Wong, Tien Tin, Ronald Klein, Cong Sun, Paul Mitchell, David J. Couper, Hong Lai, Larry D. Hubbard, A. Richey Sharrett; for the Artherosclerosis Risk in Communities Study. 2006. Age-Related Macular Degeneration and Risk for Stroke. *Annals of Internal Medicine* 145(2):98-106.

■ Facts in silver font deal specifically with older Americans.



Advancing Science. Enhancing Lives.

2021 K Street , NW, Suite 305
Washington, DC 20006
T 202.293.2856
F 202.785.8574

www.agingresearch.org



Acknowledgements:

The Alliance extends its thanks to the following experts for reviewing *The Silver Book®: Vision Loss*:

- **Anthony J. Adams, OD, PhD**, Professor & Dean Emeritus, University of California, Berkeley, School of Optometry; Editor-in-Chief, *Optometry & Vision Science*
- **Kevin D. Frick, PhD**, Associate Professor, Johns Hopkins Bloomberg School of Public Health
- **Paul L. Kaufman, MD**, Peter A. Duehr Professor and Chair, Department of Ophthalmology & Visual Sciences, University of Wisconsin School of Medicine and Public Health, Madison, Wisconsin

This volume of *The Silver Book®* was produced in partnership with



NAEVR
National Alliance For
Eye And Vision Research

Serving as Friends of the National Eye Institute