

THE FOUR MAJOR EYE DISEASES



NORMAL VISION



AGE-RELATED MACULAR DEGENERATION (AMD)



GLAUCOMA



Diabetic Macular Edema/
Diabetic Retinopathy



CATARACTS

Image Source: NEI

EYE FACTS

- Destroys central vision through proliferation of new blood vessels (“wet” AMD) or gradual breakdown of cells (“dry” AMD) in the central part of the retina called the macula, making it increasingly difficult to read, drive, and perform other everyday tasks.
- Leading cause of vision loss overall, as well as the leading cause in Americans age 60-plus. Affects 10 million Americans age 40-plus (both intermediate and advanced-stage disease). Each year, more than 200,000 additional Americans are at increased risk for progression to advanced-stage AMD. More than one-in-ten White Americans age 80-plus has vision loss from AMD in this fastest growing segment of the population.
- In 2010, AMD affected more than 30 million people worldwide at a cost of \$343 billion. Altogether, these individuals were deprived of an estimated six million years of healthy life.
- One-third of AMD patients experience clinical depression.

- Glaucoma is a group of complex neurological diseases that damages the optic nerve, causing loss of peripheral vision. In its most common form—primary open angle glaucoma (POAG)—nerve damage results from an increase in intraocular pressure (IOP), which occurs when the fluid that circulates in and out of the front part of the eye drains too slowly.
- Affects more than 2.7 million Americans age 40-plus, and projected to rise to 4.3 million by 2030. This includes both diagnosed and undiagnosed glaucoma. Often, individuals do not know they have the disease since it is painless, initially affecting peripheral vision and progressing slowly, affecting central vision, and leading to irreversible blindness.
- The prevalence of glaucoma is three-to-four times higher in African Americans than in non-Hispanic Whites. Additionally, the risk of visual impairment is higher and the age of onset is earlier than for Whites.
- The leading cause of blindness in the Latino population age 65-plus.

- In diabetic macular edema, blood vessels in the light-sensitive back of the eye called the retina leak and cause swelling, primarily within the retina’s center called the macula, necessary for central vision. In diabetic retinopathy, closure of normal retinal capillaries leads to the production of substances that cause new blood vessels to grow and bleed or detach the retina off the back wall of the eye.
- Primary cause of vision loss and blindness in the industrialized world among individuals age 25-74, the “working age” population.
- Affects more than 7 million Americans, or almost one-third of individuals age 40-plus with diabetes.
- Second leading cause of low vision and blindness in adult Latinos.

- Clouding of the natural lens blurs field of vision, making everyday activities difficult to perform. The single largest risk factor is age, although it can result from genetic factors or environmental stresses.
- In the U.S., cataract affects 24 million individuals age 40-plus and more than fifty percent of people age 80.
- Leading cause of blindness in the world, though highly treatable by extracting the natural lens and replacing it with an intraocular lens.
- Together with glaucoma, the leading cause of vision loss among African Americans.

IMPACT OF NEI RESEARCH

- Identification of subtle alterations in several genes in the body’s Complement Pathway that affect the risk of developing AMD. Complement Factors function as part of the immune system and normally respond to pathogens to fight infection. These gene variations may contribute to an abnormal inflammatory response in AMD.
- NEI’s International AMD Gene Consortium discovered seven new regions of the human genome—called loci—associated with increased risk of AMD, and confirmed 12 others from previous studies. All 19 loci account for 10-30 percent of the disease risk in AMD.
- Research increasingly suggests that AMD is likely multiple diseases with substantial overlap and that co-segregates with other major systemic diseases.
- Development of the first generation of anti-angiogenic ophthalmic drugs to inhibit abnormal blood vessel growth in “wet” AMD, stabilizing vision loss and, in some cases, improving lost vision.
- The *Age-Related Eye Disease Study (AREDS)* demonstrated that daily high doses of vitamins C and E, beta-carotene, and minerals zinc and copper reduced the risk of progression to advanced AMD by 25 percent. Data from a follow-up study, *AREDS2*, suggest that replacing beta-carotene with lutein and zeaxanthin may produce a safer, more effective formulation.

- The *Ocular Hypertension Treatment Study (OHTS)* reported that pressure-reducing eye drops delayed disease onset and that certain characteristics such as age, African descent, high IOP, the anatomy of the optic nerve, and thinness of the cornea offer prognostic indicators to disease development.
- The *African Descent and Glaucoma Evaluation Study (ADAGES)* seeks to explain the differences in glaucoma onset/rate of progression between individuals of African and European descent and to establish baseline measures of optic nerve function and anatomy for these two groups that will help improve screening and treatment strategies.
- NEI’s Glaucoma Human Genetics Collaboration (NEIGHBOR) has identified the first risk variant in a gene thought to play a role in the development of the optic nerve head.
- Mutations in the myocilin gene have been found in up to four percent of people with adult-onset glaucoma and ten percent with juvenile-onset glaucoma. A recent NEI study suggests this gene may be needed in myelin, a material that insulates and protects nerve fibers. It is possible that an abnormal myelin sheath could make the optic nerve susceptible to damage, leading to glaucoma.

- Three NEI-sponsored Diabetic Retinopathy Clinical Trials Networks held over 20 years determined the best treatment strategies through diabetes control and laser photocoagulation. The current Diabetic Retinopathy Clinical Research (DRCR) Network confirmed that laser treatment for diabetic macular edema, when combined with anti-angiogenic drug therapy, is more effective than laser treatment alone, the latter of which has been the standard of care for the past 25 years.
- In the *Los Angeles Latino Eye Study (LALES)*, one-in-five individuals with diabetes was newly diagnosed during the study’s clinical exam, and 25 percent of those were found to have diabetic retinopathy
- Of the first generation of anti-angiogenic ophthalmic drugs to inhibit abnormal blood vessel growth in “wet” AMD, Lucentis has been FDA-approved for treatment of diabetic macular edema. Other drugs are currently undergoing regulatory review.

- To-date, researchers have identified more than 200 genes contributing to many different forms of cataract, providing insights into molecular pathways essential for lens transparency.
- By studying cellular mechanisms, the NEI has identified proteins that help prevent the lens from clouding, which could form the basis of new therapies to delay cataract formation.
- Studies of aquaporin zero (AQPO), a water permeable channel needed for lens transparency, have revealed how it opens and closes to control water flow. This may be a step toward drugs for cataract prevention.
- Research has demonstrated an association between smoking and cataract formation, as well as a delay in cataract formation through protection from ultraviolet ray exposure

RESEARCHER PERSPECTIVES



“The personal costs of AMD for all those afflicted are, quite simply, unacceptable. After years of hard work and dedication by many, we now have an unprecedented understanding of the clinical, biological, and pathological foundations of this devastating disease. This knowledge is paving the way for a new era in the development of effective diagnostics and treatments.”

Gregory Hageman, Ph.D.
(University of Utah Moran Eye Center)



“Research has increasingly revealed glaucoma to be a complex neurodegenerative disease in which detectable structural and functional changes may not progress linearly or in concert, with damage detected and characterized primarily by observable structural change for early-stage disease, by both structural and functional change for middle-stage disease, and primarily by measurable functional change for end-stage disease.”

Anne Coleman, M.D., Ph.D. (University of California -Los Angeles Jules Stein Eye Institute)



“Compared to non-Hispanic Whites, U.S. Latinos are more likely to develop diabetic retinopathy. Over a four-year period, one out of every three Latinos who have diabetes develops diabetic retinopathy. Furthermore, one out of every three Latinos who have diabetic retinopathy shows a worsening over a four year period. This highlights the need for regular eye examinations in Latinos—only one out of every two Latinos with diabetes receives regular eye exams.”

Rohit Varma, M.D., M.P.H.
(University of Illinois at Chicago Eye and Ear Infirmary)



“If we understand and can delay the clouding of the natural lens, we could save millions of dollars in healthcare costs, especially with the aging of the population. Our goal is to help seniors live the best quality of life possible.”

Marjorie Lou, Ph.D.
(University of Nebraska-Lincoln)