THE FUTURE OF VISION

Forecasting the Prevalence And Costs of Vision Problems

JUNE 11, 2014

PRESENTED TO:
Prevent Blindness

PRESENTED BY:
John Wittenborn
David Rein
NORC at the
University of Chicago
55 East Monroe Street
30th Floor
Chicago, IL 60603
(312) 759-4000
(312) 759-4004

NORC at the UNIVERSITY of CHICAGO

Contents

Tables

Figures

1. Introduction

"What can we do to help reduce the toll of vision problems?"

This is the essential question facing patients and their families and caregivers, healthcare professionals, researchers and policymakers involved in eye and visual health. But before we can begin to properly address this question, we must understand 1) where we currently stand in terms of vision problems facing the U.S., 2) the impacts and costs incurred by these vision problems, and 3) where we are headed in the future if nothing is done.

In 2012, the release of "Vision Problems in the U.S.: Prevalence of Adult Vision Impairment and Age-Related Eye Disease in America" helped answer the first question by producing a comprehensive accounting of the current scale of vision problems among the 2010 U.S. population.[1] In 2013, with the release of "The Cost of Vision Problems: The Economic Burden of Vision Loss and Eye Disorders in the United States", we knew for the first time the full cost and quality of life impacts of these vision problems across the entire U.S. population and economy.[2] In this report, "The Future of Vision: Forecasting the Prevalence and Costs of Vision Problems", we build on the knowledge gained through the preceding two reports on the prevalence and costs of vision problems and forecast how their impacts may change and grow in the coming years.

Forecasting the Prevalence and Costs of Vision Problems

In this analysis, we use a prevalence-based approach to generate projections of the future prevalence and costs of vision problems based on the US Census Bureau's national population projections from the year 2014 to 2050. Prevalence projections are based on current per-person prevalence rates from "Vision Problems in the US". Cost projections are based on current per-person cost estimates from "The Costs of Vision Problems" and projected changes in inflation, medical costs, wage growth, healthcare access and utilization, and medical intensity. This report details the data, methods and results of this analysis, and shows the potential impacts of projected changes and trends in visual health, costs and the population.

Important Trends in Visual Health

These projections starkly illustrate the potential impacts of looming changes to the landscape of visual health driven largely through demographic shifts that will occur in the coming decades. The most critical aspect is the aging of the baby-boomer generation. Currently, the leading edge of this generation is aging into the Medicare program, while simultaneously beginning to reach the ages at which the incidence rates of many vision problems quickly escalates. By the year 2032, the baby-boomer population will have almost fully moved into the Medicare ranks and the rapid growth of the population from ages 65 to the mid 80's will cause dramatic increases in the prevalence and costs of vision problems. In the following decades, the confluence of the aging baby-boomers' numbers and increased longevity will drive spectacular growth in the elderly population, which will lead to the age group of persons 90 and older exhibiting by far the highest rates of growth in the prevalence of vision problems and costs of any age group.

In addition to the aging of the baby-boomers, the coming decades will see transformational shifts in the racial composition of the US population, as the population of non-Hispanic whites actually will decrease while the population of minority groups will grow at high rates, none more so than Hispanics, whose population will double by 2050. This demographic shift will be evident in visual health as the prevalence and costs of vision problems will shift towards conditions more prevalent among minorities, particularly glaucoma and diabetic retinopathy.

Major Results

Vision Loss Prevalence:

We estimate that the current population with vision loss includes nearly 3.1 million impaired and almost 1.4 million blind in 2014. We project these populations will grow substantially in the future; by 2032 we estimate that the visually impaired population aged 40 and older will increase by 66% to nearly 5.1 million and the blind population will increase 59% to 2.2 million. By 2050, the impaired and blind populations are projected to reach 7.3 million (2.4 times higher than in 2014) and 3.1 million (2.3 times higher than in 2014), respectively. The number of impaired or blind among the population aged 90 and older is forecast to increase nearly 3.5 fold by 2050.

Eye Disease Prevalence:

We estimate that in the year 2014, 25.7 million Americans currently have cataracts, 8.1 million live with diabetic retinopathy, 2.9 million have glaucoma and 2.2 million suffer from advanced stages of age related macular degeneration (AMD). We project that the total number of cases of these four diseases will increase by 50% by 2032. By 2050, the number of Americans with advanced-stage AMD will double to 4.4 million, glaucoma prevalence will increase 93% to 5.5 million, cataract will grow by 78% to 45.6 million, and the prevalence of diabetic retinopathy will increase by 63% to 13.2 million.

Cost of Vision Problems:

The growth and shifts in vision loss and eye disease prevalence will be evident in their resulting costs, with real costs expressed in constant 2014 dollars expected to grow from $145 billion in 2014 to $247 billion in 2032, and reach $376 billion by 2050. Nominal expenditures, which include the impacts of inflation and represent actual dollars spent per year, will reach $385 billion by 2032 and $717 by 2050.

As with disease prevalence, the costs of vision problems are also forecast to shift to older ages. By 2032, with the baby-boomer population reaching Medicare, the costs for those aged 65-89 are projected to increase by 111% while costs for those aged 90 and older are projected to grow by 85%. From 2032 to 2050, as the baby-boomers age into the oldest age groups, the rate of cost growth among those aged 65-89 is projected to slow, yielding a 37% increase in costs. However, from 2032-2050 the costs among those aged 90 and older is projected to increase by 163%. In total, costs among persons aged 90 and older are projected to increase nearly 5-fold from 2014 to 2050, costs among those aged 65-89 will nearly triple, while costs for persons younger than 65 will increase by 60%.

Forecasts do not show us the future, they show us where we are headed

In forecasting, we are essentially trying to predict a future by looking at the past. However, assuming that any forecast can truly predict the future is a fallacy, as the future is inherently unpredictable. What forecasts can do however is show the direction we are likely headed based on what we know of our current position and recent trends. In the Future of Vision, we integrate information on the current epidemiology and costs of vision problems with emerging population patterns to show how the complex interaction of these trends will drive future growth in vision problem prevalence and costs. While these projections cannot tell us exactly what will happen in the future, they can be used to help identify important trends and areas of need that will likely arise in the future, and together with "Vision Problems in the US" and the "Cost of Vision Problems", these forecasts can help guide the discussion about "w*hat can we do to help reduce the toll of vision problems*".

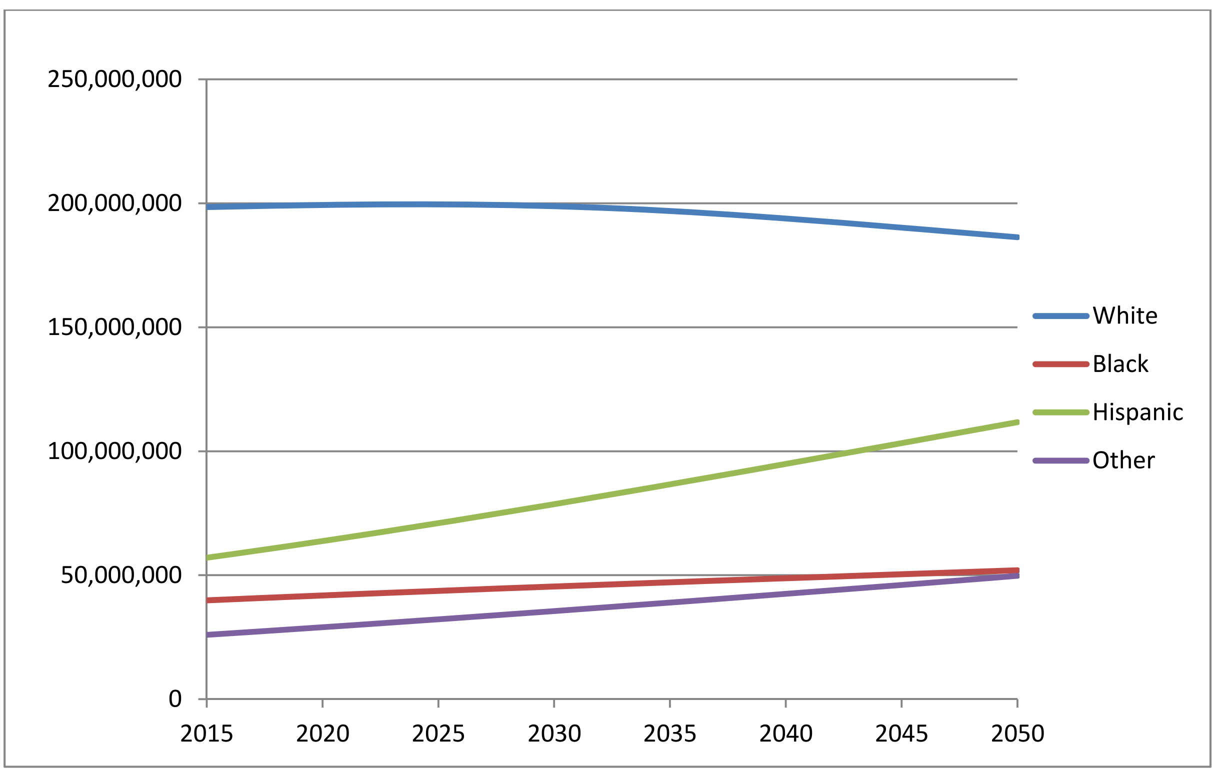
2. Population Projections

Population projections are based on the U.S. Census Bureau's 2012 National Population Projection files.[3] The 2014 US population projection is 318.9 million persons. This is projected to grow to 363 million by 2032 and 400 million by the year 2050. As the population grows, the components of the population are expected to shift.

2.1 Projected Population, by Race

We include four race/ethnicity groups; white alone, black alone, Hispanic of any race, and all others as shown in **Figure 2.1**. The population of white alone is expected to decrease, while the population of minorities will increase until the total minority population exceeds that of whites by 2042, spearheaded by the near doubling of the Hispanic population. This shift in the racial composition of the population will lead to changes in the relative prevalence of eye diseases towards those that disproportionately affect minorities.

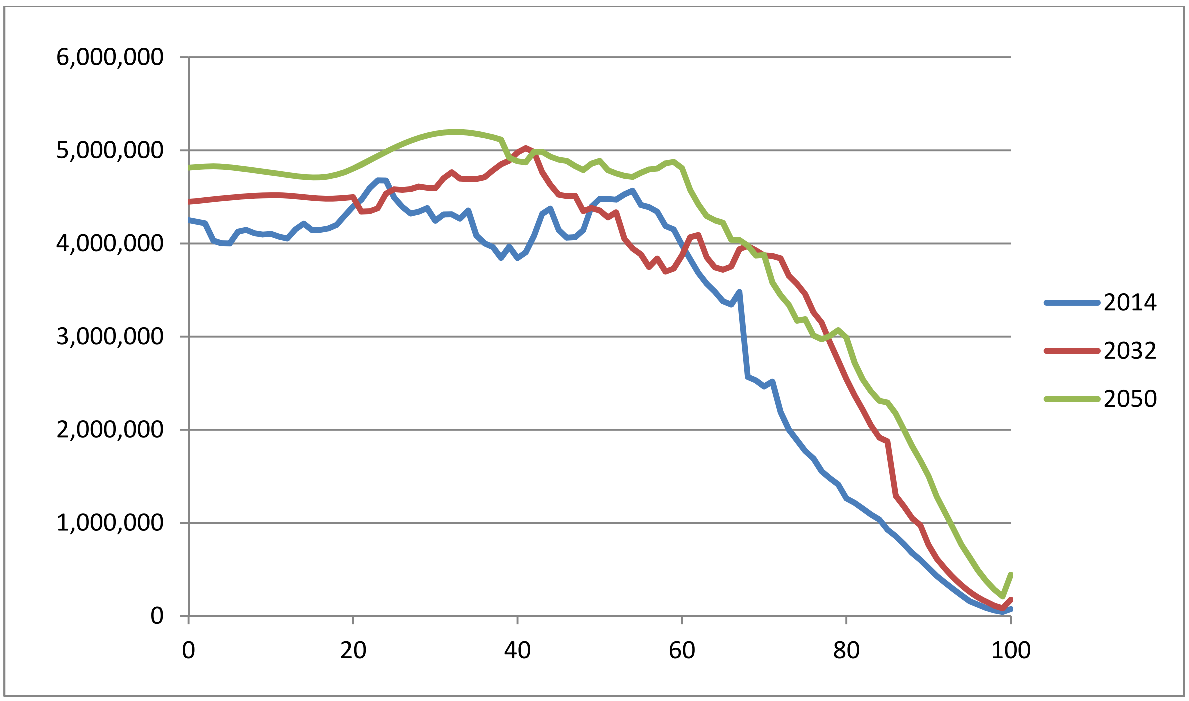
Figure 2.1. Projected Population, by Race



2.2 Projected Population, by Age

The population will also change in terms of the distribution of age. The aging of the baby boomers will have a major impact on the prevalence and costs of vision and eye disorders in the coming decades as they move into the Medicare program and age through their 60's, 70's and 80's. **Figure 2.2** shows the age distribution of the US population in 2014, 2032 and 2050. In 2014, the baby-boomer bulge is clearly visible from about ages 50 to 70. By 2032, this bulge has shifted right to ages 68-88 and is entirely in the Medicare eligible age range. By 2050, the overall population is visibly higher, but most pronounced is the increase in the population older than the mid 80's. The group of those aged 90 and older is projected to be by far the fastest growing population segment, with their population more than tripling due to both the aging baby-boomers and increasing longevity. The very high prevalence and costs of eye disorders in the population, in addition to their high rates of placement in long-term care facilities has important implications for burden and cost projections.

Figure 2.2. Projected Population Age Distribution, in Years 2014, 2032 & 2050



3. Disease Projections

We forecast the future prevalence of four major adult eye diseases as well as visual impairment and blindness by age, race and sex from the years 2014 to 2050. Prevalence rates are based on the per-person prevalence of these conditions in the year 2010 population as estimated in the Vision Problems in the US database. Detailed results and sources are available at http://www.visionproblemsus.org.

3.1 Overall Projections

Table 3.1.1 shows an overview of the estimated population in year 2010 for each of the included disorders from the Vision Problems in the US database. At more than 25 million, the projected 2014 prevalence of cataract far exceeds that of any of the other included disorders. Diabetic retinopathy is the second most prevalent at more than 8 million patients. Impairment (3.06 million) and blindness (1.36 million) combine to total 4.4 million with vision loss. Glaucoma and AMD are estimated to affect 2.86 million and 2.2 million Americans, respectively. Of note however is that this measure of AMD includes only those with advanced, vision threatening forms of AMD including geographic atrophy and choroidal neovascularization. The population with early stages of AMD is not included.

This table and **Figure 3.1.1** show the projected population with each condition in future years. We project that by 2050, the population with cataracts will increase by 87% from 2010 levels to 45.6 million. The population with diabetic retinopathy will increase 72% from 7.7 million to 13.2 million. The populations with visual impairment or blindness will increase by approximately 150%, while the population with glaucoma and AMD will double from 2010 to 2050. A major driver of the growth in prevalence is not only the current population with each disease, but the age and racial prevalence of each condition. **Figure 3.1.2** shows the age distribution of the current prevalent population of each disease. As the major demographic trend projected by year 2050 is the growth in the older population, disorders disproportionately affecting older persons are expected to exhibit higher rates of growth.

Table 3.1.1. Current Estimate and Projections of Prevalent Populations with Vision Problems

	Current Estimate	Projections		
	2010	2014	2032	2050
Cataract	24,409,978	25,666,427	38,477,608	45,620,606
Diabetic Retinopathy	7,685,237	8,084,767	10,938,504	13,190,538
Impaired	2,907,691	3,058,852	5,073,572	7,301,814
Glaucoma	2,719,379	2,858,572	4,275,758	5,526,347
AMD	2,069,403	2,176,985	3,387,560	4,425,989
Blind	1,288,275	1,355,248	2,161,164	3,088,249

Figure 3.1.1. Projected Prevalent Population of Vision Problems, by Year

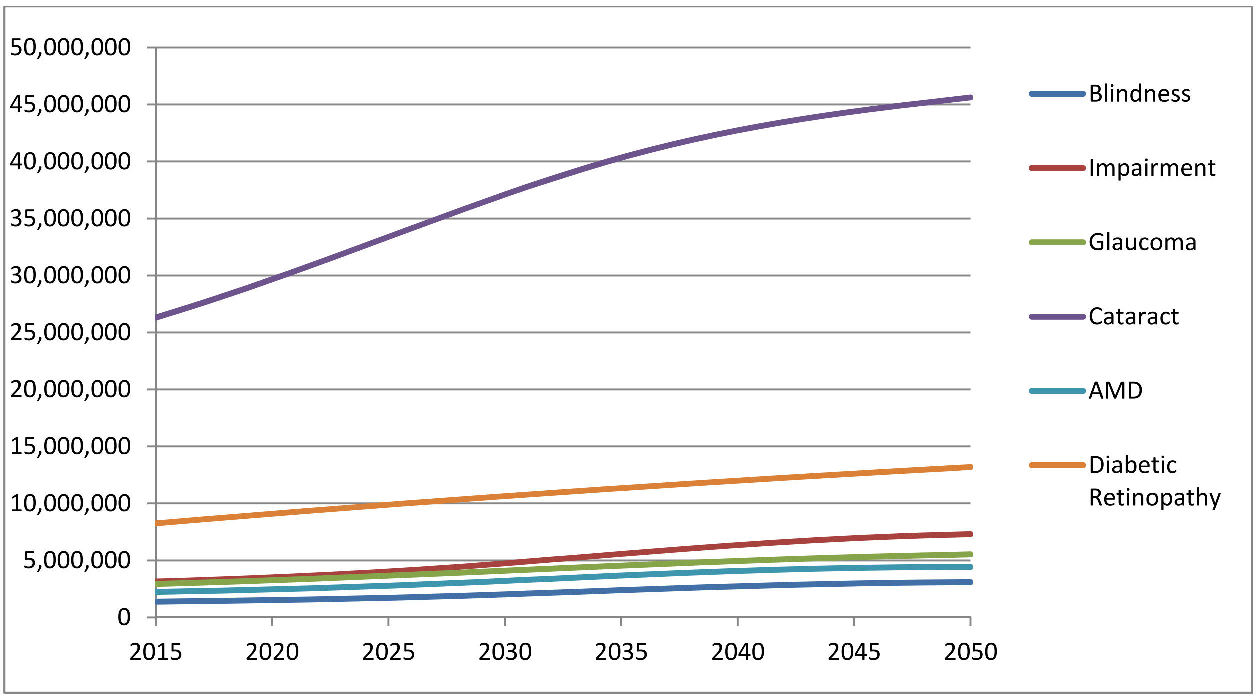
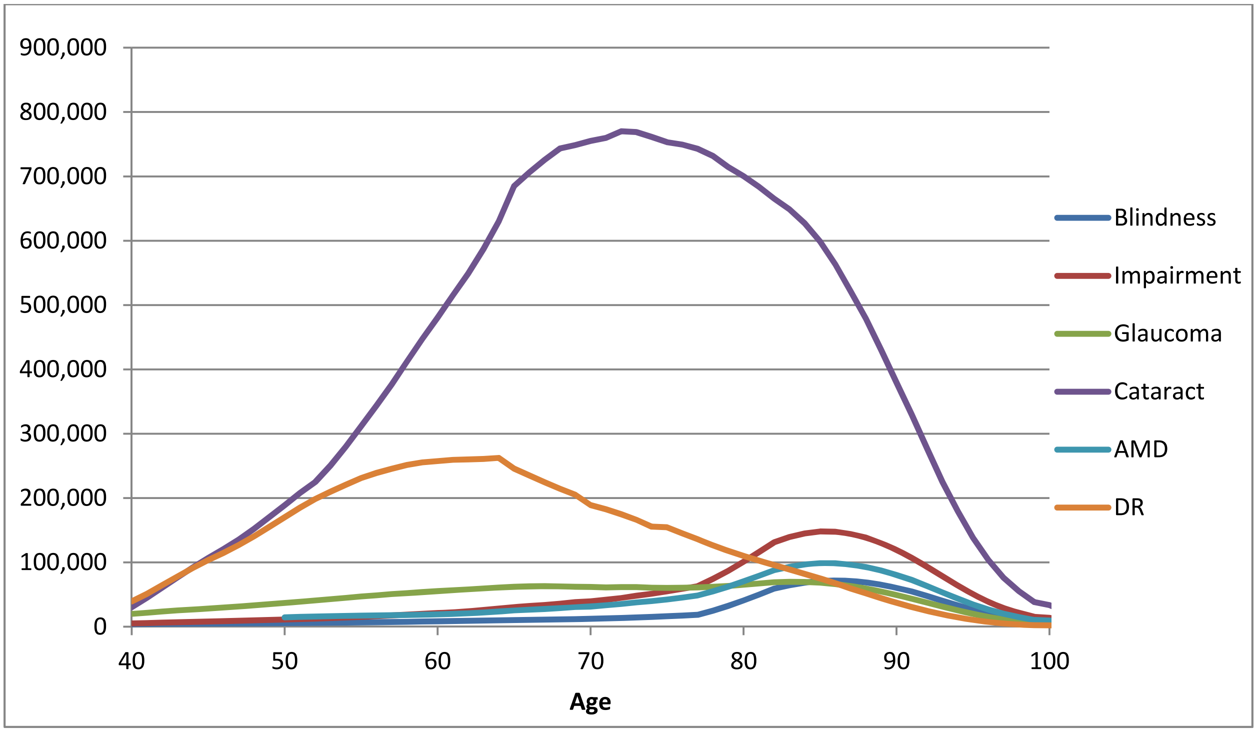


Figure 3.1.2. 2014 Prevalence of Vision Problems, by Age



3.2. Glaucoma

Vision Problems in the US estimated the population with glaucoma to be 2.7 million in 2010. This is estimated to be 2.86 million in 2014, and will increase by nearly 50% to 4.3 million by 2032 and by more than 90% to 5.5 million by 2050. Currently, the largest age group of glaucoma patients is the age 40-59 group. By 2018, the largest age group of glaucoma patients will be 70-79. The largest age group will be 80-89 after 2032. Currently, 64% of glaucoma patients are white and 20% are black. By 2050, most glaucoma patients will be non-white, due primarily to the rapid increase in Hispanic glaucoma patients. By 2050, blacks and Hispanics will each constitute about 20% of all glaucoma patients, with other minorities adding more than 10%.

Figure 3.2.1. Age Distribution of Current Glaucoma Population

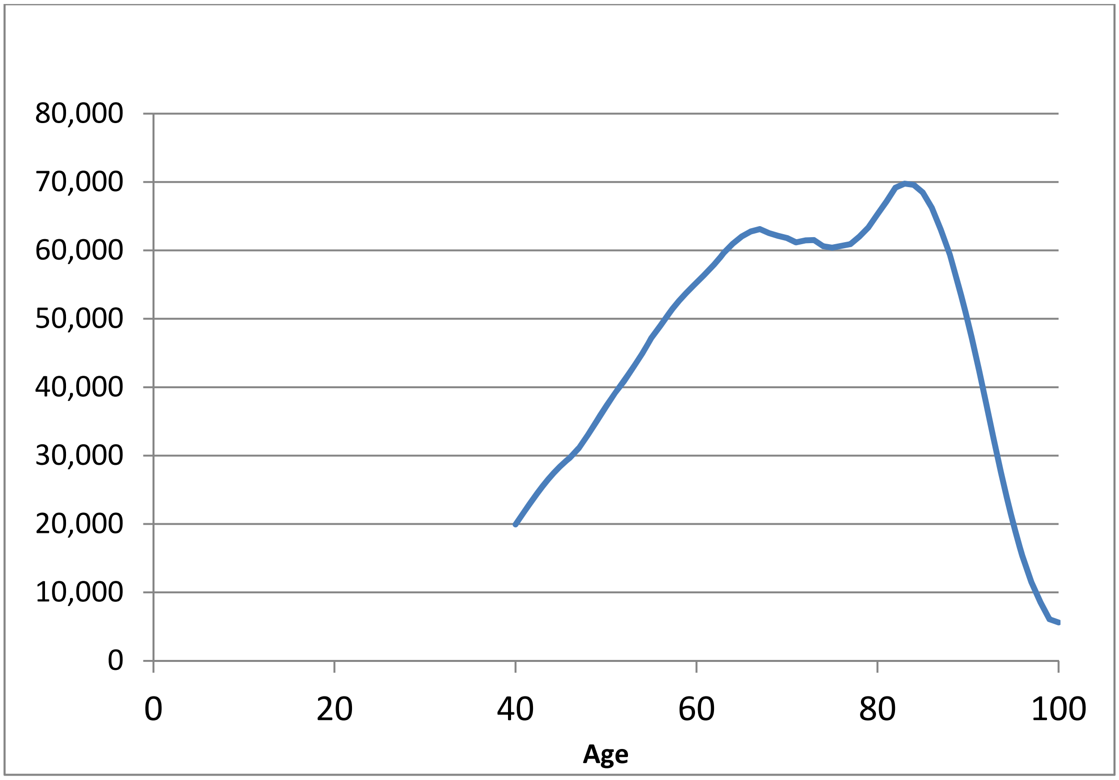


Figure 3.2.2. Glaucoma Population by Age Group, 2014, 2032 & 2050

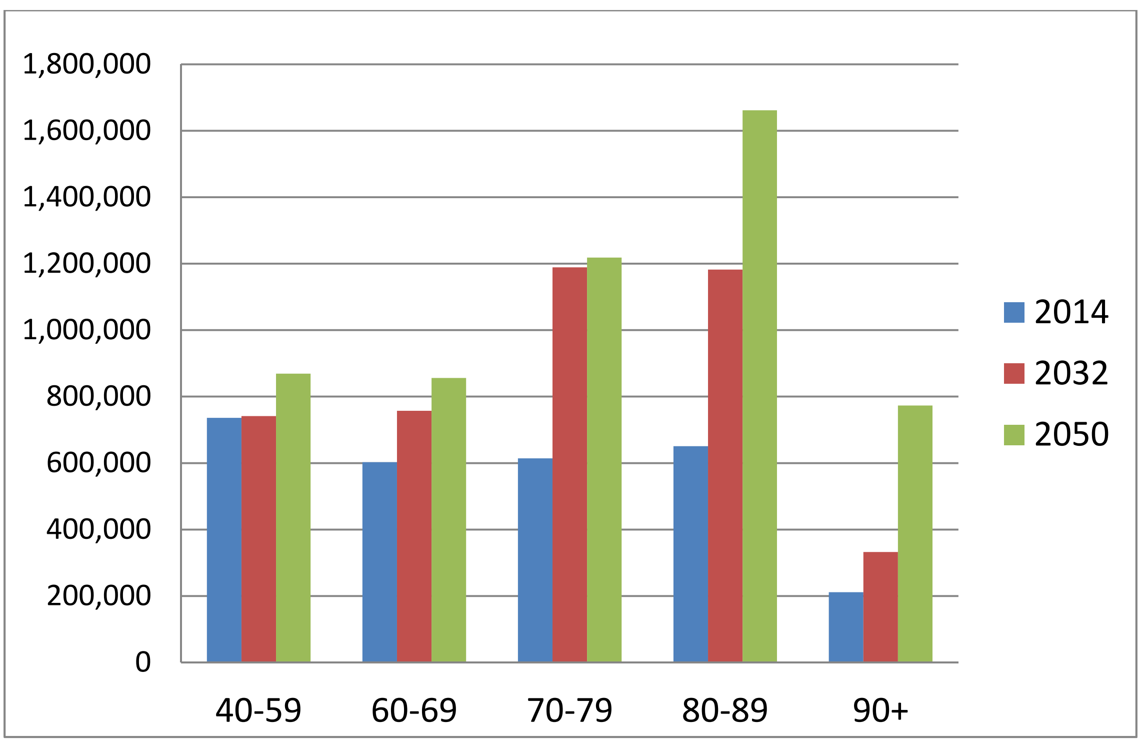


Figure 3.2.3. Projected Glaucoma Population by Sex and Year

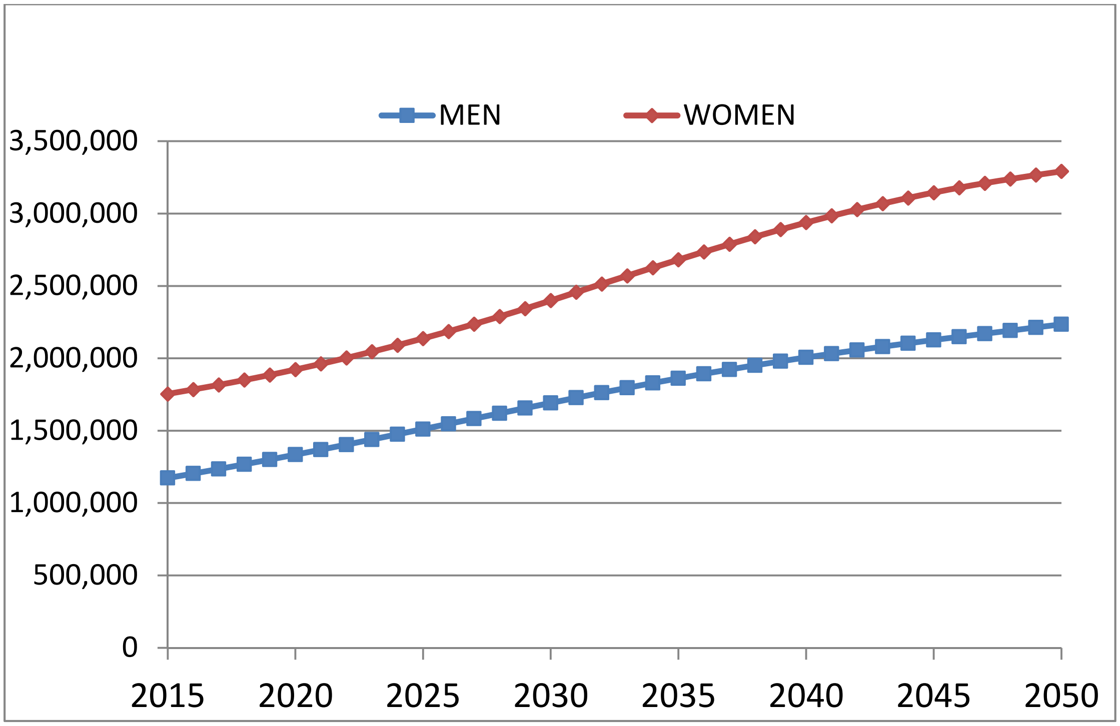


Figure 3.2.4. Projected Glaucoma Population by Race and Year

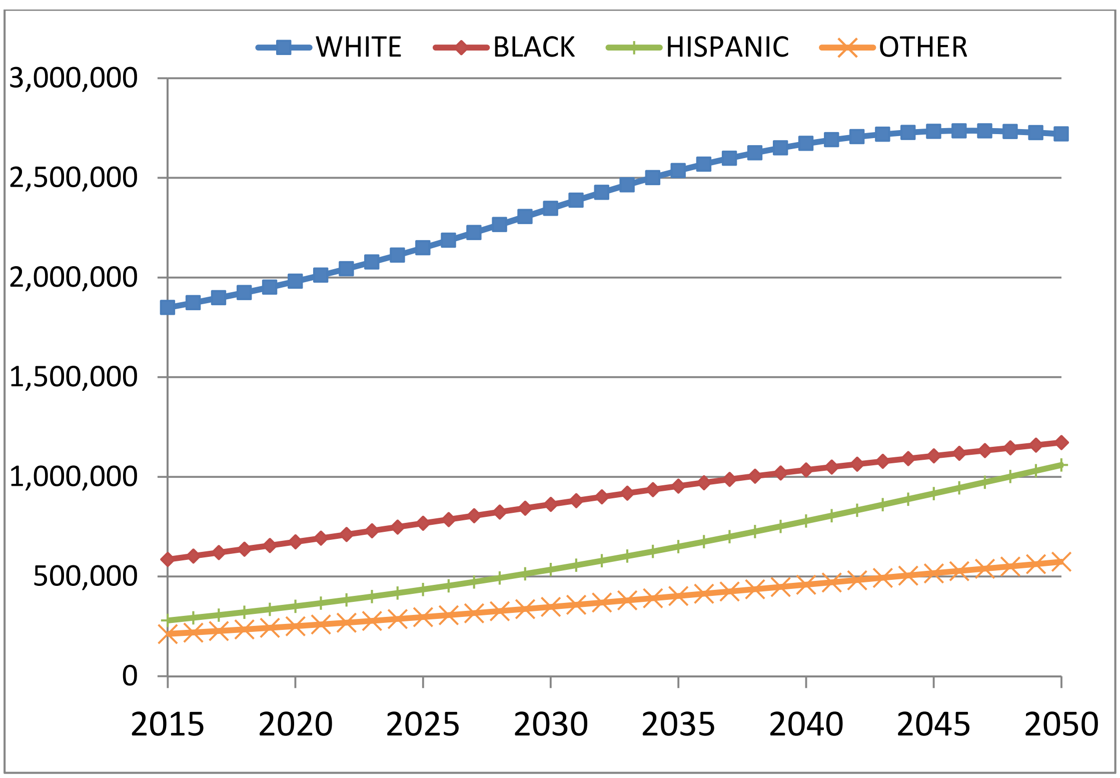


Figure 3.2.5. Projected Glaucoma Population by Race, 2014, 2032 & 2050

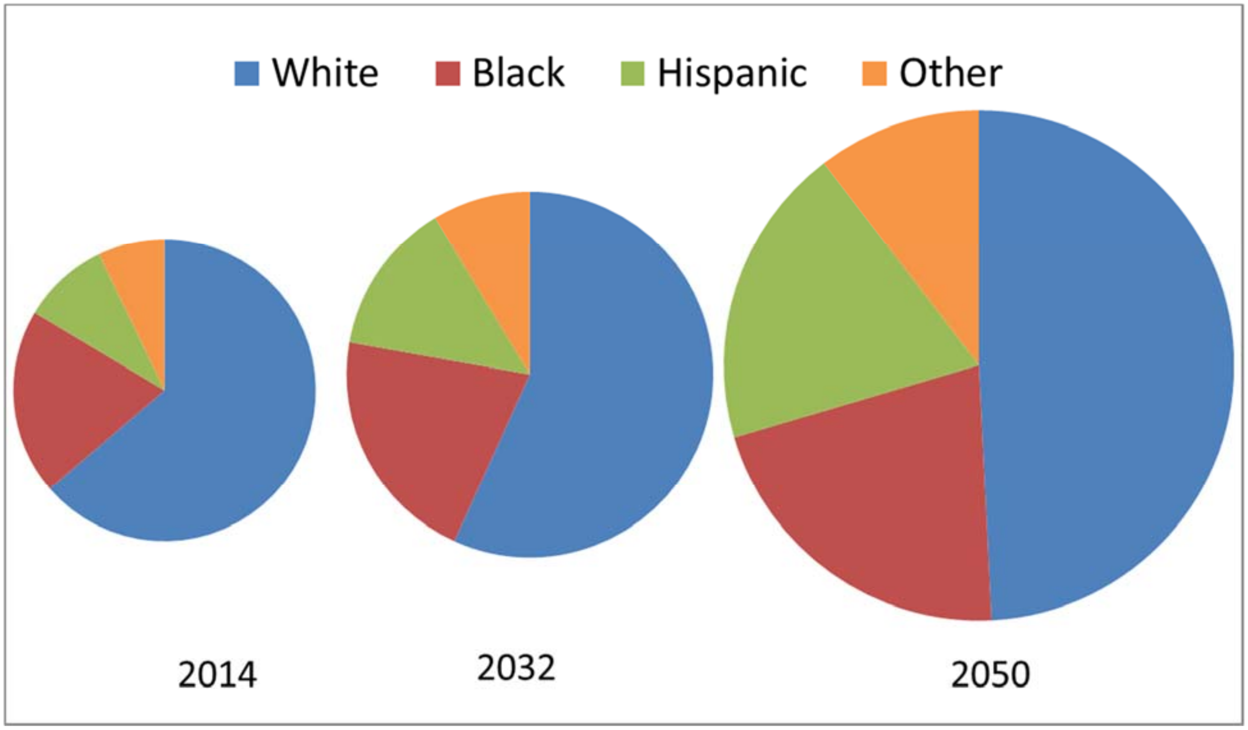


Table 3.2.1. Projected Glaucoma Population by Age Group

Year	40-59	60-69	70-79	80-89	90+
2014	736,144	602,719	614,199	650,982	211,505
2015	734,771	628,857	634,335	656,444	221,215
2016	732,641	656,732	654,987	662,765	230,425
2017	729,461	668,837	694,834	669,104	238,090
2018	726,205	684,579	730,391	678,858	245,466
2019	723,135	700,910	766,917	690,735	252,073
2020	719,345	717,840	804,494	704,053	257,236
2021	716,301	733,514	842,808	721,141	263,370
2022	714,357	747,668	879,102	744,231	267,772
2023	712,368	759,781	909,759	778,013	271,364
2024	710,159	769,305	947,810	809,950	274,448
2025	709,571	774,640	990,222	839,735	276,807
2026	712,259	776,409	1,035,223	869,186	282,443
2027	716,543	773,935	1,055,451	927,507	287,976
2028	721,585	770,799	1,081,837	979,000	293,834
2029	726,829	767,680	1,109,366	1,030,695	302,111
2030	730,065	764,225	1,138,385	1,082,621	310,713
2031	734,292	761,718	1,165,074	1,133,735	320,978
2032	741,260	757,453	1,188,982	1,182,114	332,412
2033	750,420	750,475	1,209,661	1,225,338	347,240
2034	760,955	742,039	1,226,487	1,276,109	369,097
2035	770,111	736,282	1,237,017	1,330,841	386,225
2036	781,072	734,196	1,241,699	1,385,570	402,569
2037	790,862	735,910	1,239,656	1,416,680	417,297
2038	800,550	738,200	1,236,569	1,454,442	455,482
2039	809,368	740,608	1,233,818	1,492,819	485,456
2040	815,124	741,430	1,231,244	1,533,685	512,599
2041	822,283	742,092	1,229,645	1,570,295	539,049
2042	828,522	748,427	1,225,035	1,601,909	564,241
2043	835,116	758,979	1,216,104	1,629,136	589,035
2044	842,926	771,027	1,204,821	1,651,733	614,851
2045	848,920	783,028	1,198,255	1,666,585	641,817
2046	855,370	798,299	1,197,210	1,671,719	670,399
2047	861,990	811,850	1,201,958	1,668,626	696,391
2048	867,257	826,784	1,207,955	1,663,923	723,670
2049	869,773	842,627	1,214,016	1,660,818	749,291
2050	868,975	855,910	1,218,481	1,661,707	773,048

Table 3.2.2. Projected Glaucoma Population by Race

Year	White	Black	Hispanic	Other
2014	1,825,193	569,080	266,566	204,463
2015	1,849,210	585,857	279,587	211,812
2016	1,873,274	602,810	292,965	219,219
2017	1,898,403	620,130	306,761	226,828
2018	1,924,440	637,719	320,983	234,610
2019	1,951,669	655,648	335,643	242,670
2020	1,980,855	673,990	350,894	251,149
2021	2,011,403	692,412	366,604	259,748
2022	2,043,518	710,999	382,864	268,658
2023	2,077,100	729,696	399,685	277,781
2024	2,111,804	748,439	417,062	287,053
2025	2,148,577	767,333	435,101	296,594
2026	2,186,433	786,227	453,761	306,288
2027	2,225,268	805,108	473,049	316,196
2028	2,265,163	824,011	493,012	326,419
2029	2,305,947	843,009	513,636	336,989
2030	2,346,922	862,109	534,968	347,808
2031	2,387,369	881,101	556,913	358,778
2032	2,426,710	899,845	579,448	369,756
2033	2,464,679	918,279	602,512	380,740
2034	2,501,127	936,351	626,077	391,822
2035	2,535,721	953,928	650,089	402,952
2036	2,568,125	970,964	674,696	414,141
2037	2,598,149	987,554	699,863	425,361
2038	2,625,601	1,003,688	725,560	436,609
2039	2,650,373	1,019,355	751,736	447,839
2040	2,672,304	1,034,667	778,376	459,184
2041	2,690,983	1,049,508	805,392	470,551
2042	2,706,269	1,063,888	832,718	481,828
2043	2,718,360	1,077,901	860,344	493,224
2044	2,727,268	1,091,664	888,241	504,690
2045	2,732,927	1,105,246	916,381	516,190
2046	2,735,508	1,118,758	944,734	527,678
2047	2,735,034	1,132,251	973,260	539,250
2048	2,732,009	1,145,728	1,001,923	550,939
2049	2,726,796	1,159,123	1,030,656	562,584
2050	2,719,825	1,172,569	1,059,539	574,414

3.3 Cataract

Cataract is by far the most common eye disease identified by Vision Problems in the US, with 24.4 million cases in 2010. We estimate that this totals nearly 25.7 million in 2014. This will increase by 50% to 38.5 million by 2032 and by 78% to 45.6 million by the year 2050. Cataracts will see a large increase in prevalence among patients aged 70-79 immediately, with a corresponding increase among those aged 80-89 beginning in about 10 years as baby-boomers begin to age into these groups. This will then be followed by an increase in those aged 90 and older beginning in the 2030's. The majority of cataract patients are women, and this trend will continue. Whites will continue to make up the large majority of cataract patients, but this population will level off and slightly decrease by the 2040's. Hispanics will exhibit the fastest rate of growth.

Figure 3.3.1. Age Distribution of Current Cataract Population

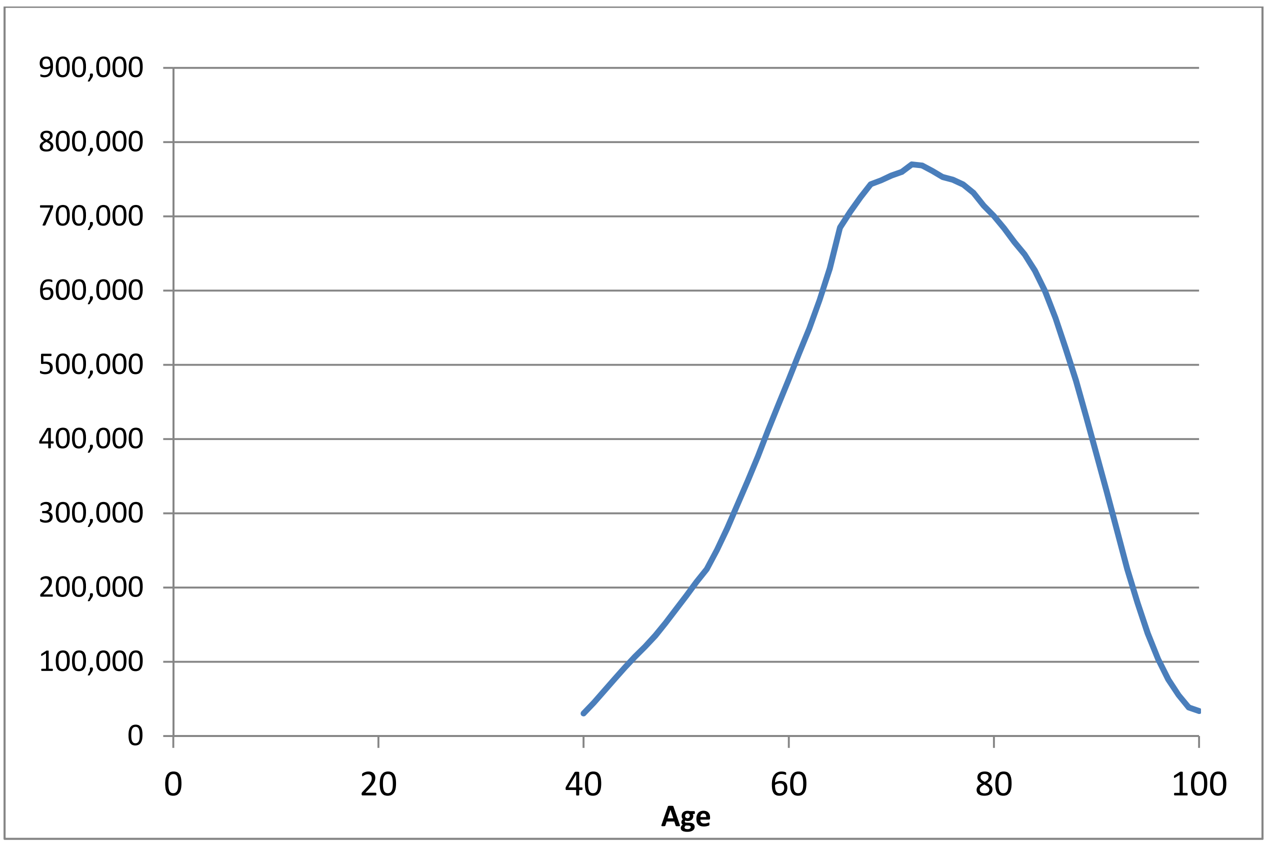


Figure 3.3.2. Projected Cataract Population by Age Group and Year

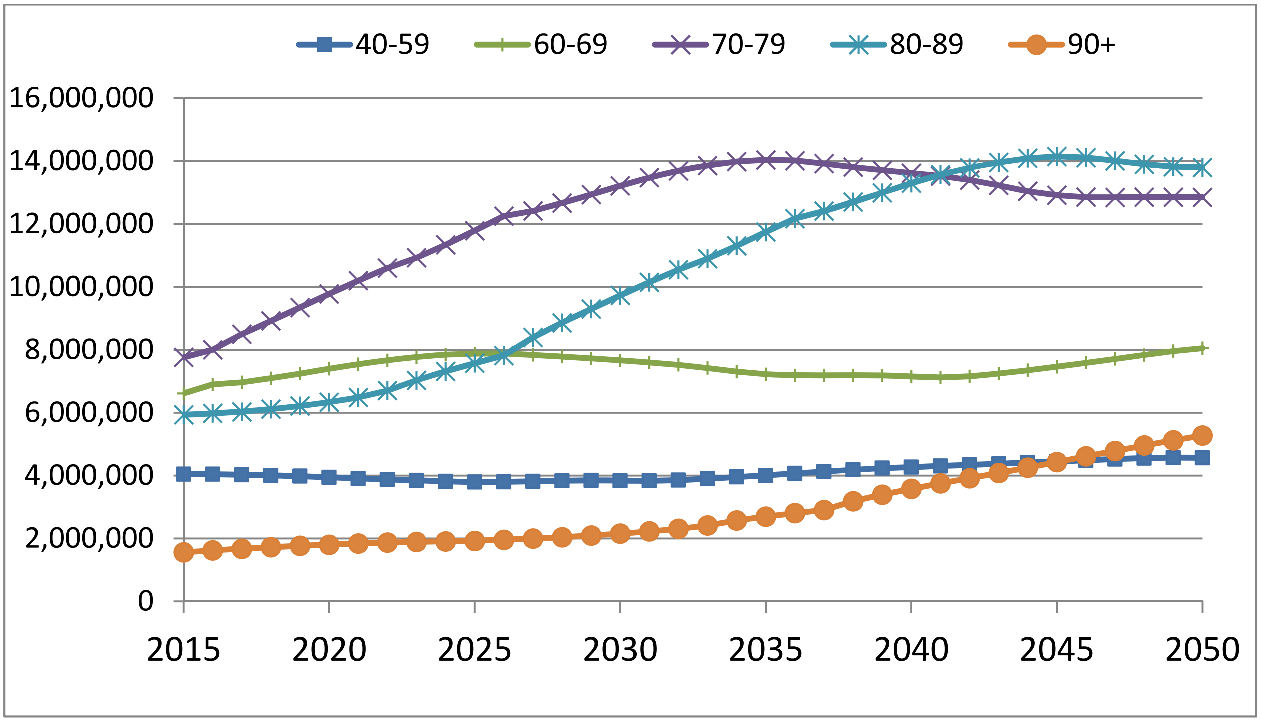


Figure 3.3.3. Projected Cataract Population by Sex and Year

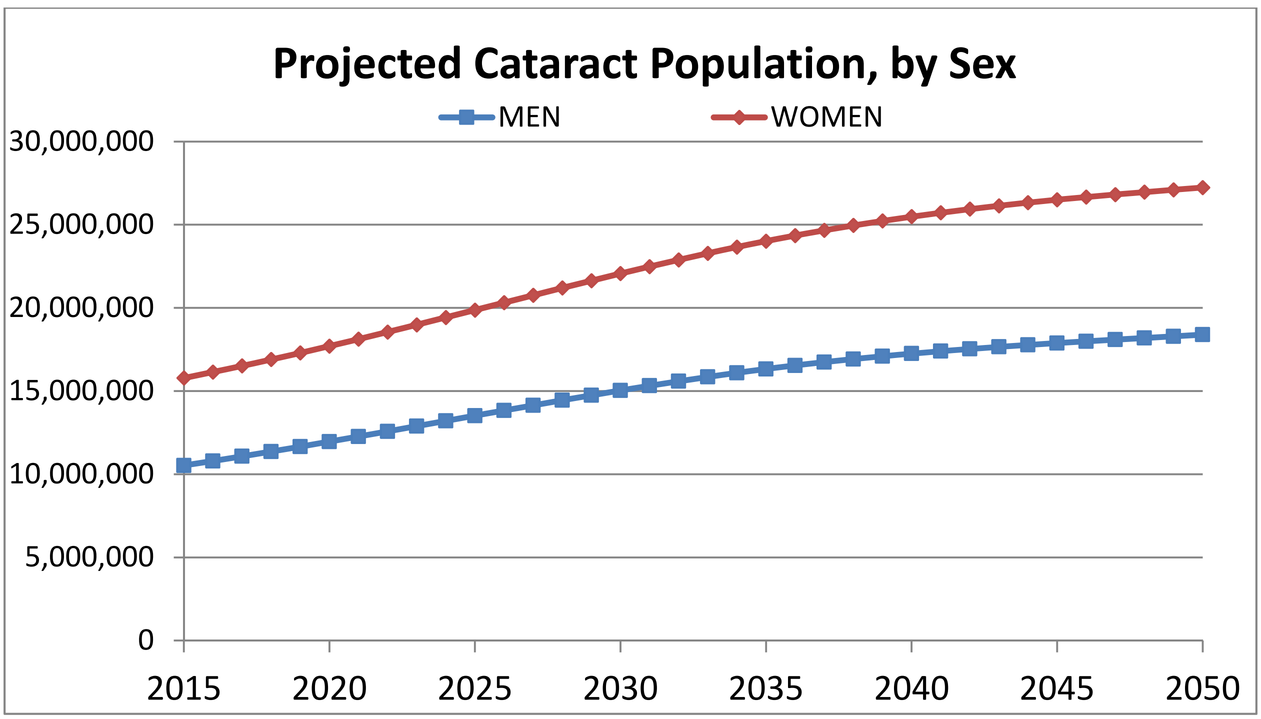


Figure 3.3.4. Projected Cataract Population by Race and Year

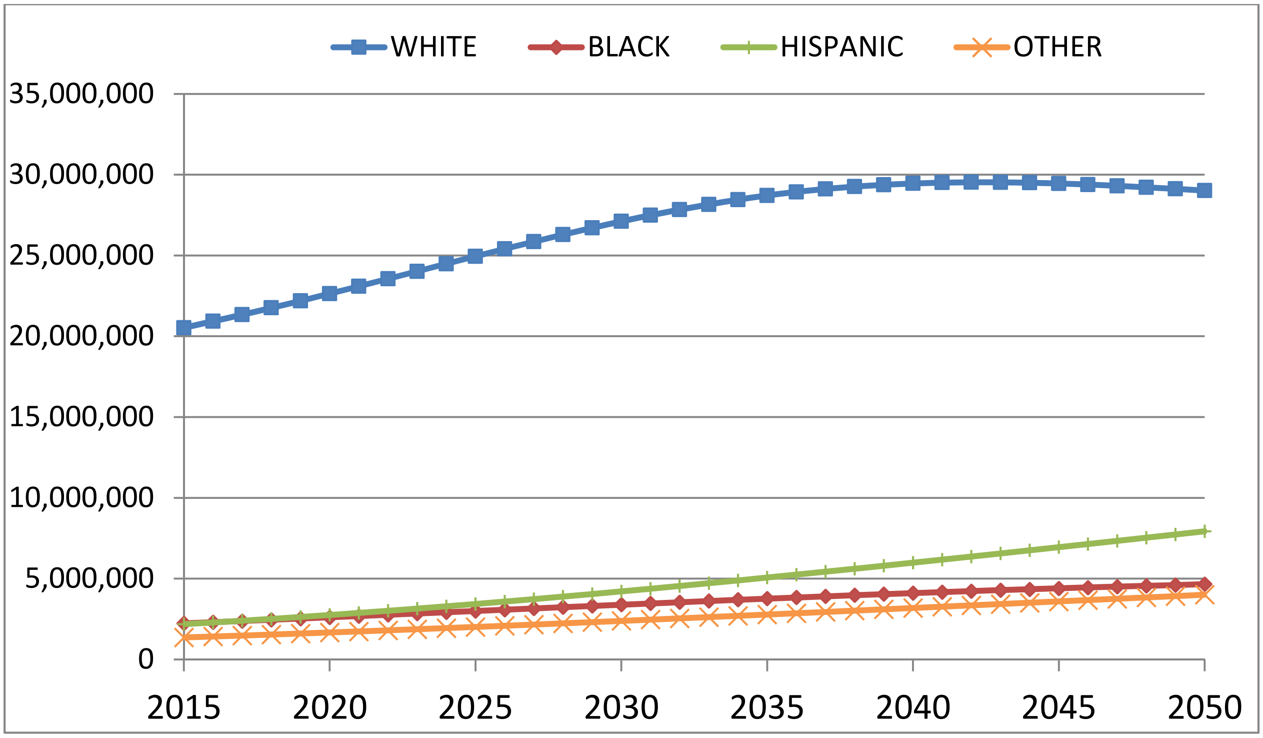


Figure 3.3.5. Projected Cataract Population by Race, 2014, 2032 & 2050

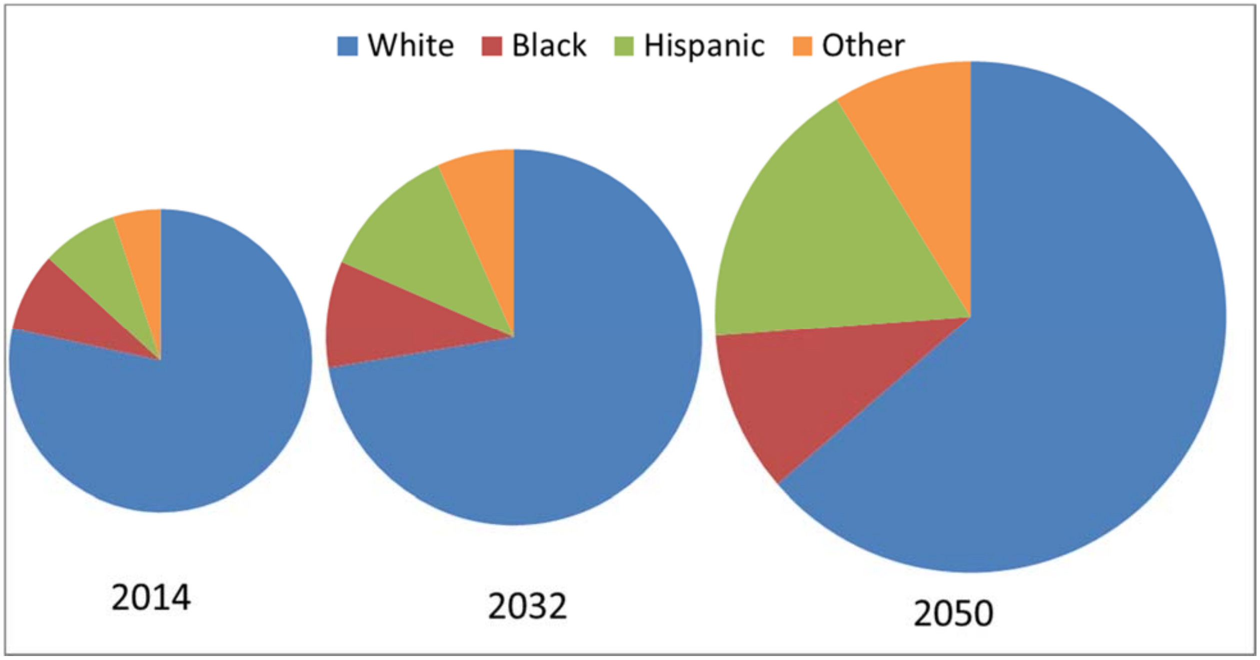


Table 3.3.1. Projected Cataract Population by Age Group

Year	40-59	60-69	70-79	80-89	90+
2014	4,045,961	6,349,780	7,525,597	5,896,481	1,493,626
2015	4,044,707	6,613,686	7,762,163	5,936,031	1,560,619
2016	4,041,622	6,899,594	8,003,588	5,981,914	1,623,250
2017	4,024,354	6,967,210	8,497,388	6,029,795	1,674,193
2018	4,003,611	7,098,147	8,920,552	6,115,166	1,723,744
2019	3,980,969	7,242,455	9,346,507	6,217,915	1,767,625
2020	3,942,854	7,396,651	9,774,852	6,334,616	1,800,706
2021	3,907,654	7,542,075	10,200,873	6,487,552	1,840,943
2022	3,878,259	7,667,476	10,599,513	6,702,874	1,869,215
2023	3,847,854	7,769,541	10,925,289	7,031,803	1,891,431
2024	3,816,314	7,845,179	11,337,368	7,316,965	1,909,700
2025	3,794,162	7,878,289	11,787,850	7,573,286	1,922,567
2026	3,799,641	7,880,790	12,251,221	7,820,011	1,960,386
2027	3,815,319	7,837,812	12,415,503	8,393,069	1,997,539
2028	3,834,474	7,782,303	12,668,718	8,857,298	2,037,558
2029	3,847,199	7,729,335	12,933,934	9,298,241	2,095,992
2030	3,837,177	7,663,154	13,217,684	9,730,020	2,156,402
2031	3,832,965	7,598,570	13,475,755	10,148,898	2,227,456
2032	3,855,306	7,521,381	13,688,408	10,545,270	2,308,140
2033	3,900,143	7,420,140	13,858,915	10,897,342	2,415,130
2034	3,956,607	7,307,051	13,984,576	11,307,861	2,575,750
2035	4,004,807	7,224,736	14,036,072	11,747,085	2,695,816
2036	4,070,489	7,189,979	14,015,908	12,173,238	2,806,758
2037	4,128,138	7,186,085	13,922,474	12,411,660	2,904,851
2038	4,186,118	7,189,717	13,809,145	12,704,531	3,186,014
2039	4,239,338	7,181,255	13,710,255	12,992,006	3,395,138
2040	4,266,403	7,146,969	13,618,118	13,301,242	3,578,843
2041	4,303,554	7,117,557	13,527,576	13,571,502	3,753,253
2042	4,336,443	7,155,992	13,401,164	13,784,806	3,918,551
2043	4,371,382	7,245,954	13,228,796	13,957,755	4,082,445
2044	4,415,857	7,353,014	13,040,957	14,090,374	4,252,609
2045	4,447,276	7,454,774	12,916,142	14,149,165	4,429,452
2046	4,483,433	7,592,545	12,852,754	14,110,499	4,615,730
2047	4,522,153	7,709,403	12,845,717	14,010,860	4,781,899
2048	4,552,767	7,834,356	12,855,047	13,900,080	4,958,935
2049	4,569,804	7,960,703	12,855,695	13,822,407	5,123,884
2050	4,562,694	8,051,122	12,850,308	13,795,945	5,272,667

Table 3.3.2. Projected Cataract Population by Race

Year	White	Black	Hispanic	Other
2014	20,143,983	2,163,193	2,081,225	1,305,490
2015	20,529,631	2,232,652	2,184,101	1,360,898
2016	20,926,419	2,303,577	2,290,555	1,418,140
2017	21,336,285	2,375,922	2,400,829	1,477,189
2018	21,758,865	2,449,631	2,515,021	1,538,035
2019	22,193,701	2,524,627	2,633,177	1,600,653
2020	22,639,432	2,600,834	2,755,740	1,665,070
2021	23,092,452	2,678,136	2,882,393	1,731,124
2022	23,552,028	2,756,333	3,013,345	1,798,861
2023	24,016,424	2,835,293	3,148,630	1,868,221
2024	24,482,949	2,914,834	3,288,131	1,939,074
2025	24,947,223	2,994,714	3,431,984	2,011,348
2026	25,405,608	3,074,721	3,579,983	2,084,900
2027	25,854,234	3,154,601	3,731,958	2,159,587
2028	26,289,913	3,234,130	3,887,857	2,235,304
2029	26,709,009	3,313,136	4,047,488	2,312,000
2030	27,109,600	3,391,592	4,210,917	2,389,547
2031	27,486,943	3,469,385	4,377,630	2,467,735
2032	27,837,518	3,546,360	4,547,346	2,546,383
2033	28,158,585	3,622,329	4,719,735	2,625,373
2034	28,448,252	3,697,029	4,894,450	2,704,641
2035	28,704,291	3,770,195	5,071,125	2,784,126
2036	28,925,494	3,841,559	5,250,637	2,863,747
2037	29,111,251	3,910,921	5,432,632	2,943,461
2038	29,261,624	3,978,150	5,616,789	3,023,225
2039	29,377,278	4,043,218	5,802,863	3,103,047
2040	29,459,913	4,106,173	5,990,716	3,182,970
2041	29,510,794	4,167,143	6,180,016	3,263,049
2042	29,531,595	4,226,285	6,370,476	3,343,286
2043	29,525,468	4,283,750	6,562,046	3,423,902
2044	29,496,942	4,339,791	6,754,715	3,505,028
2045	29,448,974	4,394,650	6,948,533	3,586,781
2046	29,385,041	4,448,611	7,143,438	3,669,259
2047	29,306,198	4,501,864	7,339,447	3,752,536
2048	29,217,105	4,554,599	7,536,379	3,836,683
2049	29,120,803	4,607,027	7,734,015	3,921,744
2050	29,020,900	4,659,363	7,932,530	4,007,812

3.4 Age Related Macular Degeneration

Vision Problems in the US estimated the 2010 US population with AMD to be nearly 2.1 million. This measure of AMD includes only those with advanced, vision threatening forms of AMD including geographic atrophy and choroidal neovascularization. The population with early stages of AMD was not included in the Vision Problems in the US database. We project that the 2014 population is now 2.2 million. We estimate the current average age of AMD patients is 80 years old, the oldest of any of the included eye diseases. Thus, the increase of the population aged 80 and older will lead to rapid growth in the AMD population in the next 20 years, reaching 3.4 million in 2032 and 4.4 million by 2050. Whites and women are at higher risk for AMD, and will continue to dominate the total affected population with AMD.

Figure 3.4.1. Age Distribution of Current AMD Population

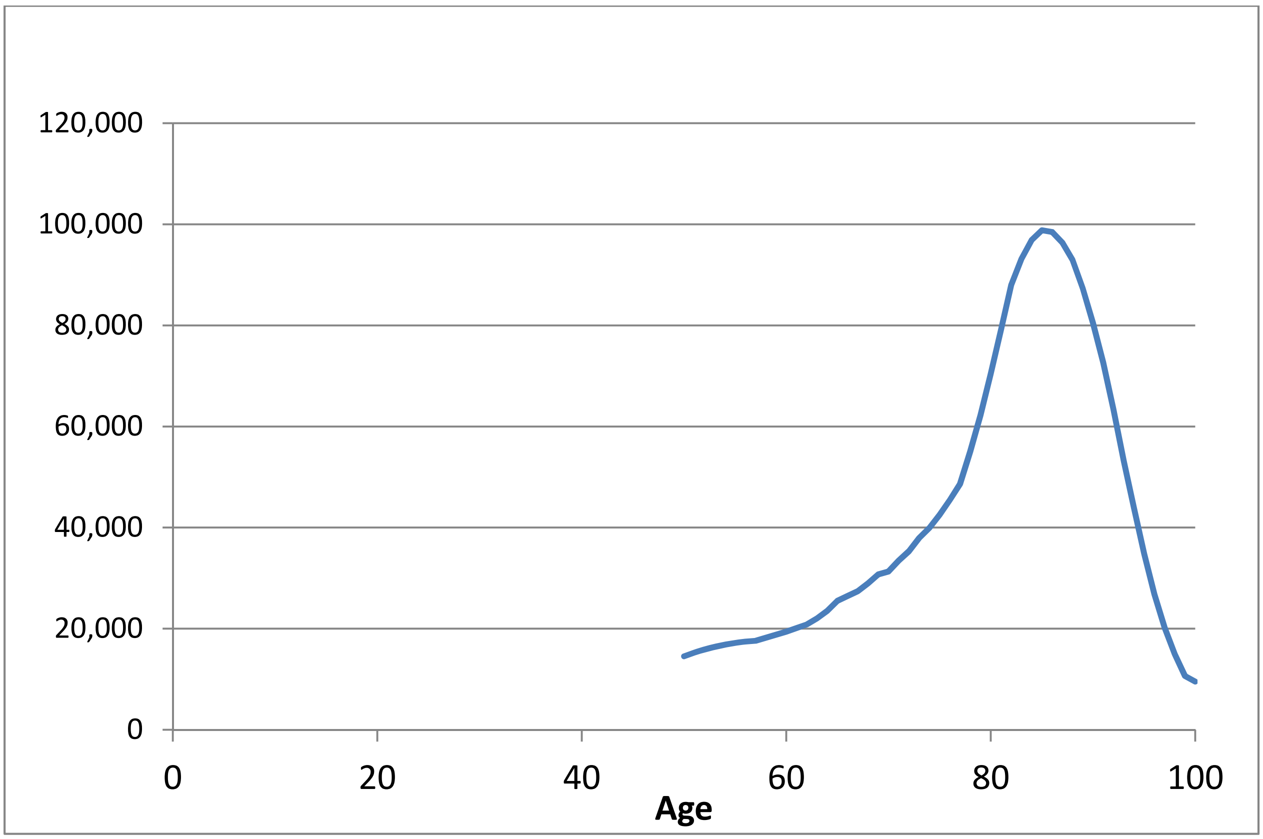


Figure 3.4.2. Projected AMD Population by Age Group, 2014, 2032 & 2050

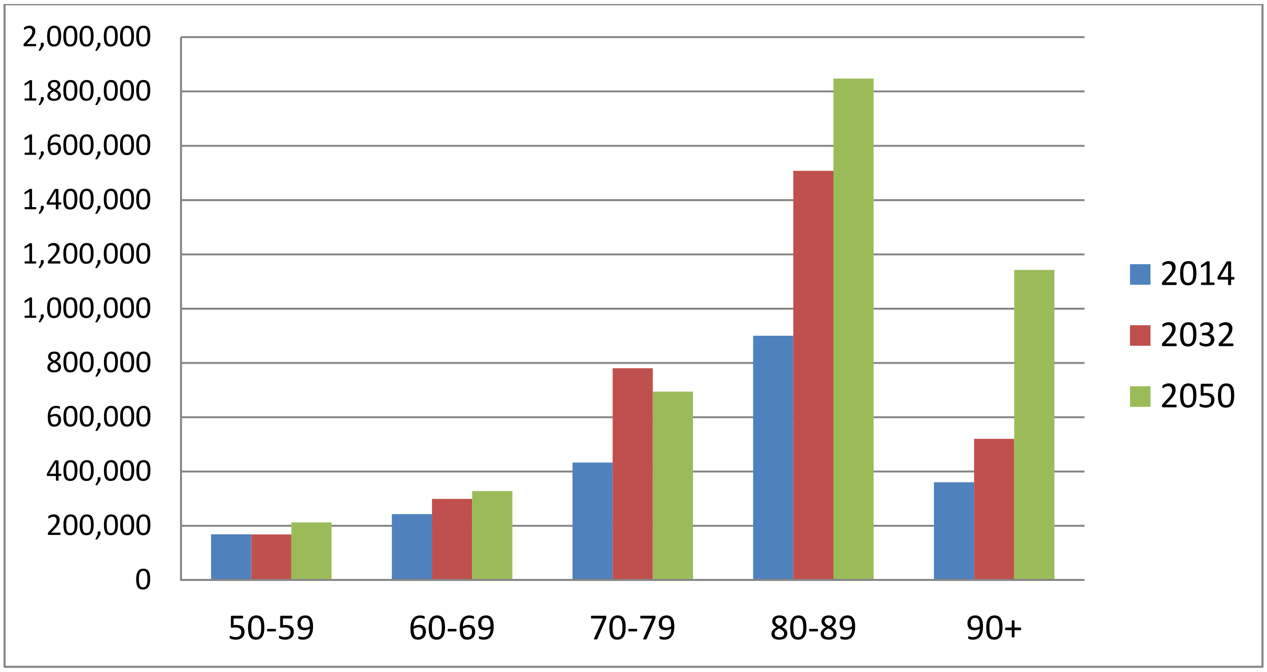


Figure 3.4.3. Projected AMD Population by Sex and Year

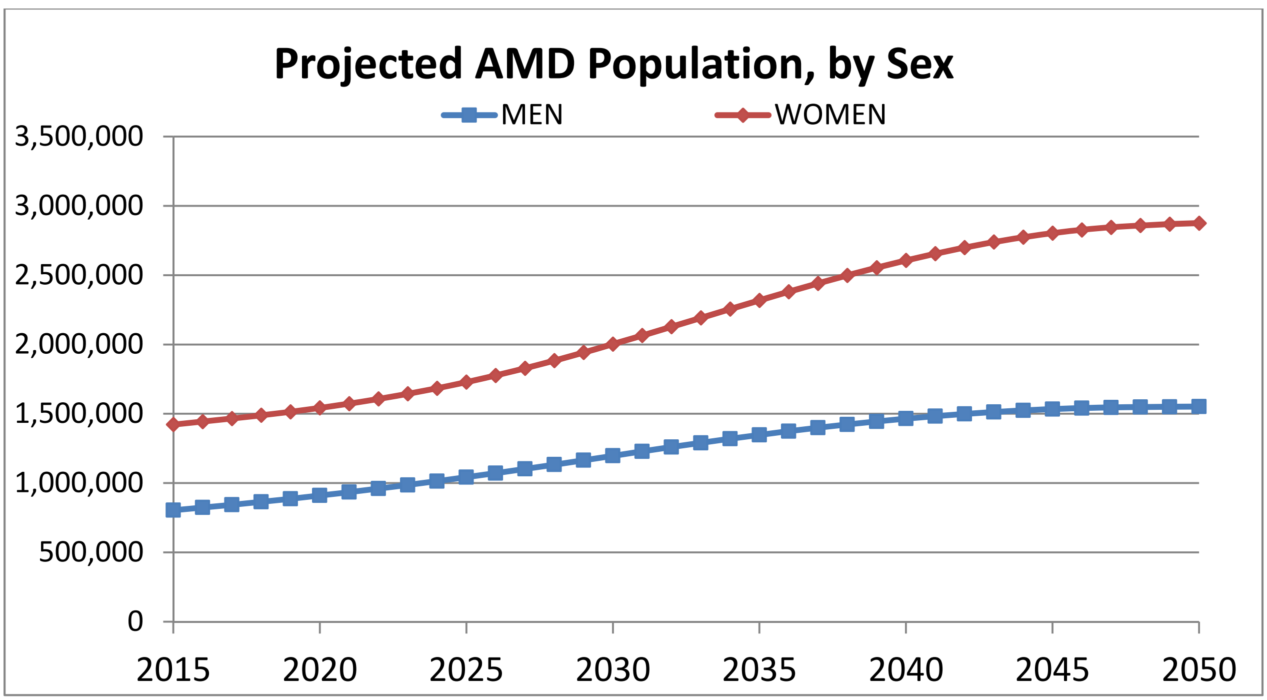


Figure 3.4.4. Projected AMD Population by Race and Year

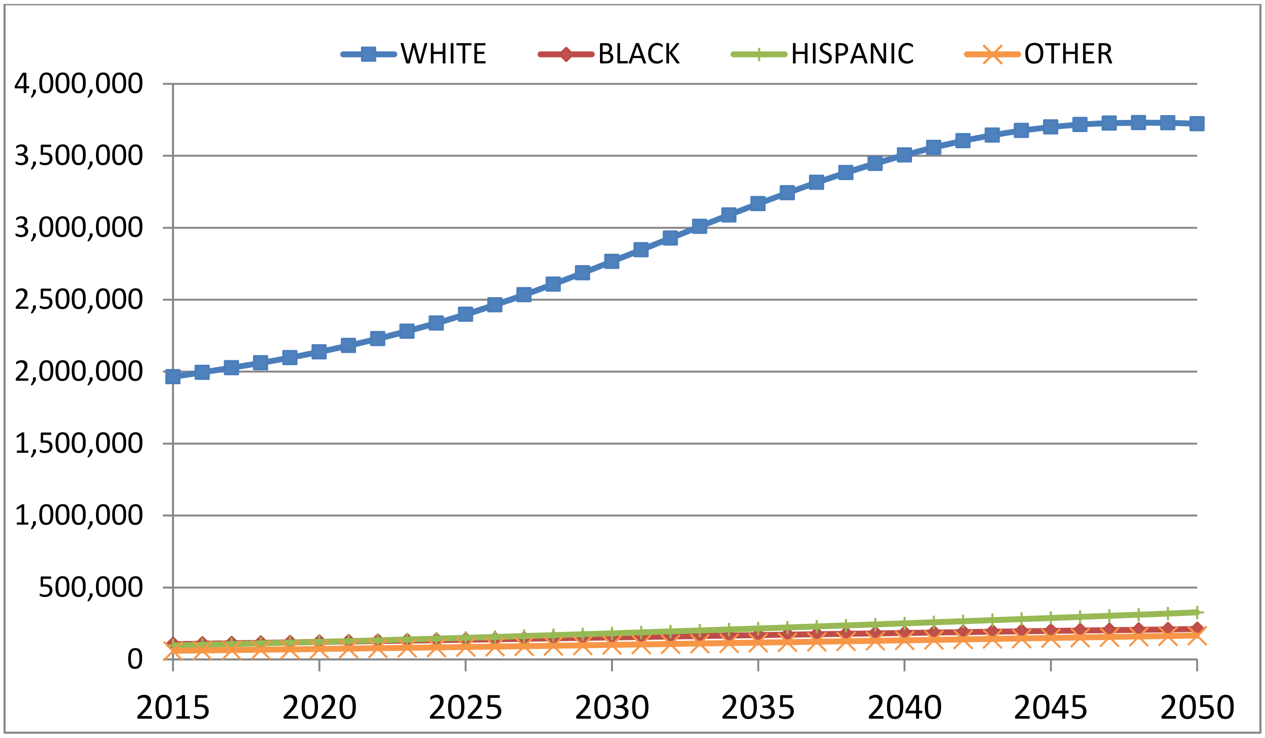


Table 3.4.1. Projected AMD Population by Age Group

Year	50-59	60-69	70-79	80-89	90+
2014	164,284	227,234	404,233	903,027	327,886
2015	166,829	234,015	417,766	903,403	345,151
2016	168,867	243,302	432,763	900,015	360,286
2017	170,017	254,065	445,299	900,021	375,322
2018	170,377	265,970	459,327	901,661	389,055
2019	169,896	268,802	485,038	903,396	399,931
2020	169,341	274,148	507,572	909,630	410,404
2021	168,916	280,092	531,407	919,608	419,369
2022	168,528	286,569	556,702	930,835	425,638
2023	168,326	292,630	583,105	948,090	433,025
2024	167,715	297,968	607,327	974,217	438,043
2025	166,504	302,524	623,245	1,015,351	441,557
2026	164,997	306,103	646,738	1,055,741	443,934
2027	164,132	308,066	675,626	1,092,105	444,995
2028	163,960	308,885	708,947	1,128,588	451,367
2029	164,556	307,857	711,894	1,200,320	457,769
2030	165,256	306,466	723,798	1,263,078	465,096
2031	165,953	305,177	737,800	1,326,919	476,637
2032	166,478	303,405	753,544	1,389,597	488,830
2033	166,892	301,609	768,291	1,450,888	503,102
2034	168,428	299,317	780,642	1,507,663	520,247
2035	170,747	296,057	790,594	1,553,221	543,635
2036	173,229	292,207	797,688	1,610,171	579,504
2037	175,698	289,543	800,452	1,671,716	606,222
2038	178,763	288,718	800,541	1,733,840	630,175
2039	181,446	289,126	794,997	1,753,490	651,256
2040	184,428	289,846	787,823	1,787,536	713,270
2041	187,606	290,081	781,137	1,823,211	758,761
2042	190,295	289,251	772,433	1,861,042	798,406
2043	193,704	288,291	762,608	1,894,806	834,810
2044	196,815	289,994	751,874	1,920,708	869,969
2045	199,729	293,752	738,827	1,939,519	904,992
2046	202,885	298,148	724,047	1,951,223	940,603
2047	205,166	302,349	712,519	1,952,409	976,895
2048	207,323	308,055	707,027	1,942,579	1,014,008
2049	209,446	312,957	704,525	1,921,140	1,046,871
2050	211,173	318,312	703,934	1,894,678	1,081,940

Table 3.4.2. Projected AMD Population by Race

Year	White	Black	Hispanic	Other
2014	1,933,484	102,970	92,206	57,816
2015	1,963,834	106,195	96,861	60,115
2016	1,994,612	109,308	101,533	62,398
2017	2,026,740	112,338	106,285	64,686
2018	2,060,557	115,380	111,205	67,092
2019	2,096,902	118,416	116,256	69,598
2020	2,136,986	121,649	121,597	72,242
2021	2,181,115	124,899	127,024	74,918
2022	2,228,979	128,047	132,533	77,640
2023	2,280,755	131,112	138,138	80,389
2024	2,336,485	134,099	143,855	83,153
2025	2,397,856	137,154	149,790	85,982
2026	2,463,425	140,127	155,761	88,793
2027	2,533,542	143,180	161,864	91,645
2028	2,607,812	146,244	168,064	94,524
2029	2,685,976	149,380	174,344	97,476
2030	2,765,769	152,667	180,999	100,553
2031	2,846,448	155,817	187,595	103,620
2032	2,927,565	158,945	194,294	106,755
2033	3,008,519	162,026	201,020	109,911
2034	3,088,350	165,027	207,704	113,061
2035	3,166,604	168,083	214,527	116,246
2036	3,242,218	171,091	221,396	119,417
2037	3,314,415	174,084	228,310	122,597
2038	3,382,693	177,126	235,340	125,829
2039	3,446,532	180,296	242,464	129,135
2040	3,505,164	183,608	249,879	132,487
2041	3,557,793	186,914	257,430	135,851
2042	3,603,972	190,129	265,094	139,172
2043	3,643,132	193,219	272,739	142,459
2044	3,674,973	196,160	280,413	145,757
2045	3,699,497	198,893	288,077	149,052
2046	3,716,655	201,421	295,709	152,359
2047	3,726,289	203,877	303,360	155,677
2048	3,729,737	206,281	311,045	159,018
2049	3,728,302	208,627	318,791	162,374
2050	3,722,476	211,012	326,688	165,813

3.5 Diabetic Retinopathy

Vision Problems in the US estimate the 2010 population with diabetic retinopathy to be 7.7 million. We project this total is now 8.1 million. Diabetic retinopathy incidence is highest among persons with more advanced diabetes. Due largely to the high mortality risk among this population, diabetic retinopathy patients have an average age of 66 years, the youngest of any of the included eye diseases. The low rate of diabetic retinopathy among the oldest age groups exhibiting high projected growth translates into the lowest projected increase among any of the included diseases. We project total cases of diabetic retinopathy to increase by 35% to 10.9 million by 2032, and by 63% to 13.2 million by 2050. More men than women are affected by diabetic retinopathy, a trend we expect to continue in the future.

Vision problems in the US identified extremely high prevalence rates of diabetic retinopathy among older Hispanics. Due to this, Hispanics are projected to exhibit extremely high growth in diabetic retinopathy cases. Currently, 67% of cases are among whites and 17% among Hispanics. By 2050 we project that 45% of diabetic retinopathy patients will be white and 35% will be Hispanic.

Figure 3.5.1. Age Distribution of Current Diabetic Retinopathy Population

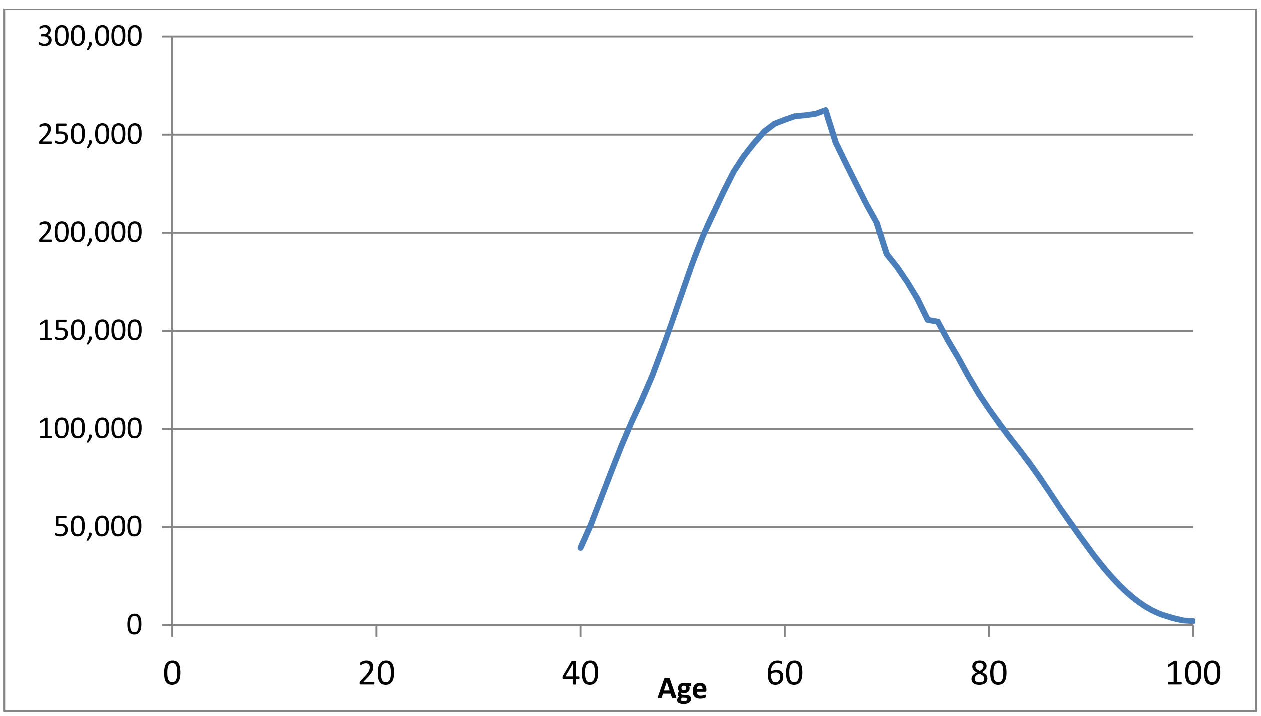


Figure 3.5.2. Projected Diabetic Retinopathy Population by Age Group, 2014, 2032 & 2050

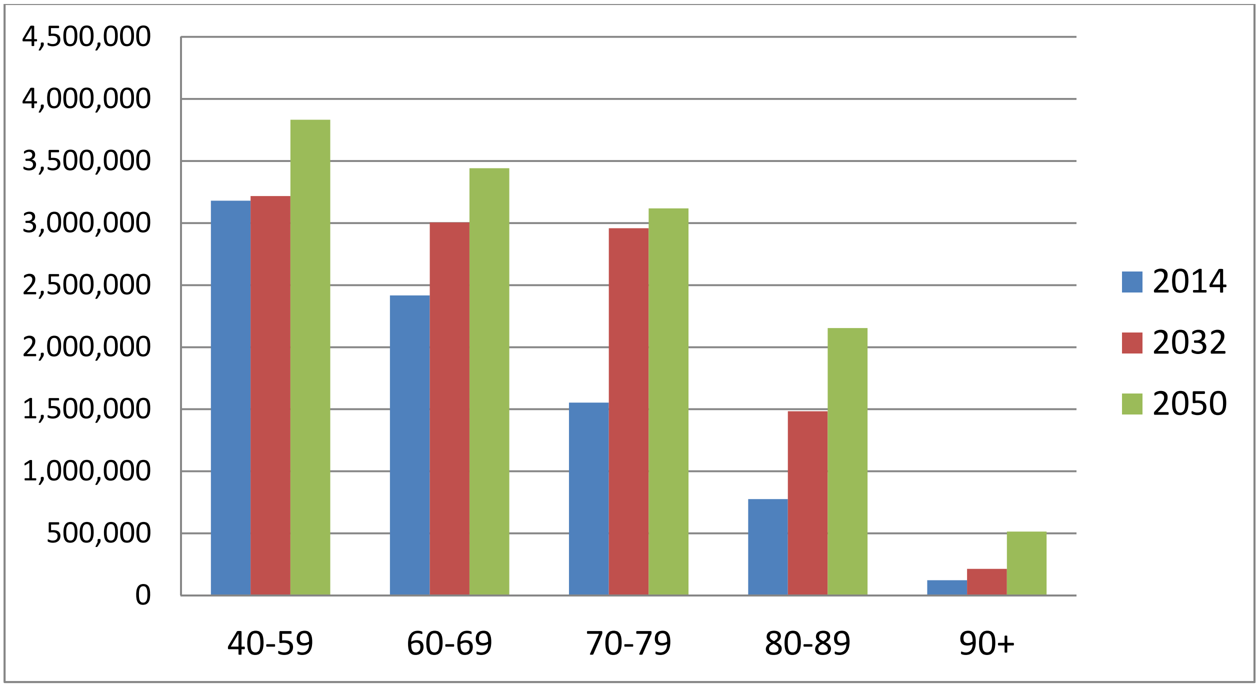


Figure 3.5.3. Projected Diabetic Retinopathy Population by Sex and Year

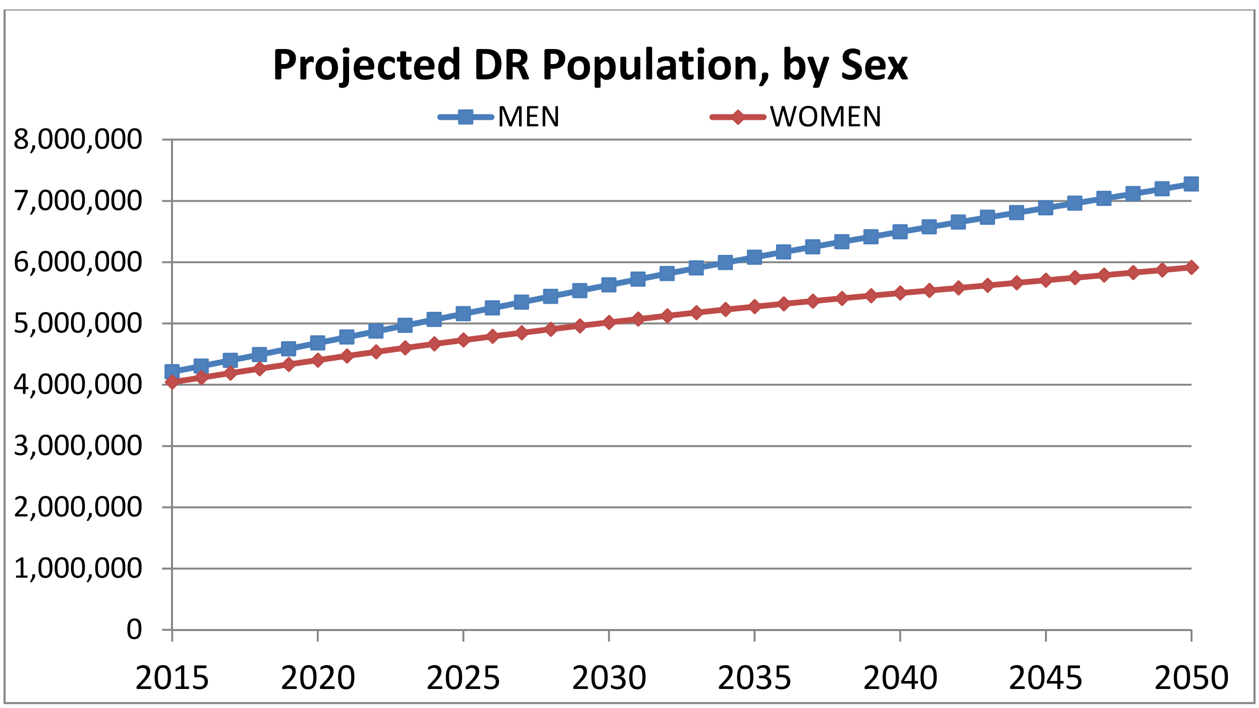


Figure 3.5.4. Projected Diabetic Retinopathy Population by Race and Year

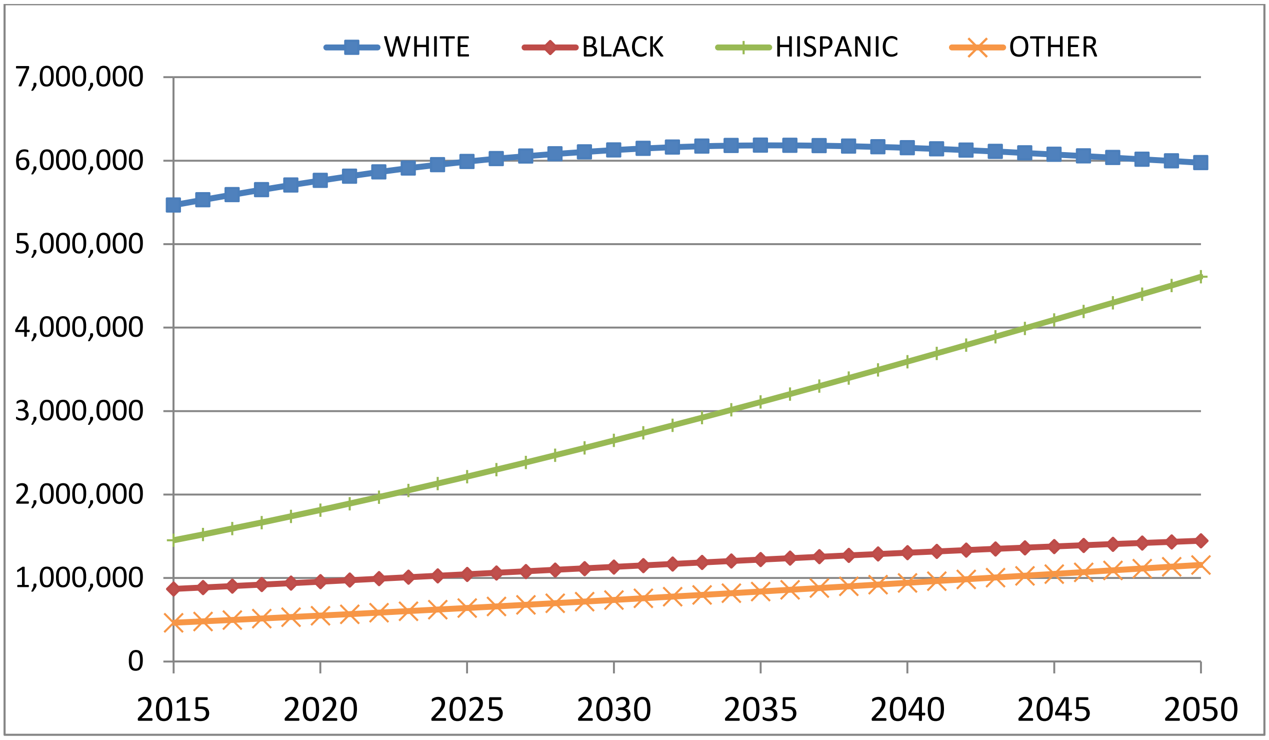


Figure 3.5.5. Projected Diabetic Retinopathy Population by Race, 2014, 2032 & 2050

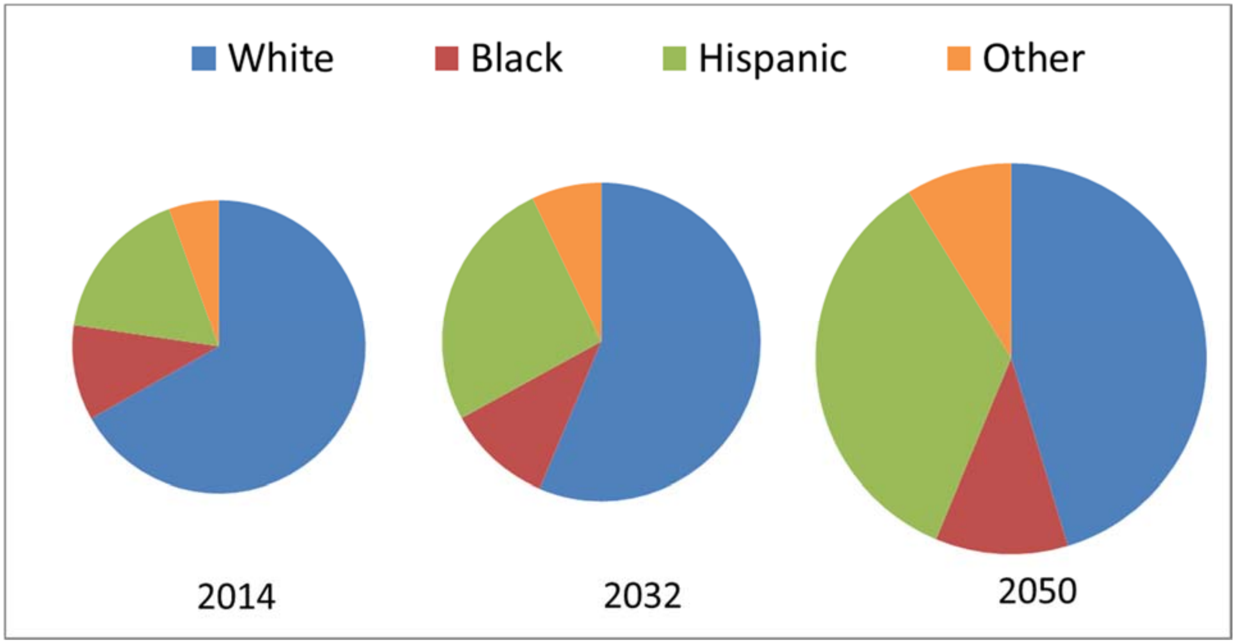


Table 3.5.1. Projected Diabetic Retinopathy Population by Age Group

Year	40-59	60-69	70-79	80-89	90+
2014	3,180,562	2,416,838	1,553,239	775,448	123,019
2015	3,181,143	2,512,403	1,605,664	786,345	129,548
2016	3,179,460	2,609,724	1,657,618	797,542	135,775
2017	3,170,732	2,655,306	1,768,940	809,054	141,077
2018	3,160,401	2,715,035	1,863,006	825,788	146,296
2019	3,149,700	2,776,635	1,953,362	844,296	151,147
2020	3,131,945	2,842,771	2,043,626	865,058	155,163
2021	3,117,525	2,902,702	2,132,484	889,749	160,088
2022	3,107,370	2,953,944	2,219,931	922,746	163,705
2023	3,097,633	2,997,187	2,296,135	971,555	166,705
2024	3,087,584	3,032,472	2,385,621	1,012,736	169,312
2025	3,083,963	3,052,333	2,482,491	1,050,953	171,536
2026	3,096,643	3,056,060	2,578,723	1,087,275	176,260
2027	3,116,092	3,046,018	2,631,914	1,171,391	180,768
2028	3,138,059	3,033,913	2,697,317	1,239,303	185,407
2029	3,158,792	3,024,766	2,764,198	1,302,732	191,704
2030	3,169,095	3,019,653	2,836,996	1,365,491	198,122
2031	3,185,739	3,016,941	2,901,750	1,425,973	205,533
2032	3,217,801	3,005,056	2,958,022	1,483,784	213,378
2033	3,261,891	2,982,915	3,006,502	1,538,649	223,512
2034	3,311,488	2,956,335	3,047,355	1,600,356	238,476
2035	3,354,727	2,941,173	3,074,116	1,666,957	249,743
2036	3,406,762	2,935,740	3,082,979	1,730,498	260,621
2037	3,453,791	2,944,147	3,078,432	1,777,061	270,429
2038	3,500,173	2,956,075	3,072,825	1,827,904	297,175
2039	3,543,717	2,968,285	3,071,576	1,878,099	317,317
2040	3,570,736	2,983,278	3,077,083	1,933,684	335,000
2041	3,604,294	2,998,718	3,082,347	1,981,936	352,457
2042	3,634,338	3,033,226	3,076,687	2,023,362	368,674
2043	3,665,034	3,080,242	3,060,393	2,060,371	384,760
2044	3,700,799	3,127,718	3,041,478	2,093,390	401,995
2045	3,727,526	3,175,474	3,037,622	2,117,243	420,345
2046	3,756,472	3,231,760	3,040,799	2,125,850	440,582
2047	3,786,786	3,280,866	3,056,112	2,126,887	458,844
2048	3,811,962	3,334,066	3,073,537	2,128,812	478,254
2049	3,829,520	3,391,006	3,091,749	2,136,021	496,602
2050	3,832,693	3,441,286	3,118,464	2,154,231	513,985

Table 3.5.2. Projected Diabetic Retinopathy Population by Race

Year	White	Black	Hispanic	Other
2014	5,402,200	850,646	1,386,500	447,424
2015	5,468,102	868,975	1,453,081	463,705
2016	5,530,794	886,703	1,521,482	480,194
2017	5,592,027	904,544	1,591,747	496,954
2018	5,651,495	922,244	1,663,732	513,936
2019	5,707,562	940,002	1,737,363	531,184
2020	5,761,918	958,220	1,812,574	548,770
2021	5,813,129	975,743	1,889,540	566,549
2022	5,864,034	993,133	1,968,349	584,649
2023	5,909,790	1,010,295	2,048,783	603,000
2024	5,951,162	1,027,068	2,130,687	621,548
2025	5,989,162	1,044,023	2,213,847	640,332
2026	6,023,141	1,060,815	2,298,423	659,288
2027	6,053,599	1,077,584	2,384,244	678,465
2028	6,080,729	1,094,650	2,471,254	697,883
2029	6,104,782	1,112,395	2,559,318	717,554
2030	6,126,782	1,130,931	2,648,412	737,490
2031	6,146,188	1,149,763	2,738,580	757,633
2032	6,162,185	1,168,572	2,829,874	777,873
2033	6,174,113	1,187,161	2,922,099	798,184
2034	6,181,446	1,205,420	3,015,238	818,611
2035	6,184,142	1,222,942	3,108,993	839,094
2036	6,182,917	1,239,625	3,203,797	859,627
2037	6,179,006	1,256,069	3,299,578	880,191
2038	6,173,032	1,272,306	3,396,216	900,800
2039	6,164,914	1,288,261	3,493,632	921,457
2040	6,154,237	1,304,220	3,591,644	942,217
2041	6,141,319	1,319,622	3,690,394	963,058
2042	6,126,027	1,334,355	3,789,818	983,907
2043	6,109,628	1,348,660	3,889,928	1,004,939
2044	6,092,775	1,362,769	3,990,687	1,026,141
2045	6,074,735	1,376,773	4,091,825	1,047,516
2046	6,056,110	1,390,856	4,193,735	1,069,042
2047	6,036,293	1,405,092	4,296,337	1,090,812
2048	6,016,053	1,419,344	4,399,788	1,112,841
2049	5,996,043	1,433,282	4,504,204	1,135,052
2050	5,976,478	1,447,240	4,609,311	1,157,509

3.6 Visual Impairment and Blindness

Vision Problems in the US estimated the 2010 US population aged 40 and older with visual impairment to be 2.9 million, and the number blind to be nearly 1.3 million. We project that these populations total nearly 3.1 million impaired and almost 1.4 million blind in 2014. We project these populations will grow substantially in the future; by 2032 we estimate that the visually impaired population aged 40 and older will increase by 65% to nearly 5.3 million and the blind population will increase 59% to 2.2 million. By 2050, the impaired and blind populations are projected to reach 7.3 million (2.4 times higher than in 2014) and 3.1 million (2.3 times higher than in 2014), respectively. We project only small increases in prevalence among the younger age groups, but very high growth at older ages. The number of impaired or blind among the population aged 90 and older is forecast to increase nearly 3.5 fold by 2050.

The population of impaired or blind will continue to be dominated by women. Currently 63% of blind and 62% of impaired are women, proportions that will drop by only about 2% each by 2050. The population visually impaired or blind will also continue to be primarily white. Currently 78% of the visually impaired and 81% of persons blind are of white race, proportions that will drop to 65% and 75% by 2050, respectively. Among minorities, Hispanics will be the second most common race/ethnicity group among the visually impaired, while blacks will be the second most common group with blindness.

Figure 3.6.1. Age Distribution of Current Visually Impaired Population

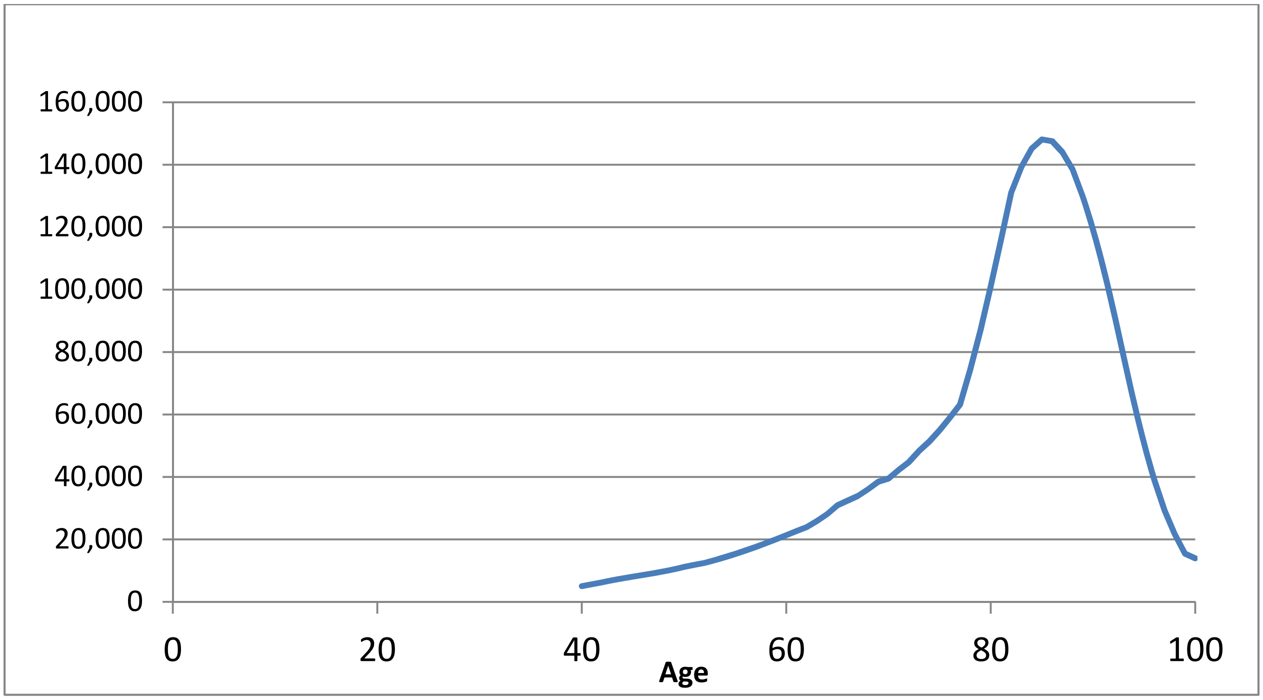


Figure 3.6.2. Age Distribution of Current Blind Population

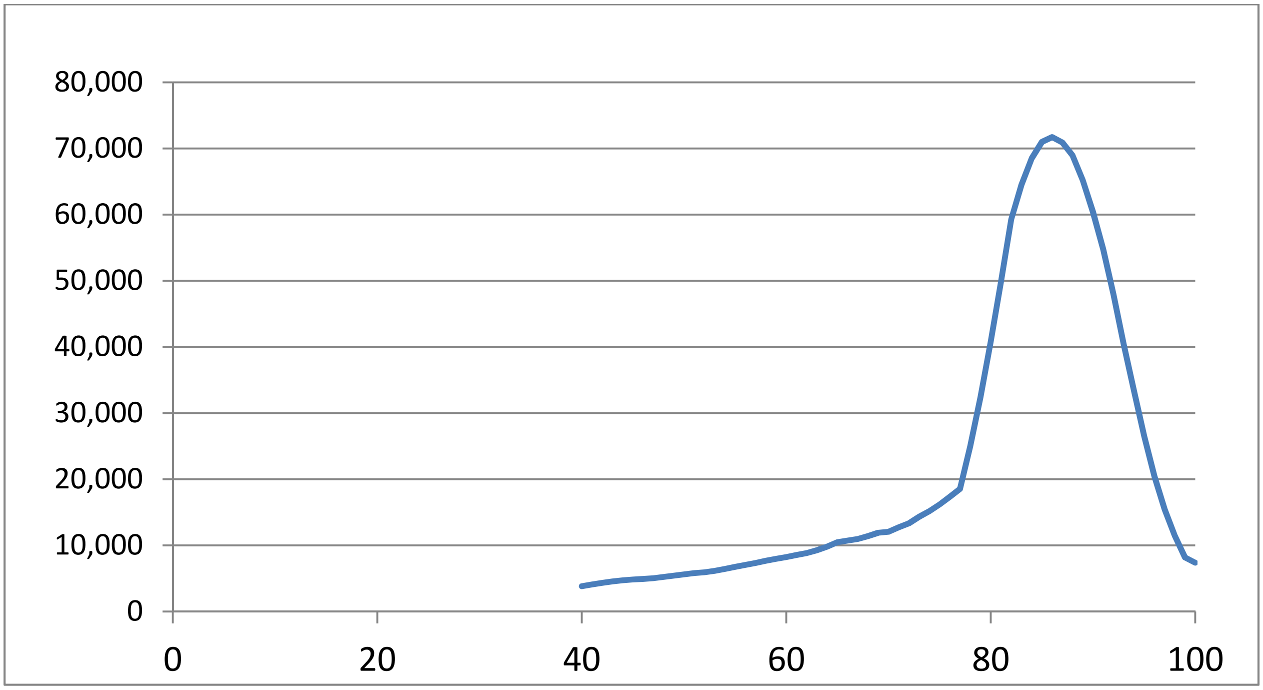


Figure 3.6.3. Projected Visually Impaired Population by Age Group, 2014, 2032 & 2050

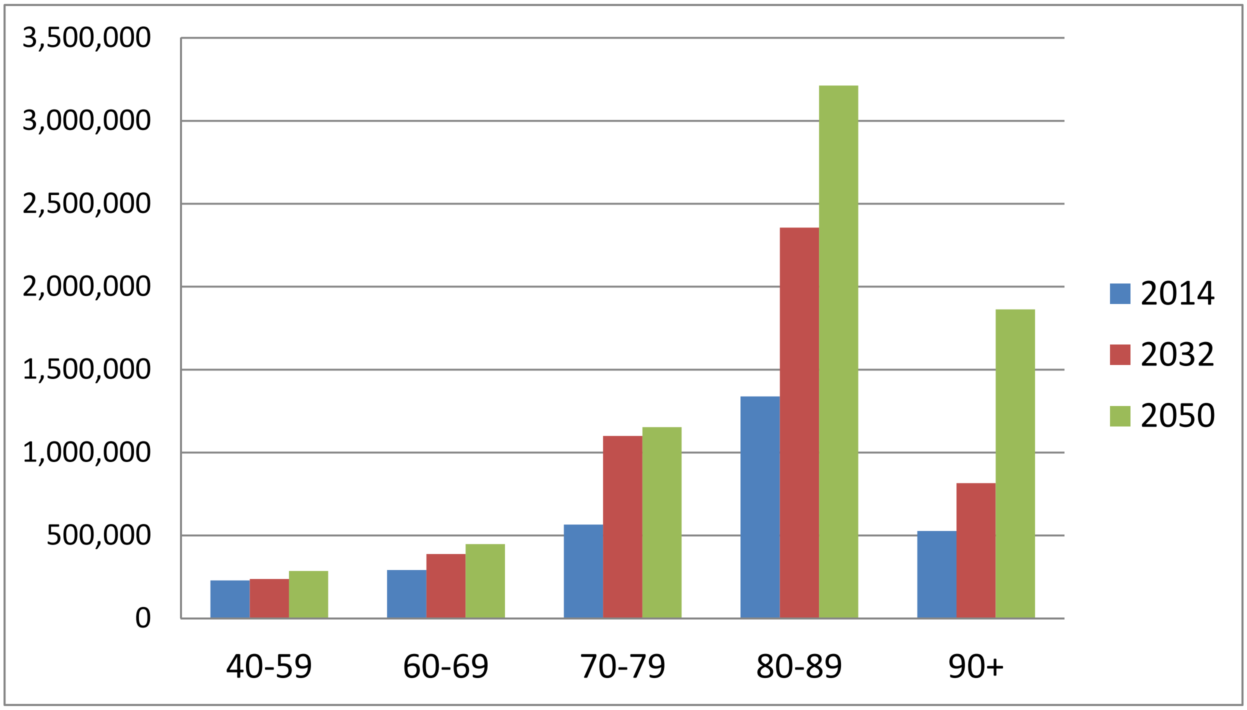


Figure 3.6.4. Projected Blind Population by Age Group, 2014, 2032 & 2050

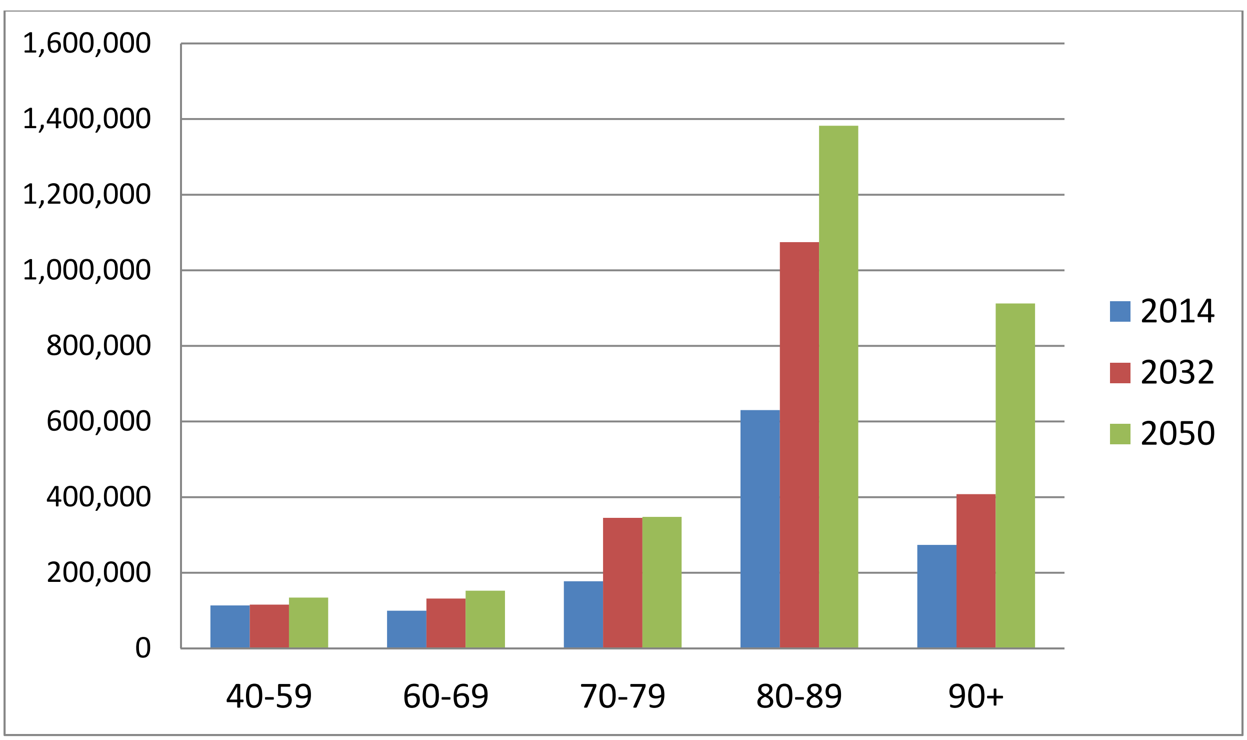


Figure 3.6.5. Projected Visually Impaired Population by Sex and Year

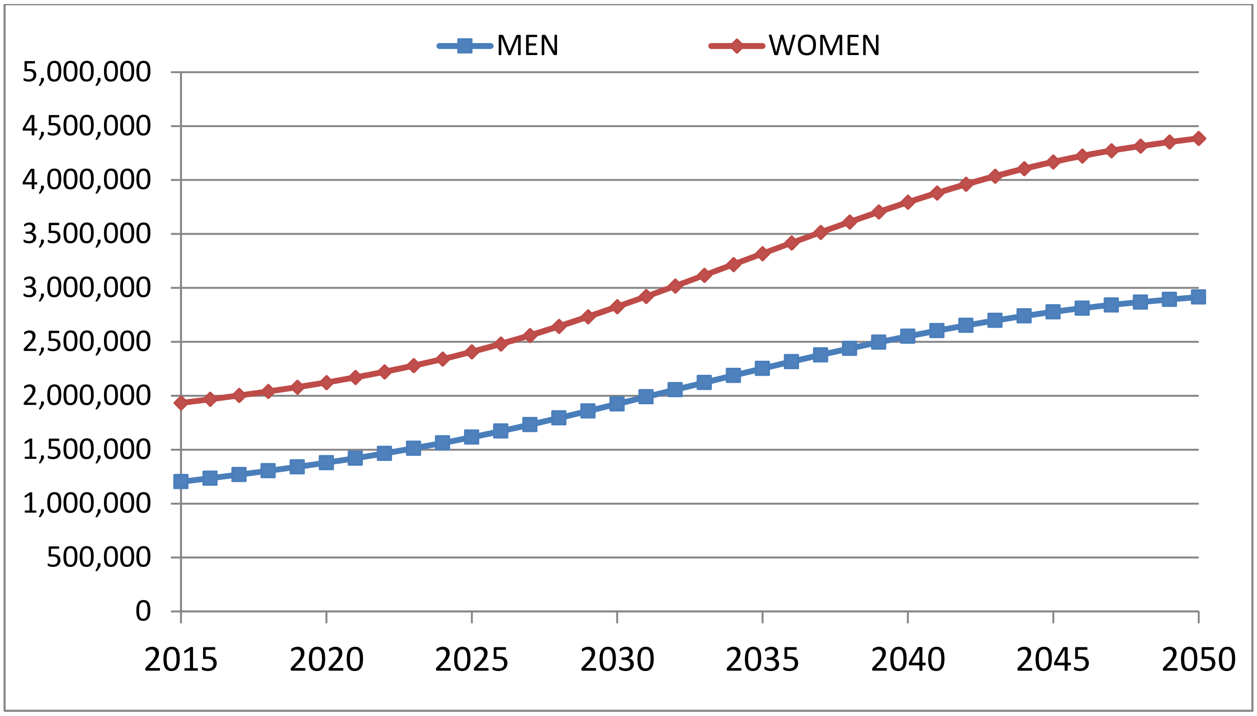


Figure 3.6.6. Projected Blind Population by Sex and Year

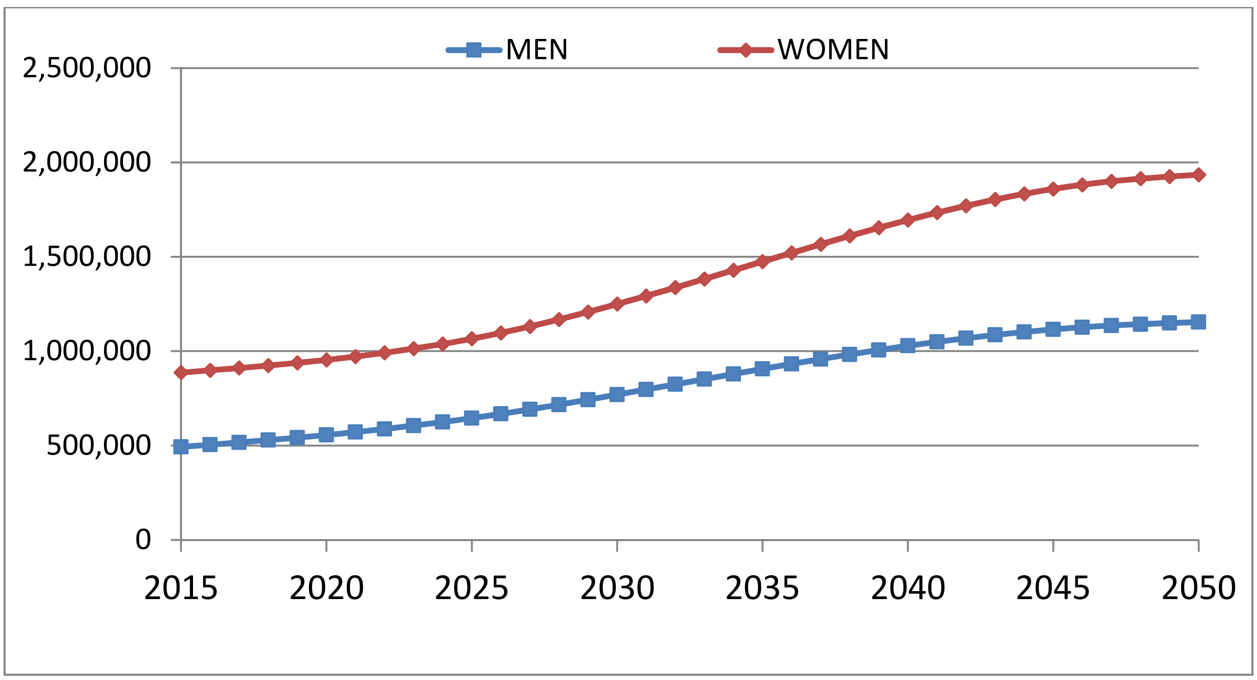


Figure 3.6.7. Projected Visually Impaired Population by Race and Year

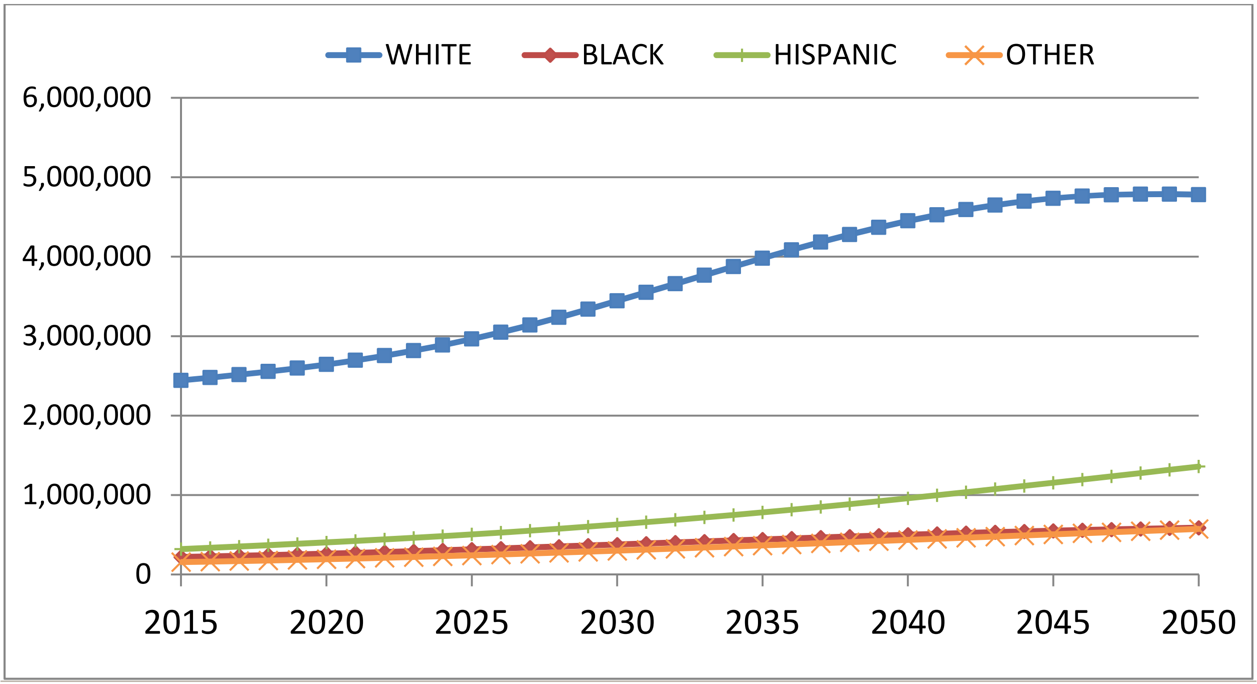


Figure 3.6.8. Projected Blind Population by Race and Year

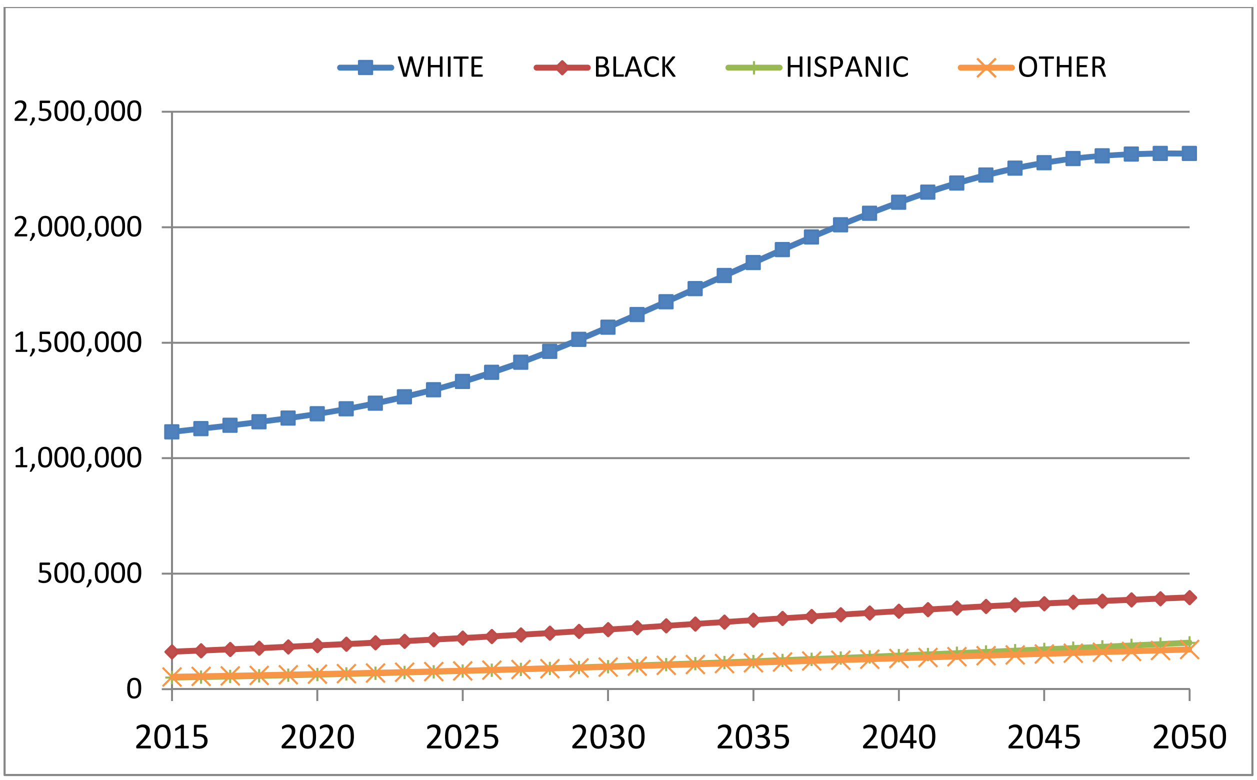


Table 3.6.1. Projected Visually Impaired Population by Age Group

Year	40-59	60-69	70-79	80-89	90+
2014	228,772	291,690	565,666	1,338,426	527,539
2015	229,132	305,215	583,170	1,345,331	551,549
2016	229,381	320,303	602,861	1,354,443	574,064
2017	229,238	325,432	636,329	1,363,602	592,685
2018	229,072	333,188	666,712	1,378,713	610,711
2019	228,908	341,657	699,328	1,399,075	626,748
2020	228,234	350,490	734,173	1,421,300	639,081
2021	227,821	359,210	771,860	1,452,041	653,461
2022	227,698	367,506	807,459	1,494,923	663,887
2023	227,521	374,867	833,033	1,558,124	672,092
2024	227,204	381,042	868,144	1,622,430	678,740
2025	227,346	385,103	911,248	1,682,274	683,477
2026	228,673	388,015	961,817	1,743,041	696,189
2027	230,474	388,896	973,864	1,851,060	708,799
2028	232,404	389,467	996,226	1,950,553	722,525
2029	234,169	389,987	1,021,455	2,054,018	742,389
2030	234,991	389,286	1,048,465	2,157,685	763,209
2031	236,123	389,087	1,075,140	2,260,205	787,597
2032	238,251	388,325	1,100,157	2,356,538	815,490
2033	241,197	386,293	1,122,380	2,438,085	852,329
2034	244,586	383,436	1,140,869	2,536,788	907,190
2035	247,481	381,670	1,153,104	2,643,332	949,664
2036	251,138	382,392	1,162,540	2,751,926	989,329
2037	254,458	384,822	1,164,818	2,799,525	1,025,010
2038	257,824	387,374	1,165,840	2,867,057	1,120,239
2039	261,045	389,393	1,167,055	2,938,042	1,193,314
2040	262,944	389,490	1,163,957	3,013,106	1,258,583
2041	265,421	389,603	1,161,347	3,082,492	1,320,847
2042	267,616	392,792	1,157,678	3,142,339	1,380,264
2043	270,005	398,439	1,150,289	3,192,502	1,439,245
2044	272,966	405,010	1,139,618	3,232,462	1,500,058
2045	275,321	411,053	1,132,260	3,256,699	1,562,902
2046	277,969	419,265	1,133,694	3,265,170	1,628,813
2047	280,830	426,523	1,140,215	3,255,648	1,688,300
2048	283,337	434,434	1,148,527	3,239,803	1,750,976
2049	285,180	442,535	1,154,657	3,225,518	1,809,910
2050	285,817	448,088	1,153,130	3,212,483	1,863,549

Table 3.6.2. Projected Visually Impaired Population by Race

Year	White	Black	Hispanic	Other
2014	2,406,842	211,807	303,744	149,859
2015	2,442,123	219,360	319,116	156,264
2016	2,477,929	227,232	334,904	162,961
2017	2,515,346	235,443	351,176	169,975
2018	2,554,682	244,016	367,951	177,335
2019	2,596,828	252,956	385,267	185,044
2020	2,643,519	262,280	403,262	193,144
2021	2,695,813	271,996	421,898	201,627
2022	2,753,817	282,115	441,279	210,531
2023	2,817,595	292,648	461,469	219,867
2024	2,886,761	303,580	482,508	229,620
2025	2,964,346	314,896	504,546	239,853
2026	3,048,416	326,568	527,580	250,573
2027	3,139,019	338,571	551,652	261,785
2028	3,235,927	350,883	576,840	273,507
2029	3,338,834	363,461	603,145	285,706
2030	3,443,909	376,225	630,549	298,283
2031	3,550,766	389,113	658,976	311,197
2032	3,658,681	402,072	688,420	324,398
2033	3,766,999	415,055	718,850	337,847
2034	3,874,630	427,992	750,212	351,526
2035	3,980,655	440,819	782,447	365,383
2036	4,083,978	453,463	815,810	379,372
2037	4,183,477	465,852	850,234	393,443
2038	4,278,312	477,932	885,683	407,560
2039	4,367,725	489,635	922,043	421,654
2040	4,450,374	500,906	959,245	435,690
2041	4,525,308	511,714	997,196	449,682
2042	4,591,987	522,038	1,035,799	463,621
2043	4,649,515	531,876	1,074,977	477,489
2044	4,697,036	541,233	1,114,647	491,287
2045	4,734,364	550,122	1,154,720	505,007
2046	4,761,338	558,568	1,195,125	518,647
2047	4,777,720	566,582	1,235,758	532,246
2048	4,785,402	574,226	1,276,622	545,904
2049	4,786,177	581,573	1,317,672	559,687
2050	4,780,500	588,700	1,358,950	573,664

Table 3.6.3. Projected Blind Population by Age Group

Year	40-59	60-69	70-79	80-89	90+
2014	113,725	99,527	177,493	630,093	273,862
2015	113,358	104,226	182,669	631,240	285,743
2016	112,883	109,426	188,616	633,604	296,737
2017	112,355	111,727	198,824	635,924	305,652
2018	111,882	114,612	208,054	640,912	314,247
2019	111,472	117,612	218,195	648,612	321,711
2020	111,014	120,657	229,286	657,158	327,198
2021	110,704	123,573	241,781	669,794	333,590
2022	110,557	126,348	253,420	688,007	338,083
2023	110,392	128,808	260,633	715,411	341,497
2024	110,178	130,807	271,201	744,392	344,133
2025	110,228	132,073	285,770	771,294	345,759
2026	110,748	132,829	304,236	798,634	351,378
2027	111,516	132,840	307,171	845,815	357,029
2028	112,380	132,767	313,821	890,313	363,288
2029	113,302	132,627	321,452	937,597	372,722
2030	113,931	132,241	329,754	984,760	382,660
2031	114,681	132,104	337,861	1,031,268	394,336
2032	115,779	131,742	345,462	1,074,419	408,037
2033	117,153	130,893	352,238	1,109,442	426,416
2034	118,718	129,743	357,643	1,153,111	454,191
2035	120,058	128,973	361,044	1,200,374	475,313
2036	121,654	128,943	363,719	1,249,004	494,619
2037	123,073	129,610	363,608	1,265,652	511,706
2038	124,490	130,329	363,113	1,292,859	559,667
2039	125,779	131,046	362,768	1,321,917	595,816
2040	126,592	131,220	360,925	1,352,378	627,808
2041	127,624	131,303	358,982	1,380,112	657,727
2042	128,500	132,377	356,908	1,403,115	686,495
2043	129,443	134,243	353,578	1,421,201	714,981
2044	130,593	136,482	348,706	1,433,972	744,018
2045	131,466	138,652	344,685	1,439,411	773,795
2046	132,423	141,532	343,865	1,437,823	804,522
2047	133,410	144,126	344,954	1,426,961	832,004
2048	134,175	147,011	347,274	1,412,205	861,125
2049	134,487	150,025	349,116	1,397,537	888,202
2050	134,262	152,421	347,658	1,382,550	912,256

Table 3.6.4. Projected Blind Population by Race

Year	White	Black	Hispanic	Other
2014	1,099,714	156,867	47,753	51,298
2015	1,113,709	161,849	50,136	53,423
2016	1,127,531	166,959	52,586	55,623
2017	1,141,894	172,230	55,114	57,907
2018	1,156,933	177,667	57,722	60,278
2019	1,173,213	183,283	60,413	62,740
2020	1,191,750	189,109	63,210	65,304
2021	1,213,276	195,111	66,101	67,958
2022	1,237,844	201,312	69,099	70,713
2023	1,265,489	207,713	72,212	73,568
2024	1,295,970	214,302	75,441	76,516
2025	1,331,615	221,121	78,805	79,568
2026	1,371,156	228,145	82,300	82,720
2027	1,414,724	235,379	85,930	85,970
2028	1,462,286	242,834	89,704	89,324
2029	1,513,785	250,514	93,620	92,777
2030	1,566,847	258,373	97,680	96,308
2031	1,621,358	266,359	101,870	99,907
2032	1,676,988	274,432	106,188	103,556
2033	1,733,449	282,560	110,626	107,249
2034	1,790,182	290,698	115,176	110,983
2035	1,846,763	298,805	119,830	114,748
2036	1,902,601	306,835	124,620	118,537
2037	1,957,052	314,764	129,537	122,340
2038	2,009,662	322,565	134,575	126,151
2039	2,060,035	330,187	139,722	129,960
2040	2,107,337	337,600	144,971	133,766
2041	2,150,955	344,761	150,308	137,568
2042	2,190,523	351,644	155,720	141,362
2043	2,225,383	358,240	161,200	145,156
2044	2,254,832	364,549	166,740	148,951
2045	2,278,651	370,566	172,332	152,748
2046	2,296,656	376,300	177,967	156,545
2047	2,308,692	381,749	183,635	160,354
2048	2,315,848	386,946	189,334	164,191
2049	2,319,157	391,921	195,055	168,060
2050	2,318,734	396,727	200,807	171,981

4. Economic Cost Projections

The Cost of Vision project estimated the total economic burden of vision loss and eye disorders in the United States for all ages. Detailed methods and results are available in the Cost of Vision report at http://costofvision.preventblindness.org/downloads. Briefly, the Cost of Vision report calculated medical costs, costs of long-term care, productivity losses, and other direct and indirect costs incurred by the US economy in 2013. Medical costs were calculated from the Medical Expenditure Panel Surveys (MEPS) based on expenditures attributable to diagnosed eye disorders, self-reported low vision with no diagnosis, and vision correction costs including optometry expenses, which were collected separately from other costs in the MEPS data.[4] Costs of long-term care were calculated based on data from the National Nursing Home Survey and the Genworth Cost of Care survey.[5] Productivity losses were estimated based on data from the Survey of Income and Program Participation.[6] Other costs were estimated based on published data and government budgets.

In this analysis, we primarily present costs in real terms in which costs are reported in constant 2014 dollars, with future changes in cost due only to changes in demographics and medical intensity, a measure that captures changes in medical care utilization, standards of care and technology. We also report certain projections in nominal terms, in which costs are reported based on the expected dollar expenditures in future years by also indexing costs for general inflation, wage growth, and medical cost inflation. In all figures below, real costs are shown using solid lines, while nominal costs are shown using dashed lines.

4.1 Overall Cost Projections

The Cost of Vision report estimated total costs at $139 billion, based on 2013 US dollars and the 2011 US population estimate. The 2014 projected costs presented in this analysis are expressed in 2014 dollars based on the 2014 population projection, which together increase the baseline real cost estimate to $145.2 billion and the nominal expenditure estimate to $150.47 billion. Nominal costs are higher in the baseline year because we assume inflation beginning in 2014. Based on this assumption, real and nominal costs were the same in 2013. Real costs and nominal expenditure projections are shown in **Figure 4.1** and **Table 4.1**.

Real costs in 2014 dollars are projected to increase by approximately to $373 billion by 2050, a more than 2.5 fold increase over 2014 costs. Of the $228 billion increase in costs, $118 billion is from demographic changes and $110 billion is due to projected increases in medical care utilization and intensity. Nominal costs adjusted for projected impacts of general inflation, wage growth and excess medical cost inflation will increase at a much faster rate, reaching $717 billion in 2050.

Figure 4.1. Projected Total Costs, 2014 Real Costs and Nominal Expenditures, $billions

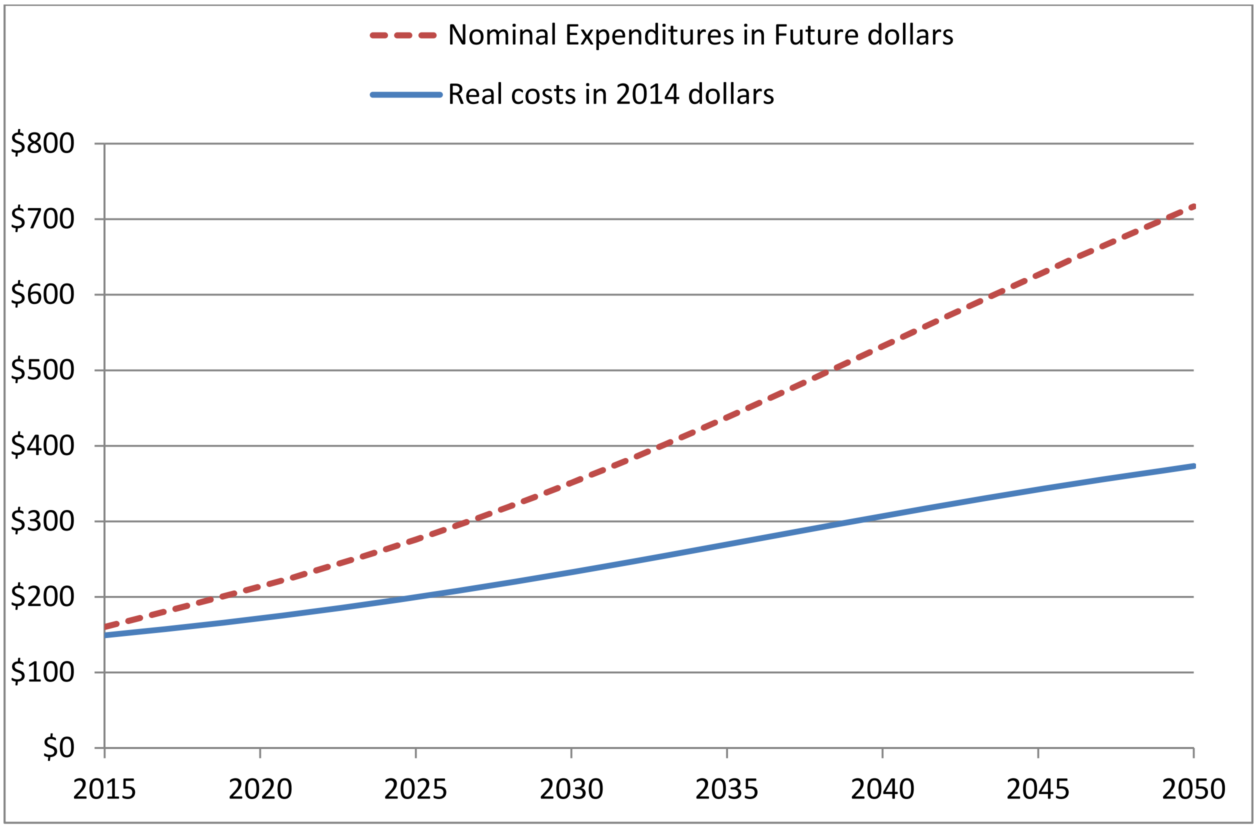


Table 4.1. Projected Total Costs, $billions

Year	2014 Real Costs	Nominal Expenditures
2014	$145.18	$150.47
2015	$149.26	$160.51
2016	$153.39	$170.83
2017	$157.66	$181.37
2018	$162.18	$192.18
2019	$166.84	$202.99
2020	$171.66	$213.92
2021	$176.68	$225.28
2022	$182.47	$237.65
2023	$187.97	$249.97
2024	$193.63	$262.71
2025	$199.63	$276.13
2026	$205.88	$290.12
2027	$212.29	$304.57
2028	$218.94	$319.59
2029	$225.73	$335.06
2030	$232.76	$351.14
2031	$239.90	$367.65
2032	$247.12	$384.55
2033	$254.48	$401.92
2034	$261.90	$419.64
2035	$269.42	$437.76
2036	$277.05	$456.32
2037	$284.60	$474.99
2038	$292.10	$493.82
2039	$299.52	$512.75
2040	$306.97	$531.94
2041	$314.30	$551.11
2042	$321.53	$570.28
2043	$328.49	$589.14
2044	$335.31	$607.90
2045	$342.08	$626.65
2046	$348.85	$645.51
2047	$354.96	$663.27
2048	$361.13	$681.24
2049	$367.21	$699.13
2050	$373.22	$716.93

4.2 Costs by Age Group

A primary driver in the growth of costs is the aging of the baby-boomer population. The baby-boomer effect will be seen essentially as a bulge in cost increases that will move towards the older age groups, reaching the 65-89 age group over the next two decades, followed by a subsequent spike in costs for the 90+ age group as the baby boomers begin to reach this age after 20 years.

This bulge will result in shifts in the peak costs, which will increase from $3.3 billion at age 85 in the current year to $11.2 billion at age 87 in 2050. The costs by age group show that by 2032, costs in the 65-89 year age group will grow by 111%, from $64.9 billion to $137 billion. Costs for the 90+ age group will increase by 85%, from $17 billion to $32 billion. However, in the period from 2032 to 2050, costs for the 80-89 age group will increase only by 34% to reach $188 billion, while costs for the 90+ age group will almost triple to $83 billion. All told, the costs for the 90+ age group are projected to increase nearly 5-fold by the year 2050. Costs among younger age groups will increase by smaller but still substantial amounts, with costs nearly doubling by 2050.

Figure 4.2.1. Distribution of Costs by Age in 2014, 2032 & 2050, 2014 $billions

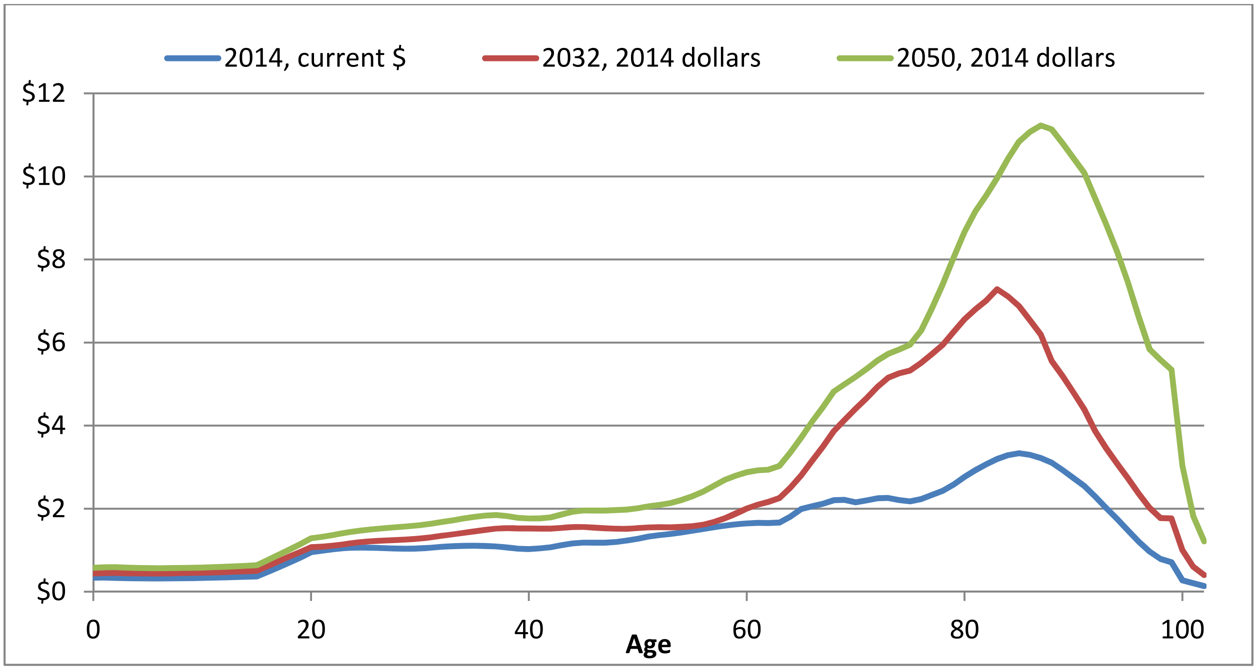


Figure 4.2.2. Distribution of Expenditures by Age in 2014, 2032 & 2050, Nominal $billions

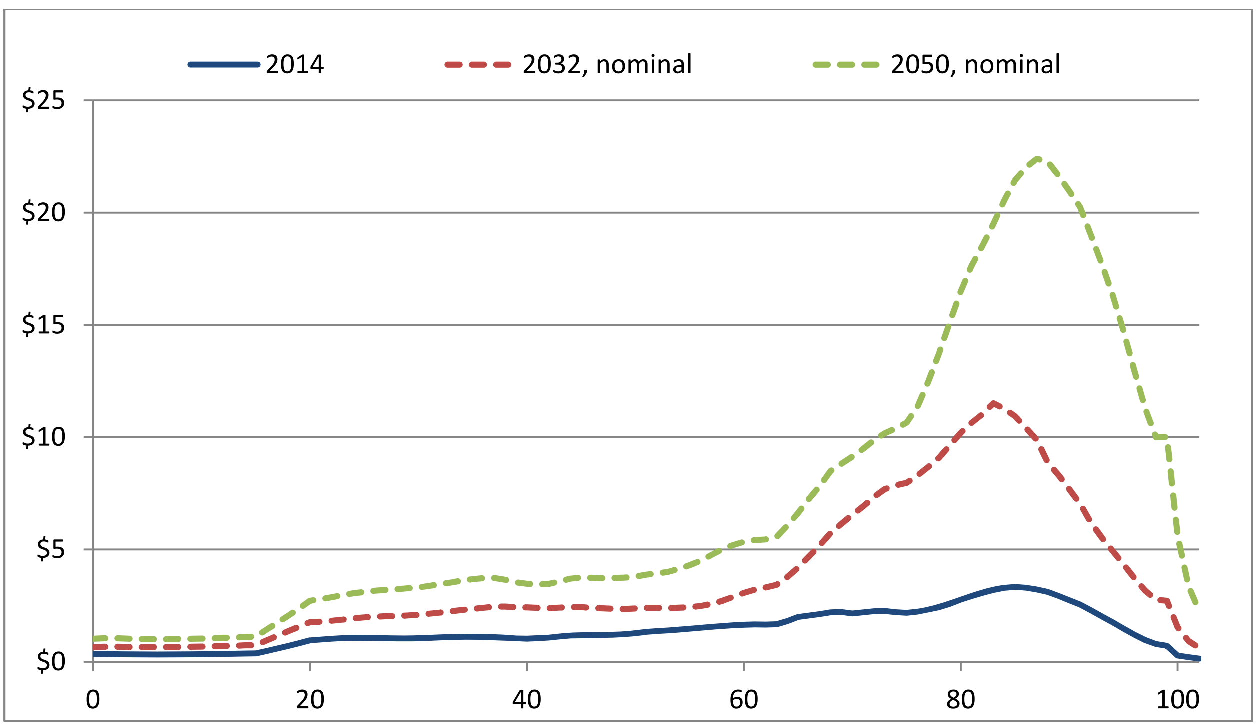


Figure 4.2.3. Total Costs by Age Group in 2014, 2032 & 2050, 2014 $billions

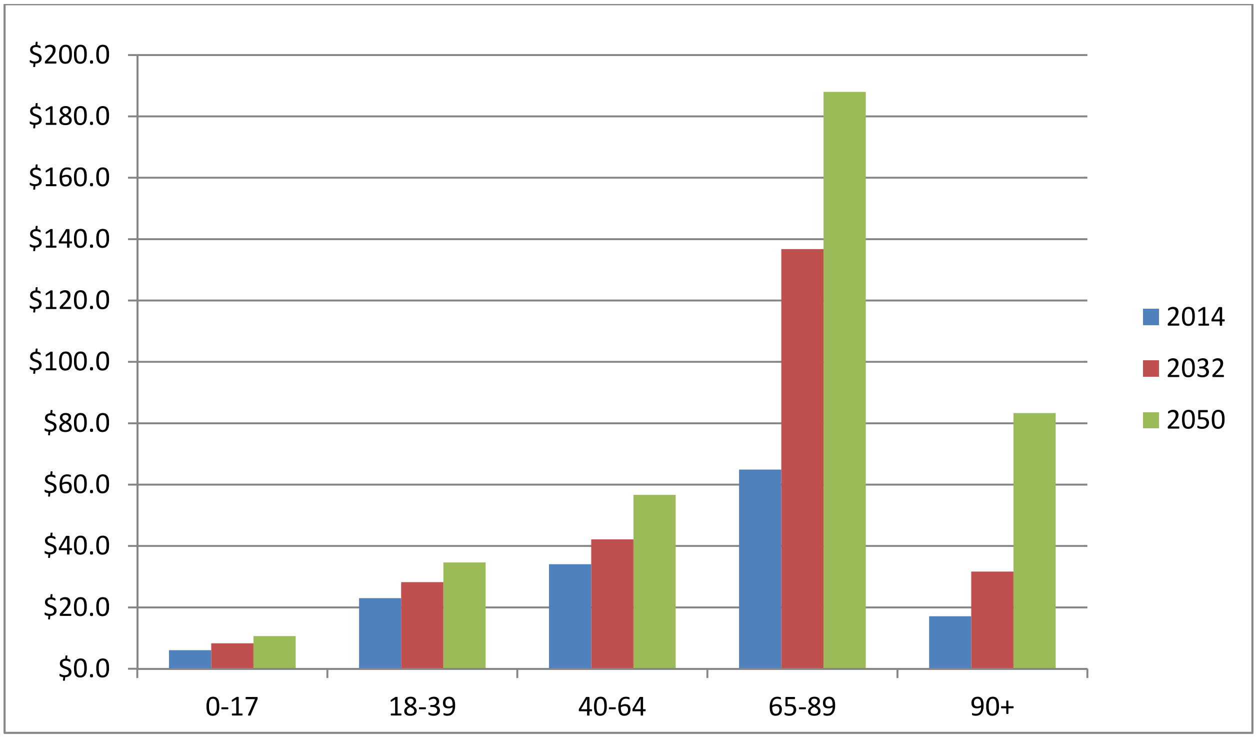


Figure 4.2.4. Share of Total Costs by Age Group in 2014, 2032 & 2050, 2014 $billions

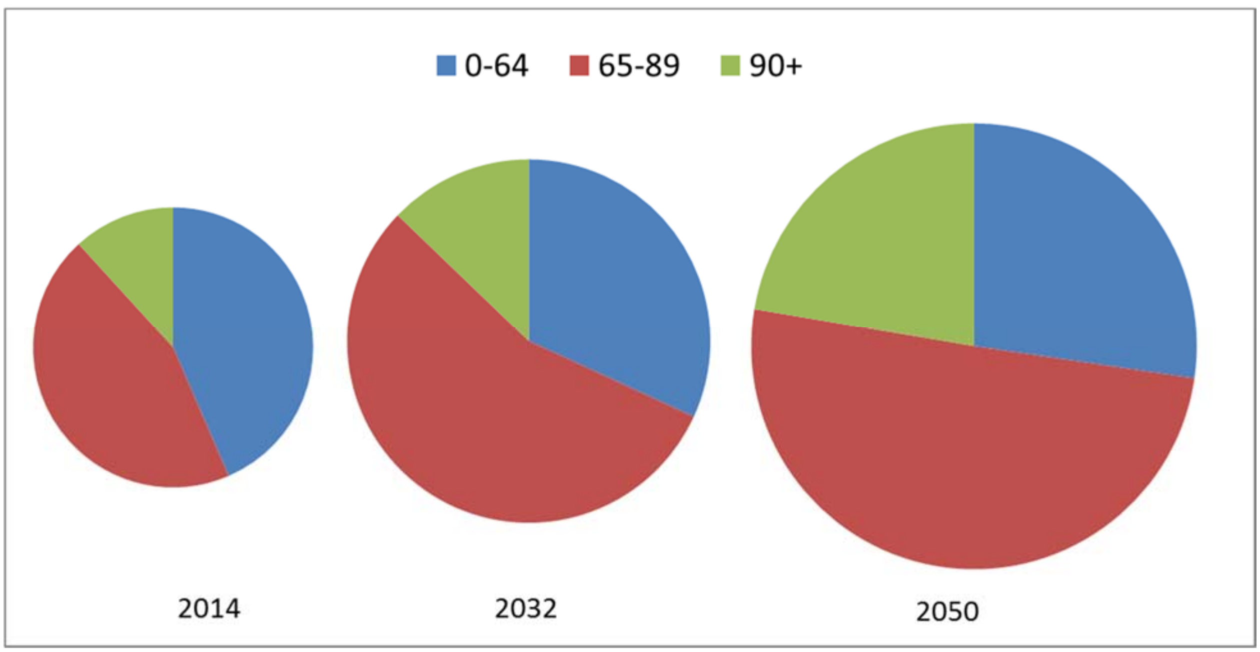


Table 4.2.1. Projected Total Costs by Age Group, 2014 $billions

Year	0-17	18-39	40-64	65-89	90+	Total
2014	$6.1	$23.0	$34.1	$64.9	$17.1	$145.2
2015	$6.2	$23.3	$34.6	$67.2	$18.0	$149.3
2016	$6.3	$23.7	$35.0	$69.6	$18.8	$153.4
2017	$6.4	$24.0	$35.5	$72.1	$19.6	$157.7
2018	$6.5	$24.4	$35.9	$75.0	$20.4	$162.2
2019	$6.6	$24.7	$36.3	$78.1	$21.1	$166.8
2020	$6.7	$25.0	$36.8	$81.4	$21.8	$171.7
2021	$6.8	$25.3	$37.2	$85.0	$22.4	$176.7
2022	$7.0	$25.6	$37.6	$89.2	$23.1	$182.5
2023	$7.1	$25.9	$38.0	$93.4	$23.6	$188.0
2024	$7.3	$26.2	$38.3	$97.8	$24.0	$193.6
2025	$7.4	$26.5	$38.7	$102.4	$24.7	$199.6
2026	$7.5	$26.8	$39.0	$107.2	$25.4	$205.9
2027	$7.7	$27.1	$39.3	$112.2	$26.1	$212.3
2028	$7.8	$27.3	$39.7	$117.1	$26.9	$218.9
2029	$7.9	$27.6	$40.2	$122.2	$27.9	$225.7
2030	$8.1	$27.8	$40.7	$127.2	$29.0	$232.8
2031	$8.2	$28.0	$41.4	$132.1	$30.2	$239.9
2032	$8.3	$28.2	$42.2	$136.8	$31.7	$247.1
2033	$8.4	$28.5	$42.9	$140.9	$33.8	$254.5
2034	$8.6	$28.8	$43.6	$145.4	$35.6	$261.9
2035	$8.7	$29.1	$44.2	$150.1	$37.4	$269.4
2036	$8.8	$29.4	$44.8	$154.9	$39.2	$277.1
2037	$8.9	$29.8	$45.5	$157.7	$42.7	$284.6
2038	$9.0	$30.1	$46.4	$160.8	$45.8	$292.1
2039	$9.2	$30.5	$47.3	$163.9	$48.7	$299.5
2040	$9.3	$30.8	$48.2	$166.9	$51.8	$307.0
2041	$9.4	$31.2	$49.2	$169.9	$54.7	$314.3
2042	$9.5	$31.6	$50.1	$172.6	$57.7	$321.5
2043	$9.7	$31.9	$51.0	$175.2	$60.7	$328.5
2044	$9.8	$32.3	$51.9	$177.4	$63.9	$335.3
2045	$9.9	$32.7	$52.6	$179.5	$67.3	$342.1
2046	$10.1	$33.1	$53.4	$181.5	$70.8	$348.9
2047	$10.2	$33.4	$54.2	$183.2	$73.9	$355.0
2048	$10.4	$33.8	$55.1	$184.9	$77.0	$361.1
2049	$10.5	$34.2	$55.9	$186.5	$80.1	$367.2
2050	$10.7	$34.6	$56.6	$188.0	$83.3	$373.2

4.3 Costs by Payer

Costs are calculated on the basis of three payers; government, private insurance and patients. Private insurance includes medical, vision and long-term care insurance plan payments for medical expenditures and nursing care placements attributable to low vision.

Government payments include medical costs and long-term care costs paid by Federal and state insurance programs, government assistance programs, entitlement programs and tax revenue losses. The entitlement programs and tax losses are budgetary outlays to government but are not included in total costs because they are considered economic transfers, not costs.

Patient costs include all other costs to patients, their families and society not paid by other payers, including out of pocket medical costs, long-term care costs, other direct costs which include low vision aids, devices and adaptations, and productivity losses. Productivity losses include the costs of informal care for children and the elderly due to low vision, as well as the costs of reduced wages and reduced work force participation among adults. Patient costs also include the social cost of deadweight loss due to allocative inefficiency resulting from transfer payments.

Currently, patients incur more than half of all costs, with government paying about a third and private insurance paying about 17% of total costs. As the baby-boomer generation ages into the Medicare program, costs will further shift from patients and private insurance to government. By 2050, government will pay more than 41% of costs while the burden paid by patients and private insurers will drop to 44% and 16%, respectively. When considering nominal costs, which account for cost and wage inflation, the share of total costs paid by patient will remain nearly constant, government costs will increase to 37% and private insurance payments will drop to less than 14% of total costs.

Table 4.3.1. Projected Total Costs by Payer, 2014 $billions

	Government Costs*	Insurance	Patients	Total*
2014	$47.4	$25.2	$74.9	$145.2
2032	$96.5	$40.6	$113.7	$247.1
2050	$154.3	$59.0	$165.2	$373.2

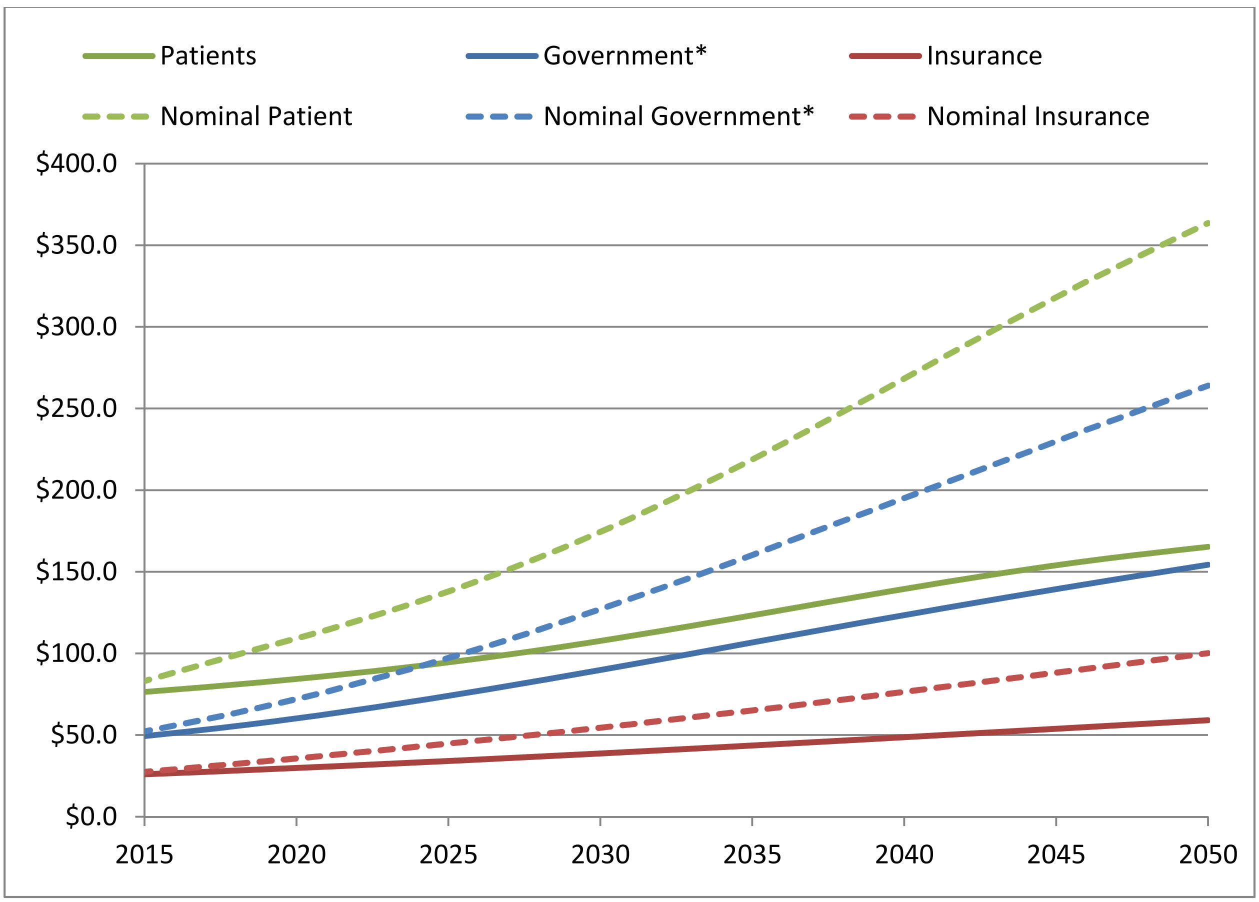
***Government Costs includes entitlement and transfer payments not counted in Total**

Table 4.3.2. Projected Total Expenditures by Payer, Nominal $billions

	Government Costs*	Insurance	Patients	Total*
2014	$48.9	$26.0	$78.0	$150.5
2032	$140.1	$58.7	$191.3	$384.6
2050	$264.1	$100.2	$363.6	$716.9

***Government Costs includes entitlement and transfer payments not counted in Total**

Figure 4.3.1. Projected Total Costs by Payer



*Government Costs includes entitlement and transfer payments not counted in Total

Table 4.3.3. Projected Total Costs by Payer, 2014 $billions

Year	Government Costs*	Insurance	Patients	Total*
2014	$47.4	$25.2	$74.9	$145.2
2015	$49.3	$25.9	$76.4	$149.3
2016	$51.3	$26.7	$77.9	$153.4
2017	$53.3	$27.4	$79.4	$157.7
2018	$55.5	$28.2	$81.0	$162.2
2019	$57.8	$29.0	$82.6	$166.8
2020	$60.2	$29.8	$84.3	$171.7
2021	$62.6	$30.6	$86.1	$176.7
2022	$65.5	$31.6	$88.1	$182.5
2023	$68.2	$32.4	$90.1	$188.0
2024	$71.0	$33.3	$92.2	$193.6
2025	$74.0	$34.1	$94.5	$199.6
2026	$77.0	$35.0	$96.9	$205.9
2027	$80.1	$35.9	$99.4	$212.3
2028	$83.3	$36.8	$102.1	$218.9
2029	$86.6	$37.7	$104.8	$225.7
2030	$89.9	$38.6	$107.7	$232.8
2031	$93.2	$39.6	$110.7	$239.9
2032	$96.5	$40.6	$113.7	$247.1
2033	$99.8	$41.6	$116.9	$254.5
2034	$103.2	$42.5	$120.1	$261.9
2035	$106.7	$43.5	$123.3	$269.4
2036	$110.2	$44.5	$126.6	$277.1
2037	$113.5	$45.5	$129.8	$284.6
2038	$116.9	$46.5	$133.1	$292.1
2039	$120.1	$47.6	$136.3	$299.5
2040	$123.5	$48.6	$139.5	$307.0
2041	$126.7	$49.7	$142.6	$314.3
2042	$130.0	$50.8	$145.7	$321.5
2043	$133.1	$51.8	$148.5	$328.5
2044	$136.2	$52.9	$151.3	$335.3
2045	$139.4	$53.9	$154.0	$342.1
2046	$142.6	$54.9	$156.5	$348.9
2047	$145.5	$55.9	$158.8	$355.0
2048	$148.5	$57.0	$161.0	$361.1
2049	$151.4	$58.0	$163.2	$367.2
2050	$154.3	$59.0	$165.2	$373.2

4.4 Cost by Category

Costs were calculated on the basis of seven cost categories, including medical costs, long-term care costs, productivity losses, government assistance programs, entitlement payments, deadweight loss from transfer payments, and other direct costs.

Total costs are dominated by medical costs, productivity losses and long-term care costs, which contribute 47%, 36% and 15% of total costs, respectively. All other costs combined contribute less than 4% of total costs. Medical costs currently total $69 billion per year, and are projected to increase to total $174 billion by 2050, 2.5-fold increase. Productivity losses will nearly double, from $52 billion to $99 billion by 2050. The cost category with by far the highest rate of growth will be long-term care costs. Driven by the enormous growth of the population aged 90 and older, long-term care attributable to low vision is projected to increase more than four-fold from $22 billion in 2014 to $95 billion in 2050. Our projections anticipate that the cost of government assistance programs will increase by only 36%. Entitlement program spending by government, which is not included in the total costs, is expected to increase by 130% based on an increase in the eligible population. Deadweight loss will increase commensurately with these transfer payments. We project other direct costs to patients to more than double from $0.8 billion to $1.7 billion per year in 2050.

Figure 4.4.1. Projected Total Costs by Category, 2014, 2032 & 2050

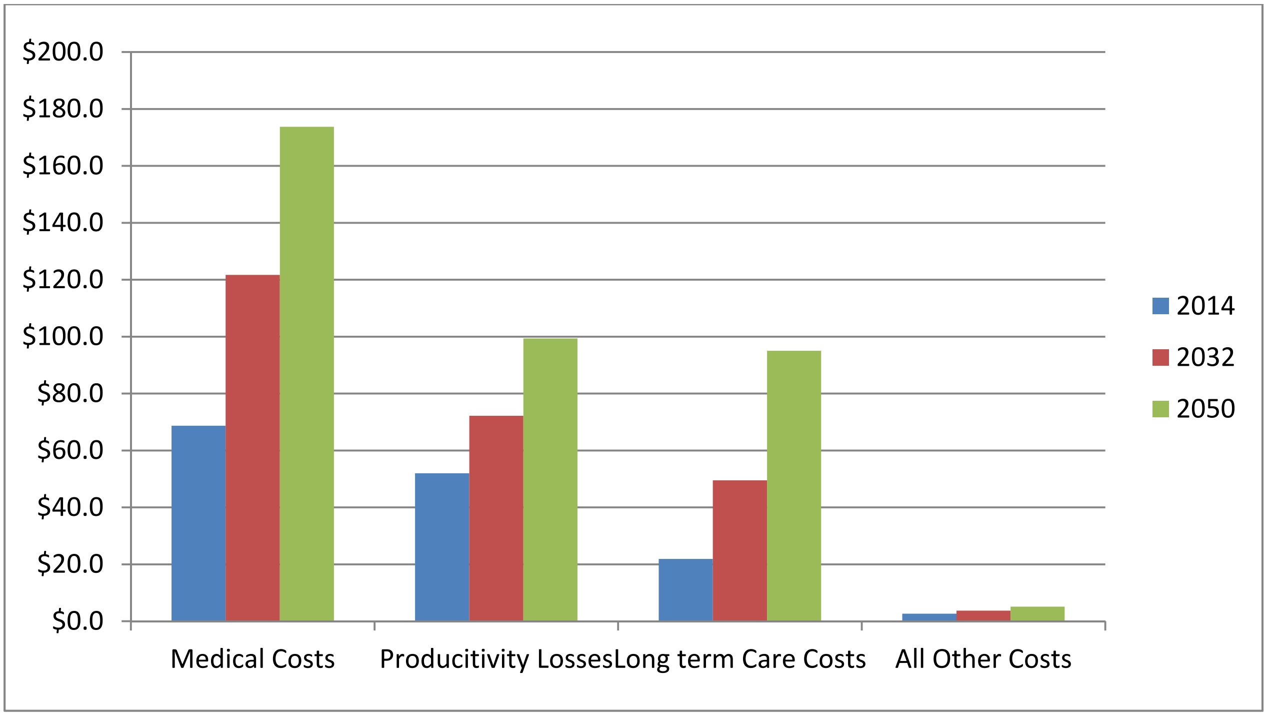


Figure 4.4.2. Projected Total Costs by Category, $billions

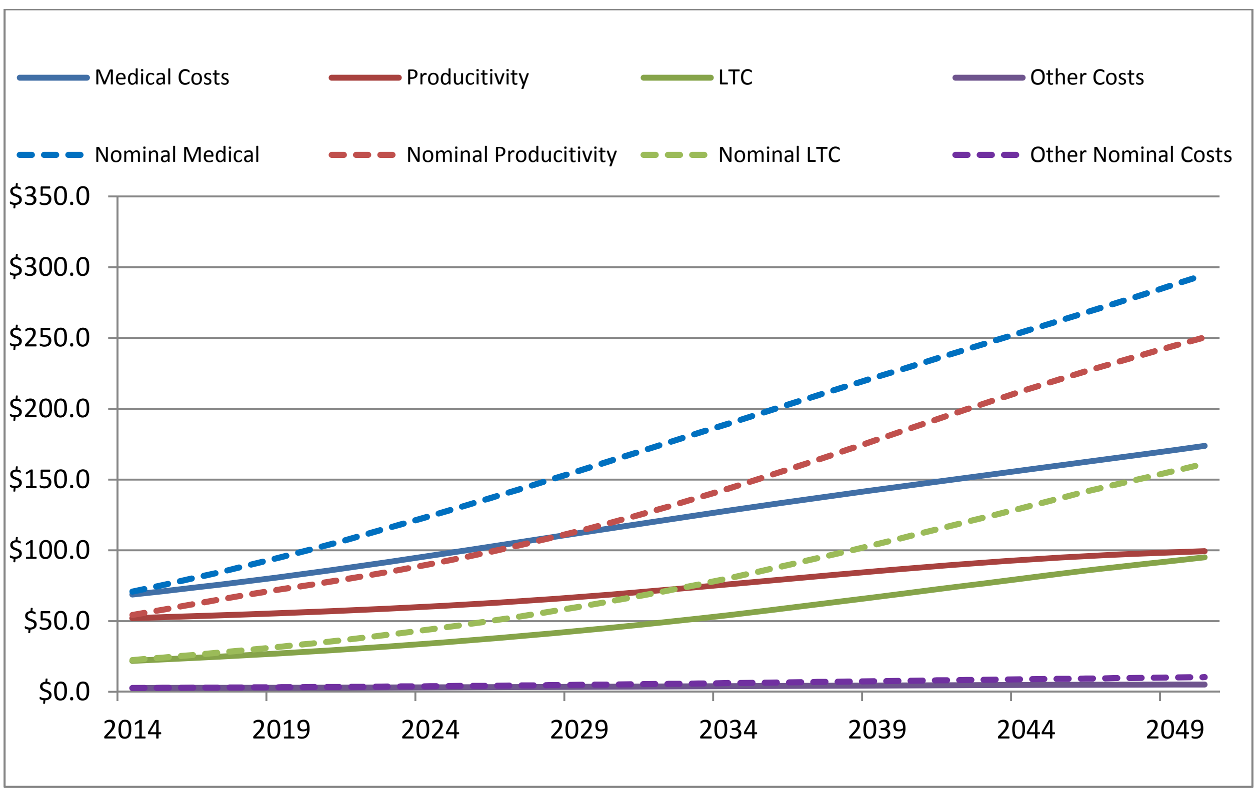


Table 4.4.1. Projected Costs by Category, 2014 $billions

	Govern-ment Programs	Entitle-ments	Dead-weight Loss	Other Direct Costs	Productivity Losses	Medical Costs	Long term Care	Total Costs
2014	$1.0	$2.3	$0.9	$0.8	$52.0	$68.7	$21.9	$145.2
2015	$1.0	$2.4	$0.9	$0.8	$52.7	$71.0	$22.8	$149.3
2016	$1.0	$2.4	$0.9	$0.8	$53.4	$73.4	$23.9	$153.4
2017	$1.0	$2.5	$0.9	$0.8	$54.1	$75.9	$24.9	$157.7
2018	$1.0	$2.5	$1.0	$0.8	$54.9	$78.5	$26.0	$162.2
2019	$1.0	$2.6	$1.0	$0.8	$55.6	$81.2	$27.2	$166.8
2020	$1.0	$2.6	$1.0	$0.9	$56.4	$83.9	$28.5	$171.7
2021	$1.0	$2.7	$1.0	$0.9	$57.2	$86.8	$29.7	$176.7
2022	$1.0	$2.7	$1.0	$0.9	$58.1	$90.1	$31.2	$182.5
2023	$1.0	$2.8	$1.1	$0.9	$59.1	$93.1	$32.7	$188.0
2024	$1.1	$2.9	$1.1	$0.9	$60.2	$96.2	$34.2	$193.6
2025	$1.1	$2.9	$1.1	$1.0	$61.4	$99.3	$35.8	$199.6
2026	$1.1	$3.0	$1.2	$1.0	$62.7	$102.5	$37.5	$205.9
2027	$1.1	$3.1	$1.2	$1.0	$64.0	$105.7	$39.3	$212.3
2028	$1.1	$3.2	$1.2	$1.1	$65.5	$108.9	$41.2	$218.9
2029	$1.1	$3.3	$1.3	$1.1	$67.0	$112.1	$43.1	$225.7
2030	$1.1	$3.4	$1.3	$1.1	$68.7	$115.3	$45.2	$232.8
2031	$1.1	$3.6	$1.3	$1.2	$70.4	$118.5	$47.3	$239.9
2032	$1.1	$3.7	$1.4	$1.2	$72.2	$121.7	$49.5	$247.1
2033	$1.2	$3.8	$1.4	$1.2	$74.0	$124.8	$51.8	$254.5
2034	$1.2	$3.9	$1.5	$1.3	$75.9	$127.9	$54.2	$261.9
2035	$1.2	$4.0	$1.5	$1.3	$77.8	$131.0	$56.6	$269.4
2036	$1.2	$4.2	$1.6	$1.4	$79.7	$134.1	$59.2	$277.1
2037	$1.2	$4.3	$1.6	$1.4	$81.6	$137.0	$61.8	$284.6
2038	$1.2	$4.4	$1.7	$1.4	$83.4	$140.0	$64.4	$292.1
2039	$1.2	$4.5	$1.7	$1.5	$85.3	$142.8	$67.0	$299.5
2040	$1.2	$4.6	$1.8	$1.5	$87.1	$145.7	$69.7	$307.0
2041	$1.3	$4.7	$1.8	$1.5	$88.8	$148.5	$72.4	$314.3
2042	$1.3	$4.8	$1.8	$1.6	$90.4	$151.3	$75.1	$321.5
2043	$1.3	$4.9	$1.9	$1.6	$92.0	$154.1	$77.7	$328.5
2044	$1.3	$5.0	$1.9	$1.6	$93.3	$156.8	$80.3	$335.3
2045	$1.3	$5.1	$1.9	$1.7	$94.6	$159.6	$83.0	$342.1
2046	$1.3	$5.2	$2.0	$1.7	$95.8	$162.4	$85.8	$348.9
2047	$1.3	$5.2	$2.0	$1.7	$96.8	$165.2	$88.1	$355.0
2048	$1.3	$5.3	$2.0	$1.7	$97.7	$168.0	$90.4	$361.1
2049	$1.3	$5.4	$2.0	$1.7	$98.6	$170.8	$92.7	$367.2
2050	$1.3	$5.4	$2.1	$1.7	$99.3	$173.7	$95.0	$373.2

4.5 Medical Treatment Costs by Disorder

The Cost of Vision report calculated the medical expenditures attributable to individual disorder categories. An important consideration is that these estimates did not represent the full cost of disease because they do not capture any costs of vision loss resulting from these conditions. The MEPS data used to estimate medical costs recorded medical expenditures as reported by medical providers and 3-digit ICD-9 codes assigned based on self-reported diagnoses and procedures. We used econometric methods to estimate the costs attributable to any diagnosed disorder (diagnosed disorders), medical costs attributable to self-reported low vision among individuals who had no eye or vision disorder diagnosis (undiagnosed low vision), and costs of optometry care and medical vision aids such as glasses and contacts (vision correction). MEPS collects vision correction costs separately, and unlike other medical costs, these costs are self-reported by patients and not associated with diagnosis codes. We therefor estimated vision correction expenditures using an accounting approach.

Figure 4.5.1 and **Table 4.5.1** show projections of costs for all diagnosed disorders, vision correction costs, and undiagnosed low vision. Medical costs for diagnosed disorders are estimated to be $48.6 billion in 2014, and are projected to grow at a high rate in future years due to both the growing population of older Americans and projected increases in medical care intensity. Vision correction and undiagnosed low vision costs are projected to grow at a comparatively slower rate, largely because these costs are not as highly skewed towards older ages and thus not as sensitive to the growth of the older population.

Figure 4.5.2 and **Table 4.5.2** break down the Diagnosed Disorder costs into eleven disorder categories. As detailed in the Cost of Vision report, MEPS codes diagnoses at the 3-digit ICD-9 level. Several important disorders are coded at the 4th or 5th digit level, and thus cannot be distinguished in our data. These include AMD and diabetic retinopathy. To approximate the costs of these disorders, we grouped all retinal disorder costs and then report these costs separately for persons with and without diabetes. Full details and validation of this assumption is included in the Cost of Vision report.

The highest cost disorder group is cataracts, followed by glaucoma. The category including conjunctivitis and disorders of the lacrimal system and eyelids is the third costliest before year 2014, but is projected to fall to the 6th costliest group after 2022. Retinal disorders among persons without diabetes are the third costliest beginning in 2014, while costs for persons with diabetes increases from 6th to 4th costliest by 2024.

Figure 4.5.1. Projected Medical Treatment Costs by Disorder Type, 2014 $billions

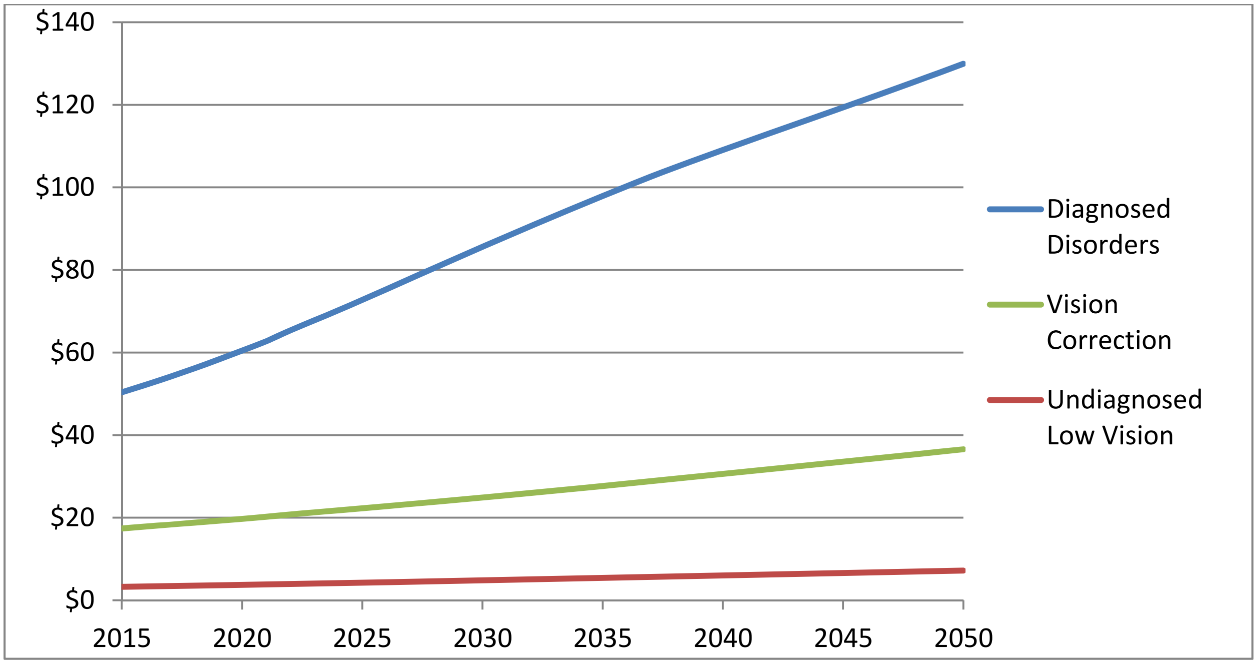


Figure 4.5.2. Projected Medical Treatment Costs by Diagnosed Disorder, 2014 $billions

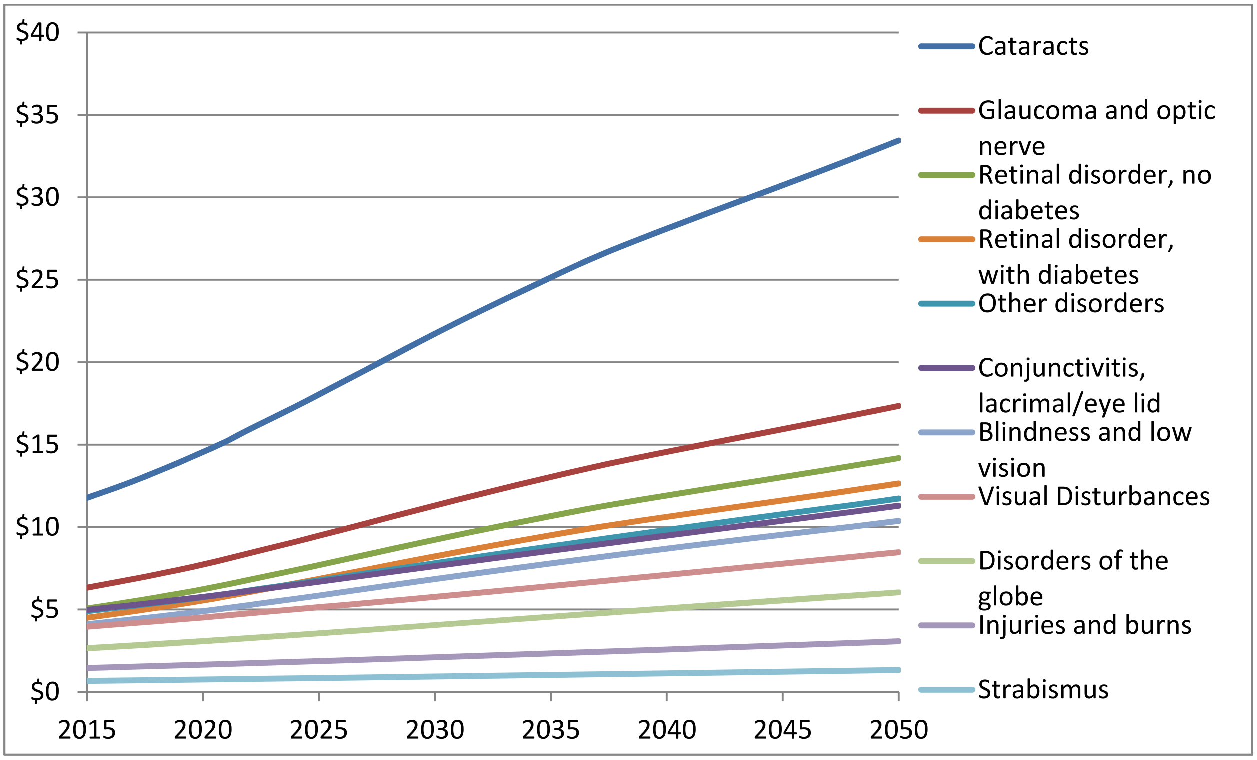


Table 4.5.1. Projected Medical Treatment Costs by Disorder Type, 2014 $billions

Year	Total Diagnosed	Undiagnosed Low Vision	Vision Correction
2014	$48.6	$3.2	$16.9
2015	$50.4	$3.3	$17.4
2016	$52.2	$3.4	$17.9
2017	$54.1	$3.4	$18.3
2018	$56.2	$3.5	$18.8
2019	$58.3	$3.6	$19.3
2020	$60.5	$3.7	$19.7
2021	$62.7	$3.8	$20.2
2022	$65.4	$4.0	$20.8
2023	$67.8	$4.1	$21.3
2024	$70.2	$4.2	$21.8
2025	$72.8	$4.3	$22.3
2026	$75.3	$4.4	$22.8
2027	$77.9	$4.5	$23.3
2028	$80.5	$4.6	$23.8
2029	$83.0	$4.7	$24.4
2030	$85.6	$4.8	$24.9
2031	$88.2	$4.9	$25.4
2032	$90.6	$5.1	$26.0
2033	$93.1	$5.2	$26.6
2034	$95.5	$5.3	$27.1
2035	$97.9	$5.4	$27.7
2036	$100.3	$5.5	$28.2
2037	$102.6	$5.7	$28.8
2038	$104.8	$5.8	$29.4
2039	$106.9	$5.9	$30.0
2040	$109.1	$6.0	$30.6
2041	$111.2	$6.1	$31.2
2042	$113.2	$6.3	$31.8
2043	$115.3	$6.4	$32.4
2044	$117.3	$6.5	$33.0
2045	$119.4	$6.6	$33.6
2046	$121.5	$6.7	$34.2
2047	$123.5	$6.9	$34.8
2048	$125.7	$7.0	$35.4
2049	$127.8	$7.1	$36.0
2050	$129.9	$7.2	$36.6

Table 4.5.2. Projected Medical Treatment Costs by Diagnosed Disorder, 2014 $billions

Year	Cataracts	Glaucoma and optic nerve	Retinal disorder, no diabetes	Conjunc-tivitis, lacrimal/ eye lid	Other disorders	Retinal disorder, with diabetes	Blindness and low vision	Visual Distur-bances	Disorders of the globe	Injuries and burns	Strabismus
2014	$11.3	$6.1	$4.9	$4.8	$4.7	$4.3	$4.0	$3.9	$2.6	$1.4	$0.7
2015	$11.8	$6.3	$5.1	$5.0	$4.9	$4.5	$4.1	$4.0	$2.6	$1.4	$0.7
2016	$12.3	$6.6	$5.3	$5.1	$5.1	$4.7	$4.3	$4.1	$2.7	$1.5	$0.7
2017	$12.8	$6.8	$5.5	$5.3	$5.2	$4.9	$4.4	$4.2	$2.8	$1.5	$0.7
2018	$13.3	$7.1	$5.7	$5.4	$5.4	$5.1	$4.6	$4.3	$2.9	$1.6	$0.7
2019	$13.9	$7.4	$6.0	$5.6	$5.6	$5.3	$4.7	$4.4	$3.0	$1.6	$0.7
2020	$14.6	$7.7	$6.2	$5.8	$5.8	$5.6	$4.9	$4.5	$3.1	$1.6	$0.7
2021	$15.2	$8.1	$6.5	$5.9	$5.9	$5.8	$5.1	$4.6	$3.2	$1.7	$0.8
2022	$15.9	$8.4	$6.8	$6.1	$6.2	$6.1	$5.3	$4.8	$3.3	$1.7	$0.8
2023	$16.6	$8.8	$7.1	$6.3	$6.4	$6.3	$5.5	$4.9	$3.4	$1.8	$0.8
2024	$17.3	$9.1	$7.4	$6.5	$6.6	$6.6	$5.7	$5.0	$3.5	$1.8	$0.8
2025	$18.0	$9.5	$7.7	$6.7	$6.8	$6.9	$5.8	$5.1	$3.6	$1.9	$0.8
2026	$18.8	$9.8	$8.0	$6.9	$7.0	$7.1	$6.0	$5.3	$3.7	$1.9	$0.9
2027	$19.5	$10.2	$8.3	$7.1	$7.2	$7.4	$6.2	$5.4	$3.8	$2.0	$0.9
2028	$20.2	$10.6	$8.6	$7.2	$7.4	$7.7	$6.4	$5.5	$3.9	$2.0	$0.9
2029	$21.0	$10.9	$8.9	$7.4	$7.6	$7.9	$6.6	$5.6	$4.0	$2.1	$0.9
2030	$21.7	$11.3	$9.2	$7.6	$7.8	$8.2	$6.8	$5.8	$4.1	$2.1	$0.9
2031	$22.4	$11.7	$9.5	$7.8	$8.0	$8.5	$7.0	$5.9	$4.2	$2.1	$1.0
2032	$23.1	$12.0	$9.8	$8.0	$8.2	$8.8	$7.2	$6.0	$4.3	$2.2	$1.0
2033	$23.8	$12.4	$10.1	$8.2	$8.4	$9.0	$7.4	$6.2	$4.4	$2.2	$1.0
2034	$24.5	$12.7	$10.4	$8.4	$8.6	$9.3	$7.6	$6.3	$4.5	$2.3	$1.0
2035	$25.1	$13.0	$10.7	$8.6	$8.8	$9.5	$7.8	$6.4	$4.6	$2.3	$1.0
2036	$25.8	$13.4	$10.9	$8.8	$9.0	$9.8	$8.0	$6.6	$4.7	$2.4	$1.1
2037	$26.4	$13.7	$11.2	$8.9	$9.2	$10.0	$8.2	$6.7	$4.8	$2.4	$1.1
2038	$27.0	$14.0	$11.4	$9.1	$9.4	$10.2	$8.3	$6.8	$4.9	$2.5	$1.1

Year	Cataracts	Glaucoma and optic nerve	Retinal disorder, no diabetes	Conjunc-tivitis, lacrimal/ eye lid	Other disorders	Retinal disorder, with diabetes	Blindness and low vision	Visual Distur-bances	Disorders of the globe	Injuries and burns	Strabismus
2039	$27.6	$14.3	$11.7	$9.3	$9.6	$10.4	$8.5	$7.0	$5.0	$2.5	$1.1
2040	$28.1	$14.6	$11.9	$9.5	$9.8	$10.6	$8.7	$7.1	$5.1	$2.6	$1.1
2041	$28.6	$14.8	$12.1	$9.7	$10.0	$10.8	$8.9	$7.2	$5.2	$2.6	$1.1
2042	$29.2	$15.1	$12.4	$9.8	$10.2	$11.0	$9.0	$7.4	$5.3	$2.7	$1.2
2043	$29.7	$15.4	$12.6	$10.0	$10.4	$11.2	$9.2	$7.5	$5.4	$2.7	$1.2
2044	$30.2	$15.7	$12.8	$10.2	$10.6	$11.4	$9.4	$7.6	$5.5	$2.8	$1.2
2045	$30.7	$15.9	$13.0	$10.4	$10.8	$11.6	$9.5	$7.8	$5.5	$2.8	$1.2
2046	$31.3	$16.2	$13.3	$10.6	$11.0	$11.8	$9.7	$7.9	$5.6	$2.9	$1.2
2047	$31.8	$16.5	$13.5	$10.7	$11.1	$12.0	$9.9	$8.1	$5.7	$2.9	$1.3
2048	$32.4	$16.8	$13.7	$10.9	$11.3	$12.2	$10.0	$8.2	$5.8	$3.0	$1.3
2049	$32.9	$17.1	$13.9	$11.1	$11.5	$12.4	$10.2	$8.3	$5.9	$3.0	$1.3
2050	$33.4	$17.3	$14.2	$11.3	$11.7	$12.6	$10.4	$8.5	$6.0	$3.1	$1.3

5. Sensitivity Analyses

Sensitivity analyses show the impact of parameter uncertainty on projections. Known sources of parameter uncertainty include the projected population, the prevalence of vision problems, and the cost of vision problems. The sensitivity analysis does not reflect unknown causes of uncertainty, such as major changes in epidemiology, medical care and utilization, costs, or inflation. In this analysis we incorporate sensitivity analyses based on uncertainty in the population projections, the current prevalence of vision problems, and costs of vision problems.

5.1 Uncertainty in Projected Prevalence of Vision Problems

Sources of parameter uncertainty in the projections of eye disease prevalence include uncertainty in the population projections and the current prevalence of eye disease. The US Census' population projections are released as a middle series, as well as low and high series based on alternative assumptions. We assume the low and high series projections are analogous to the credible range of population projections.

The Vision Problems in the US database does not report confidence intervals or standard errors for the prevalence estimates. However, this data is based on a series of studies released by the Eye Disease Prevalence Research Group (EDPRG) in 2004.[7-13] The EDPRG included most of the underlying studies included in the Vision Problems database, and reported 95% confidence intervals for prevalence estimates for each disease by age, sex and race. We applied the percent ranges associated with the EDPRG confidence intervals to the prevalence estimates reported in the Vision Problems database to generate approximations of confidence intervals for the current prevalence estimates. We believe that this is a conservative approach to estimating uncertainty in the current estimates because the Vision Problems database includes all of the data from the EDPRG plus additional studies, which results in larger sample sizes than were used to create the confidence intervals. Thus, we believe that it is likely that the Vision Problems prevalence estimates would have less uncertainty than we are applying based on the level of uncertainty observed in the earlier EDPRG estimates.

Figure 5.1 and **Table 5.1** show the 95% confidence interval range of disease prevalence projections. Uncertainty is a function of both uncertainty in disease prevalence, which is static over time, and uncertainty in population projections, which increases over time. The impact of population uncertainty is much smaller than that of prevalence uncertainty, but nonetheless contributes to the range between the low and high prevalence projections increasing over time.

In terms of overall scale of uncertainty in the current prevalent population, cataract and diabetic retinopathy dwarf the other conditions due primarily to their high overall prevalence estimate. The 2014 cataract prevalence estimate ranges from 23.9 million to 27.4, a range of over 3.5 million. Diabetic retinopathy has a current range of uncertainty of over 2 million, while all other disorders are less than 1 million. However, in terms of percentage range of uncertainty, the prevalence of blindness is by far the most uncertain, with the difference between the high and low values equal to half the baseline prevalence estimate. Uncertainty in each disorder increases slightly over time.

Figure 5.1. 95% Confidence Intervals of Prevalence Projections

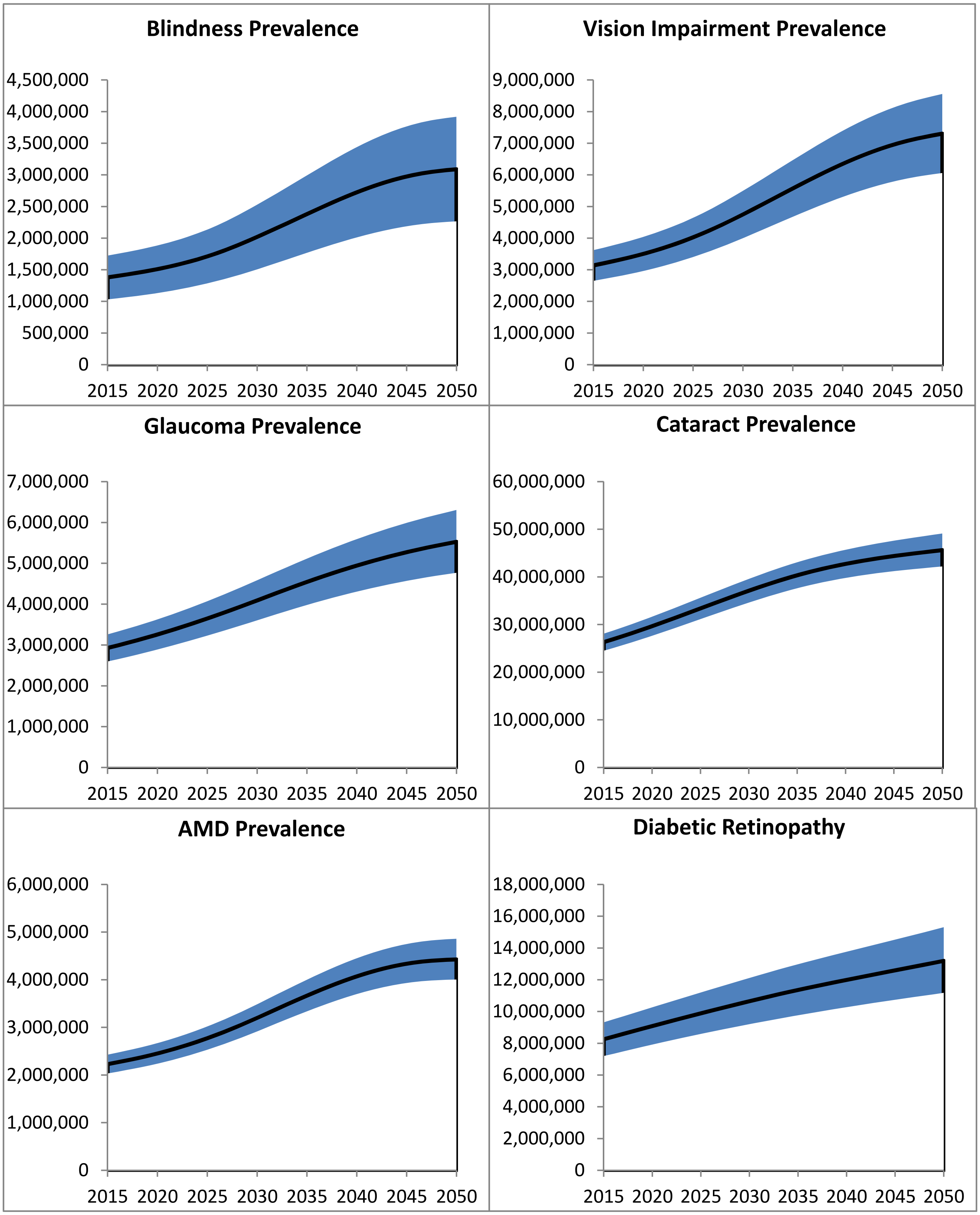


Table 5.1. 95% Confidence Intervals of Prevalence Projections

Year	Blindness	Impairment	Glaucoma	Cataract	AMD	Diabetic Retinopathy
2015	1,031,214 - 1,723,458	2,649,032 - 3,620,524	2,595,831 - 3,258,556	24,504,901 - 28,091,273	2,032,473 - 2,426,335	7,194,070 - 9,320,906
2016	1,049,461 - 1,752,343	2,705,714 - 3,696,126	2,651,028 - 3,327,107	25,093,499 - 28,765,113	2,069,984 - 2,470,684	7,338,297 - 9,507,518
2017	1,068,456 - 1,782,249	2,764,837 - 3,774,746	2,707,776 - 3,398,166	25,704,737 - 29,457,638	2,108,748 - 2,516,320	7,482,259 - 9,696,109
2018	1,088,089 - 1,813,533	2,826,408 - 3,857,254	2,765,856 - 3,471,481	26,334,334 - 30,171,328	2,149,328 - 2,564,197	7,625,300 - 9,885,846
2019	1,108,978 - 1,846,755	2,891,485 - 3,944,399	2,825,897 - 3,547,367	26,981,314 - 30,906,073	2,192,370 - 2,615,102	7,767,068 - 10,074,028
2020	1,131,875 - 1,883,305	2,961,585 - 4,038,532	2,888,772 - 3,627,171	27,645,937 - 31,659,772	2,239,294 - 2,670,828	7,909,521 - 10,262,899
2021	1,157,326 - 1,924,011	3,037,581 - 4,140,822	2,953,246 - 3,709,425	28,323,110 - 32,429,198	2,289,927 - 2,731,183	8,049,865 - 10,450,205
2022	1,185,042 - 1,969,345	3,119,199 - 4,252,170	3,019,319 - 3,795,283	29,015,195 - 33,211,090	2,344,051 - 2,795,651	8,188,848 - 10,642,699
2023	1,214,579 - 2,019,849	3,206,016 - 4,373,170	3,086,889 - 3,884,425	29,717,031 - 34,006,030	2,401,488 - 2,864,676	8,324,134 - 10,832,003
2024	1,246,769 - 2,074,195	3,299,128 - 4,502,006	3,156,113 - 3,975,699	30,426,008 - 34,811,099	2,462,691 - 2,937,931	8,456,105 - 11,018,548
2025	1,283,441 - 2,135,398	3,401,067 - 4,642,632	3,227,951 - 4,070,699	31,138,812 - 35,620,296	2,529,423 - 3,017,647	8,586,154 - 11,203,737
2026	1,323,675 - 2,201,751	3,510,255 - 4,792,693	3,301,269 - 4,167,978	31,849,753 - 36,430,918	2,599,976 - 3,101,827	8,713,041 - 11,387,095
2027	1,365,042 - 2,275,995	3,623,372 - 4,955,625	3,374,625 - 4,268,849	32,556,996 - 37,234,947	2,674,015 - 3,192,102	8,837,862 - 11,568,517
2028	1,410,034 - 2,355,539	3,743,856 - 5,127,724	3,449,793 - 4,372,055	33,255,420 - 38,031,678	2,752,066 - 3,286,936	8,960,593 - 11,749,019
2029	1,458,259 - 2,440,672	3,870,849 - 5,309,072	3,526,484 - 4,477,738	33,941,418 - 38,816,353	2,833,833 - 3,386,305	9,081,713 - 11,929,137
2030	1,507,885 - 2,528,345	4,000,869 - 5,495,078	3,603,989 - 4,585,097	34,614,036 - 39,586,083	2,917,618 - 3,488,214	9,202,902 - 12,109,423
2031	1,558,744 - 2,618,308	4,133,503 - 5,685,006	3,681,432 - 4,692,795	35,266,014 - 40,336,709	3,001,964 - 3,590,934	9,322,828 - 12,289,110
2032	1,610,560 - 2,710,151	4,267,990 - 5,877,987	3,758,029 - 4,799,842	35,894,254 - 41,062,962	3,086,805 - 3,694,387	9,440,573 - 12,466,683
2033	1,662,997 - 2,803,533	4,403,543 - 6,073,265	3,833,359 - 4,905,894	36,495,574 - 41,761,219	3,171,407 - 3,797,767	9,555,145 - 12,640,973
2034	1,715,535 - 2,897,735	4,539,061 - 6,269,482	3,907,277 - 5,010,848	37,067,547 - 42,428,698	3,254,788 - 3,899,880	9,665,687 - 12,811,640
2035	1,767,811 - 2,992,149	4,673,562 - 6,465,454	3,979,304 - 5,114,034	37,608,408 - 43,061,157	3,336,887 - 4,000,633	9,771,773 - 12,977,447
2036	1,819,620 - 3,085,718	4,806,654 - 6,659,638	4,049,471 - 5,214,982	38,114,833 - 43,660,679	3,416,498 - 4,098,610	9,874,472 - 13,139,445
2037	1,870,135 - 3,177,874	4,936,808 - 6,850,891	4,117,452 - 5,313,680	38,586,119 - 44,225,652	3,492,890 - 4,193,082	9,975,443 - 13,299,487
2038	1,919,279 -	5,063,580 -	4,183,188 -	39,022,334 -	3,565,818 -	10,075,283 -

Year	Blindness	Impairment	Glaucoma	Cataract	AMD	Diabetic Retinopathy
	3,267,736	7,037,731	5,409,684	44,755,363	4,283,637	13,458,058
2039	1,966,764 - 3,354,647	5,186,189 - 7,218,940	4,246,499 - 5,502,726	39,424,566 - 45,249,605	3,634,876 - 4,369,769	10,173,753 - 13,614,920
2040	2,011,652 - 3,437,824	5,302,925 - 7,393,217	4,307,288 - 5,593,069	39,795,556 - 45,708,779	3,699,455 - 4,450,896	10,270,855 - 13,769,495
2041	2,053,779 - 3,516,096	5,413,500 - 7,558,703	4,365,304 - 5,679,555	40,133,227 - 46,137,156	3,758,565 - 4,525,773	10,366,572 - 13,921,584
2042	2,092,896 - 3,588,843	5,517,373 - 7,714,680	4,420,244 - 5,761,941	40,439,193 - 46,536,051	3,811,752 - 4,593,673	10,459,723 - 14,071,632
2043	2,128,364 - 3,655,379	5,613,492 - 7,860,194	4,472,388 - 5,840,922	40,716,697 - 46,909,206	3,858,359 - 4,653,819	10,551,436 - 14,221,956
2044	2,159,617 - 3,714,883	5,701,050 - 7,994,219	4,521,764 - 5,916,573	40,971,224 - 47,261,096	3,898,176 - 4,705,950	10,642,368 - 14,373,581
2045	2,186,669 - 3,766,867	5,780,094 - 8,116,180	4,568,350 - 5,988,780	41,207,568 - 47,593,882	3,931,230 - 4,749,799	10,731,075 - 14,526,134
2046	2,209,828 - 3,810,628	5,851,093 - 8,225,160	4,612,725 - 6,057,377	41,426,295 - 47,914,674	3,957,519 - 4,785,286	10,819,504 - 14,679,987
2047	2,228,700 - 3,846,270	5,913,332 - 8,321,261	4,654,780 - 6,122,701	41,629,651 - 48,223,642	3,976,848 - 4,812,569	10,907,484 - 14,834,169
2048	2,244,044 - 3,875,275	5,968,330 - 8,407,076	4,694,810 - 6,185,471	41,822,067 - 48,525,763	3,990,462 - 4,833,188	10,995,758 - 14,989,577
2049	2,256,359 - 3,899,272	6,017,296 - 8,485,164	4,732,702 - 6,245,921	42,007,062 - 48,823,725	3,999,485 - 4,848,662	11,084,594 - 15,146,701
2050	2,265,319 - 3,919,002	6,060,125 - 8,556,954	4,768,829 - 6,305,404	42,190,723 - 49,119,660	4,004,491 - 4,859,878	11,173,926 - 15,306,283

5.2 Uncertainty in Projected Cost of Vision Problems

Sources of parameter uncertainty in the projections of the cost of vision problems include uncertainty in the population projections and uncertainty in the cost estimates derived from the Cost of Vision report. The Cost of Vision report included a probabilistic sensitivity analysis based on simultaneously sampling over 70 underlying parameters from their prior distributions and recording the resulting cost estimates, and then repeating this process 10,000 times. The distribution of cost estimates over these 10,000 replications equates to the full spectrum of possible results, with the 2.5th percentile and 97.5th percentile cost values representing the 95 percent credible interval of costs. A credible interval is essentially the Bayesian statistical equivalent of a confidence interval.

The projected credible intervals of total costs by year are shown in **Figure 5.2** and **Table 5.2** below. As with the prevalence projections, the increased range of uncertainty is associated with both higher costs and later years of projection. In 2014, the baseline real cost projection is $145 billion, while the lower bound of the 95% credible interval is $117 billion, the upper bound is $182 billion, equating to a range of $65 billion. By 2032, the lower and upper bound cost projections are $199 billion and $309 billion, yielding a range of $110 billion. By 2050, the lower and upper bound cost projections reach $300 billion and 467 billion; a range of $167 billion.

Figure 5.2. 95% Confidence Intervals of Cost Projections

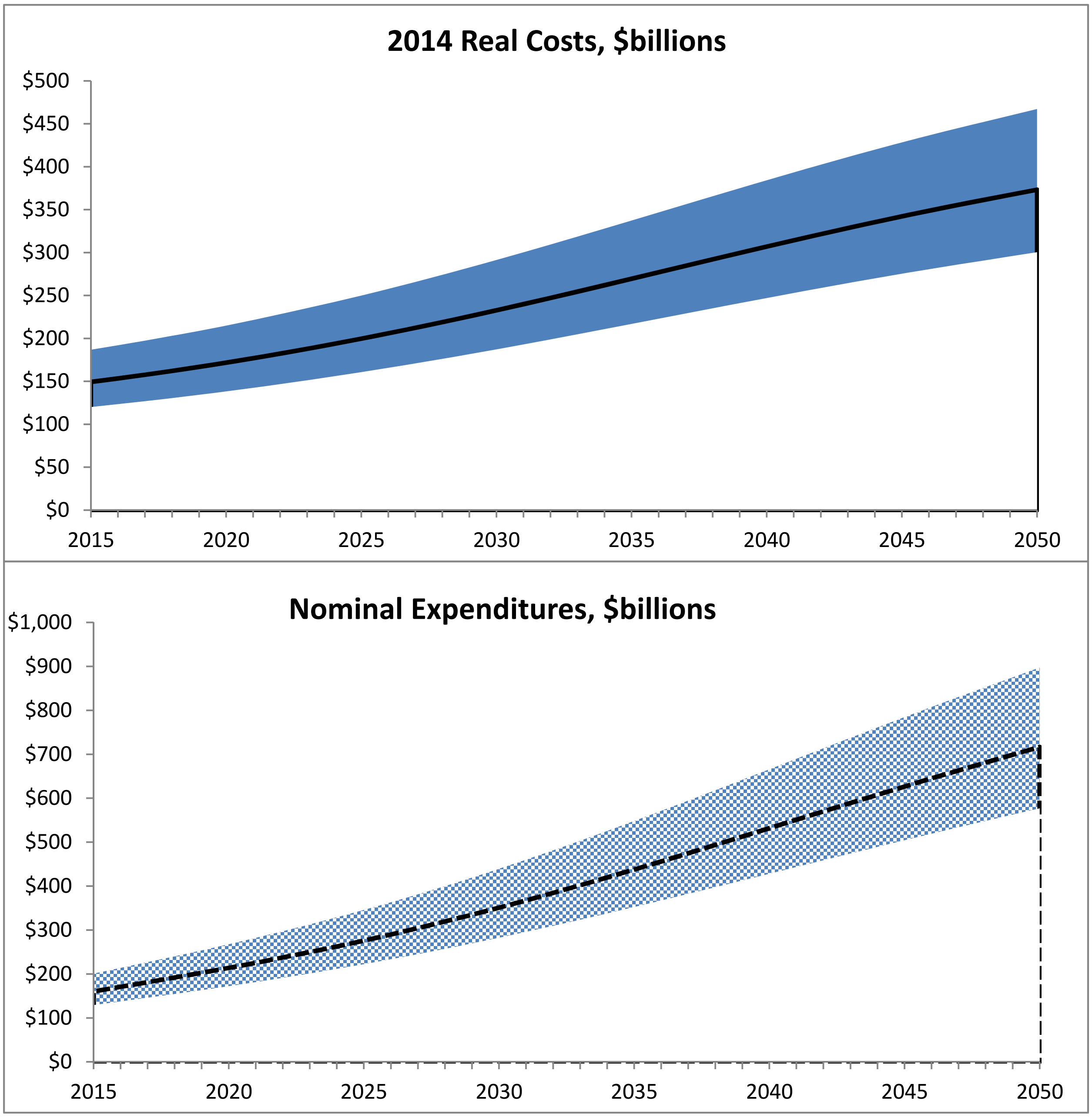


Table 5.2. 95% Credible Intervals of Real Cost Projections

Year	Real Cost Projection	95% Credible Interval
2014	$145.18	($116.8 - $181.7)
2015	$149.26	($120.1 - $186.8)
2016	$153.39	($123.4 - $192.0)
2017	$157.66	($126.9 - $197.3)
2018	$162.18	($130.5 - $203.0)
2019	$166.84	($134.3 - $208.8)
2020	$171.66	($138.1 - $214.9)
2021	$176.68	($142.2 - $221.1)
2022	$182.47	($146.8 - $228.4)
2023	$187.97	($151.3 - $235.3)
2024	$193.63	($155.8 - $242.4)
2025	$199.63	($160.7 - $249.9)
2026	$205.88	($165.7 - $257.7)
2027	$212.29	($170.8 - $265.7)
2028	$218.94	($176.2 - $274.0)
2029	$225.73	($181.7 - $282.5)
2030	$232.76	($187.3 - $291.3)
2031	$239.90	($193.1 - $300.3)
2032	$247.12	($198.9 - $309.3)
2033	$254.48	($204.8 - $318.5)
2034	$261.90	($210.8 - $327.8)
2035	$269.42	($216.8 - $337.2)
2036	$277.05	($223.0 - $346.8)
2037	$284.60	($229.0 - $356.2)
2038	$292.10	($235.1 - $365.6)
2039	$299.52	($241.0 - $374.9)
2040	$306.97	($247.0 - $384.2)
2041	$314.30	($252.9 - $393.4)
2042	$321.53	($258.7 - $402.4)
2043	$328.49	($264.3 - $411.2)
2044	$335.31	($269.8 - $419.7)
2045	$342.08	($275.3 - $428.2)
2046	$348.85	($280.7 - $436.7)
2047	$354.96	($285.7 - $444.3)
2048	$361.13	($290.6 - $452.0)
2049	$367.21	($295.5 - $459.6)
2050	$373.22	($300.3 - $467.2)

6. Methods and Data

This analysis provides estimated projections of the future prevalence and cost of vision loss and eye disorders in the United States. The baseline year is 2014, with annual projections through year 2050. We use a prevalence-based approach whereby we assign future prevalence on the basis of current per-capita prevalence, adjusted for projected population change and changes in cost and medical cost inflation. The projections in this analysis are based on three primary data sources:

1. The Vision Problems in the US database
2. The Cost of Vision Problems: The Economic Burden of Vision Loss and Eye Disorders in the United States
3. U.S. Census Bureau population projections

The Vision Problems database was released at the first national Focus on Eye Health National Summit in 2012.[1] This database updates prior meta-analyses of multiple population-based studies measuring the prevalence of major eye disorders and vision loss.[7-13] The database provides an online tool to report the prevalence rate or prevalent population in the United States with each of eight disorders.

The second annual Eye Summit saw the release of the Cost of Vision Problems report.[2] For the first time, the economic burden of vision loss and eye disorders was estimated for the entire US population. We found the total cost to be $139 billion based on the 2011 US population in 2013 dollars. This report serves as both the latest but most comprehensive accounting for the economic and quality of life impact of vision loss available.

This analysis builds off both the Vision Problems database and the Cost of Vision report by using US Census population projections to forecast the future prevalence of disorders included in the Vision Problems database, and the future costs included in the Cost of Vision report.[1, 2, 14]

6.1 Projecting the Prevalence of Vision Loss and Eye Disorders

The Vision Problems database reports the prevalence of vision loss and eye disorders in the United States. We include the following disorders from the Vision Problems database:

- Visual impairment,
- Blindness,
- Glaucoma,
- Cataract,
- Age-related macular degeneration, and
- Diabetic retinopathy

For each condition, the Vision Problems database reports the prevalence rate by sex, race and age category. The Vision Problems analysis also reports the prevalent population with each condition by race, sex, and age category based on the 2010 US Census population estimate.

The race categories include non-Hispanic whites, non-Hispanic blacks, Hispanics (which is treated as race), and all others. The Vision Problems in the US database reports prevalence for ages 40-49, and by 5-year age groups through age 79, and for ages 80+. AMD prevalence is not reported for persons younger than 50. Diabetic retinopathy is reported in 40-49, 50-64, 65-74, and 75+ age groups. VPUS does not include any prevalence estimates for the population younger than age 40 due to data limitations.

We calculated annual projections of the prevalent population by multiplying age, race, and sex-specific prevalence rates for each disorder by annual US Census population projections for each corresponding demographic group from years 2014 through 2050. Our predictions exactly match the Vision Problems estimates in 2010, but our baseline results are higher than the Vision Problems results due to the difference between the 2010 Census estimates and the 2014 Census projections.

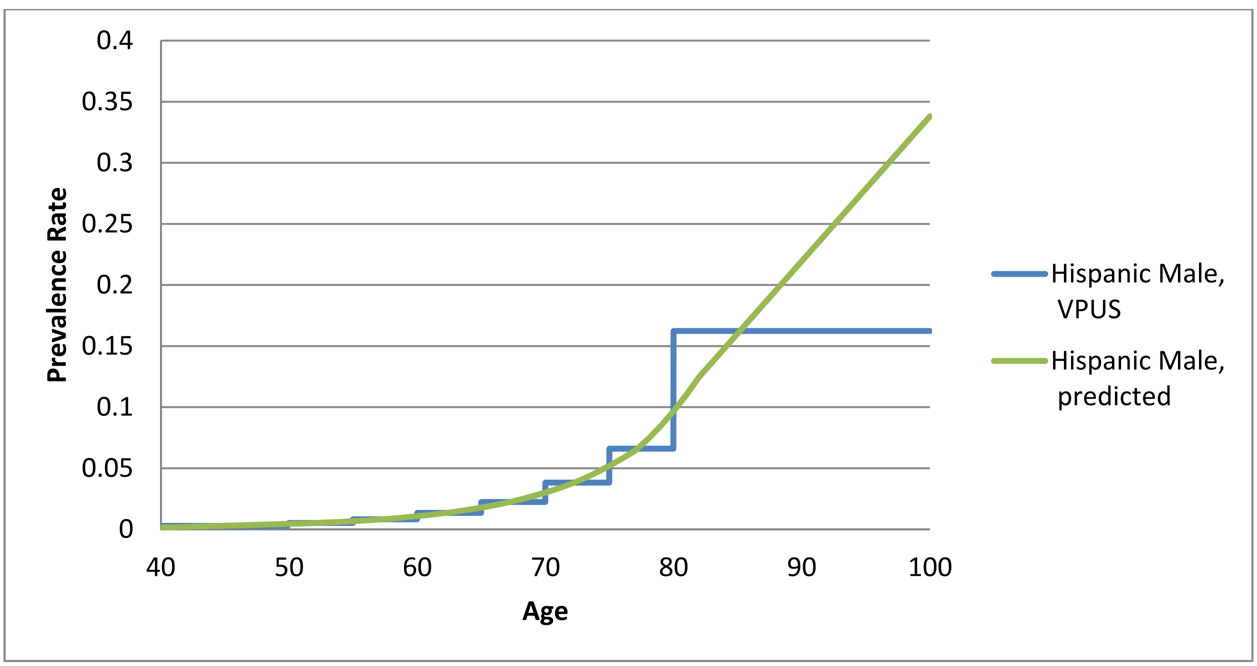
We estimated per-capita prevalence by single year of age in order to fit prevalence data to future population projections. For each sex, race, and disorder combination, we created a prevalence curve - a line depicting the single-year prevalence for ages 40 to 100, or 50-100 in the case of AMD. We converted the step-based age bin prevalence rates to annual prevalence rates through the following process:

1. We adjusted the Vision Problems in the US prevalence estimates, based on the 2010 US Census population estimate, to fit the 2014 US Census population projection.
2. We calculated the mean population age for each age group for which prevalence was reported.

3. We used regression to fit a line between each consecutive age group, based on the prevalence of each age group at the mean age of each age group.
4. We adjusted the slope of the line between each subsequent age group to ensure continuity of the prevalence estimate line.
5. We adjusted the height of the line to ensure predicted prevalence of each age group exactly matched the 2014 prevalence estimate calculated in step 1.

Figure 6.1 shows the Vision Problems values and the predicted values for the prevalence of visual impairment among Hispanic males. Using this annual prevalence prediction process “evens-out” the prevalence estimates by age, but also serves to approximate high prevalence rates among the oldest Americans, including those aged 90+. This is an important consideration because while the prevalence estimates in the baseline year are identical whether using either approach, in future years the predicted annual values result in slightly higher projected prevalence. This is because the US population is projected to not only grow, but to shift to older ages. While this age shift causes increased prevalence projections, the impact is more pronounced using the annual predictions because of the high projected growth of the population aged 90 and older, at which point the predicted annual prevalence rates become much higher than the pooled 80+ estimates from Vision Problems database.

Figure 6.1. Predicted Annualized Prevalence versus Age-bin Prevalence



Very limited data exists on the prevalence of eye disorders and vision loss at these ages; most studies including Vision Problems in the US, the original EDPRG studies, and national surveys such as the National Health and Nutrition Examination Survey (NHANES) top-code age at 80 or 85. Many studies, including NHANES, also either under-report or exclude institutionalized individuals, so these studies may not capture prevalent cases among individuals in long-term care, likely excluding a substantial proportion of the population of vision disorders. Nearly all disorders in Vision Problems in the US saw substantial increases in prevalence among the 80+ population compared to younger age groups, and our single-year prevalence predictions continue this trend to age 100. In many cases, this yields very high prevalence predictions at ages approaching 100.

While nationally representative prevalence data at these ages is not available in the US, a UK-based study of vision loss among the elderly by Evans et al supports this trend, and in fact shows even higher increase in prevalence from ages 80-84 to 90+ than we predict.[15] For example, Evans et al finds the prevalence of visual impairment and blindness more than triples from ages 80-84 to ages 90+, while in the same ages our predicted annual prevalence rates increase by about 150% and 180%, respectively. This supports our assumption that prevalence continues to increase after age 80.

6.2 Projecting the Cost of Vision Loss and Eye Disorders

As with the prevalence of disorders, projecting future costs of vision loss and eye disorders required multiplying annual costs of vision by future population projections. The Cost of Vision report estimated the total US economic burden of low vision and eye disorders based on the 2011 US population estimate in 2013 US dollars. The Cost of Vision report calculated costs by cost category and by payer for the age groups 0-17, 18-39, 40-64 and 65 and older.

Cost categories include:

- Medical costs
- Productivity losses
- Long-term care costs
- Government program costs
- Other direct costs, and
- Deadweight loss

Costs are also reported by payer, including:

- Patients/family members
- Private Insurers, and
- Government payers

Government-only costs also include the budgetary cost of entitlement programs, which are not included in total costs as these are considered economic transfers, not costs.

The Cost of Vision report also reported medical treatment costs for the following disorders:

- Cataracts
- Glaucoma and optic nerve
- Retinal disorder, no diabetes
- Conjunctivitis, lacrimal/eye lid
- Retinal disorder, with diabetes
- Blindness and low vision
- Visual Disturbances
- Disorders of the globe
- Injuries and burns
- Strabismus
- Other diagnosed disorders
- Undiagnosed, self-reported low vision
- Vision correction costs

An important limitation is that these disorder costs only included medical costs. Costs attributable to low vision were not allocated to specific disorders.

As with the disease prevalence rates, projecting future costs required estimation of per-capita costs by single year of age. For many cost components that were originally allocated to age groups based on vision loss or blindness prevalence, we simply needed to allocate costs by single year prevalence of vision loss or blindness. For other costs such as medical costs, we re-estimated costs on the basis of 10-year age groups, and then used the same process described for eye disorder prevalence to fit a continuous cost function by age and payer. For each cost by category and payer, we calculated per-capita costs based on the 2011 US Census population estimate which was the basis of the Cost of Vision report's total cost.

Multiplying the per-capita costs by the projected population in each year yields projections in terms of real costs in constant 2013 dollars. However, this will ignore the likely impacts of general inflation, medical cost growth, and wage growth in future years. Controlling for these price increases yields nominal costs, which are the basis of the expenditure projections reported in this analysis.

Real and Nominal Costs

This analysis provides forecast costs in both real and nominal terms. Real costs are expressed in constant 2014 dollars and show the change in costs over time due to population change, population aging, and projected increases in medical care utilization and healthcare intensity, which refers to the measure of complexity or technology of healthcare services. We also report overall costs in nominal terms, in which costs are adjusted to account for price changes due to general inflation, wage growth, and excess medical cost inflation.

Nominal cost inflators

For nominal expenditures, general inflation and wage inflation projections are based on the 2013 Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Federal Disability Insurance Trust Funds.[16] This report includes annual projections of general inflation and wage growth. Medical cost inflation is complex, and includes the combined effects of general inflation, excess cost inflation observed in the healthcare sector, increased per-person healthcare utilization rates (driven largely by insurance coverage), and increases in intensity and/or complexity of services (driven largely by increasing standards of care and technology). For years 2014-2022, we use annual projections of per-capita health care expenditures reported by the CMS Office of the Actuary, which accounts for projected cost changes as well as anticipated impacts of implementation of the Affordable Care Act.[17] However, these projections are only reported through year 2022. Beginning in year 2023, we use the medical cost inflation estimate from the 2012 Annual Report of the Boards of Trustees of the Federal Hospital Insurance and Federal Supplementary Medical Insurance Trust Funds, which assumes a constant annual increase in medical costs of 5.1% based on historical trends.[18]

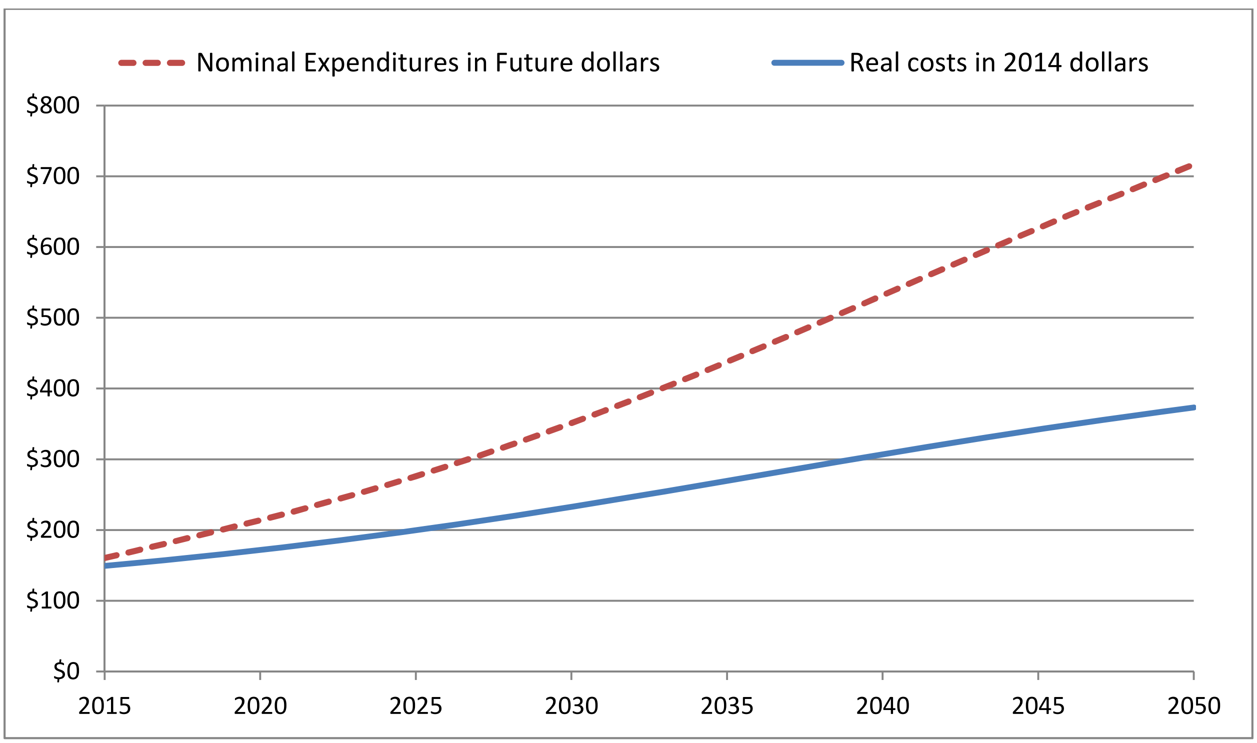
Real medical cost inflator

Real costs are not adjusted to account for price and wage changes, but should account for changes in medical care utilization and intensity. The Medicare Board of Trustees report calculates a constant 5.1% of per-person medical cost changes, which includes 3.2% total medical cost inflation and 1.9% annual cost increases due to increased medical care utilization and intensity.[18] We calculate annual changes in medical care utilization and intensity by subtracting the 3.2% price change component from our medical inflation estimates, which are based on CMS Office of the Actuary annual estimates through 2022, and the Medicare Trustees' assumed 5.1% rate in years 2023-2050.[17]

Impact of Real Costs versus Nominal Expenditures

The figure below shows the results for projected total costs from vision and eye disorders through year 2050. The solid line represents cost growth in real 2014 dollars, which shows a 257% increase from 2014 to 2050. This increase is due to demographic changes from expansion and aging of the population and projected increases in medical care utilization and intensity. This figure however does not factor in inflation, wage growth or non-demographic changes in healthcare expenditures due to inflation and medical cost growth. The predicted impacts of these cost changes are captured in the dashed line of nominal costs, which shows a 476% increase in costs from 2014 to 2050. Thus, the impact of cost and wage inflation more than doubles the projected increase in costs.

Figure 6.2. Projected Total Costs, Real Costs versus Nominal Expenditures, $billions



6.3 Limitations

There are a number of limitations in this analysis. Inherent in all forecasts is the limitation of the uncertainty of future changes which cannot be predicted. Major shifts in medical care or technology, healthcare utilization, access to care, economic conditions, or demographic changes would impact the prevalence and costs of vision problems in ways that cannot be predicted. In addition to the uncertainty of the future, this analysis is limited by uncertainty in the data. The population projections, disease prevalence and costs are all measured with a degree of uncertainty, which we attempt to measure in the sensitivity analyses.

Other limitations include limited availability of data. Comparable nationally representative prevalence data is not available for persons aged younger than 40, and these age groups are therefore not included in the prevalence projections. All underlying data in this analysis groups results among ages 80 or 85 and older. The projections indicate that the growth of the population aged 90 and older is among the most important trends that will occur in the coming decades, yet almost no data is available for this age group. Our methodology of predicting single-age prevalence functions attempts to conservatively predict the high prevalence rates reported at these ages based on small or international samples.

Finally, our prevalence-based projection methodology may not fully account for the future impact of current or recent trends in visual health. For example, some of the underlying studies in the Vision Problems in the US database were first reported more than 10 years ago. Since that time frame, emerging changes have occurred that may not be fully accounted for as their effects were not fully realized in the prevalence data. For example, in this time period AMD has seen many important changes such as possible decreases in incidence, vitamin formulations for early stage AMD, and anti-VEGF treatments for choroidal neovascularization. Whether and to what extent such recent and ongoing developments may impact future prevalence and costs remains subject to high uncertainty.

7. References

1. Friedman, D.S., B. O'Colmain, and I. Mestril, Vision Problems in the U.S., Fifth Edition, 2012, Prevent Blindness America: Washington DC.

2. Wittenborn, J.S. and D.B. Rein, Cost of Vision Problems: The Economic Burden of Vision Loss and Eye Disorders in the United States, 2013, NORC at the University of Chicago: Chicago.

3. US Census Bureau, 2012 National Projections, U.S.D.o. Commerce, Editor 2013: Washington, D.C.

4. Medical Expenditure Panel Survey (MEPS), Medical Expenditure Panel Survey pooled Agency for Healthcare Research and Quality, Editor 2003–2008, Agency for Healthcare Research and Quality: Rockville, MD.

5. Genworth Cost of Care Survey, Genworth 2013 Cost of Care Survey, 2013, Genworth Life Insurance Company: Richmond, VA.

6. US Census Bureau, Survey of Income and Program Participation, 2004.

7. The Eye Diseases Prevalence Research, G., The prevalence of refractive errors among adults in the United States, Western Europe, and Australia. Archives of Ophthalmology, 2004. **122**: p. 495-505.

8. The Eye Diseases Prevalence Research, G., Prevalence of open-angle glaucoma among adults in the United States. Archives of Ophthalmology, 2004. **122**: p. 532-538.

9. The Eye Diseases Prevalence Research, G., Prevalence of Cataract and Pseudophakia/Aphakia Among Adults in the United States. Archives of Ophthalmology, 2004. **122**: p. 487-494.

10. The Eye Diseases Prevalence Research, G., Prevalence of Age-Related Macular Degeneration in the United States. Archives of Ophthalmology, 2004. **122**: p. 564-572.

11. The Eye Diseases Prevalence Research Group, Causes and prevalence of visual impairment among adults in the United States. Archives of Ophthalmology, 2004. **122**: p. 477-485.

12. The Eye Diseases Prevalence Research Group, Prevalence of Age-Related Macular Degeneration in the United States. Archives of Ophthalmology, 2004. **122**: p. 564-572.

13. The Eye Diseases Prevalence Research Group, The Prevalence of Diabetic Retinopathy Among Adults in the United States. Archives of Ophthalmology, 2004. **122**: p. 552-563.

14. Wittenborn, J.S., et al., The Economic Burden of Vision Loss and Eye Disorders among the United States Population Younger than Age 40. Ophthalmology, 2013. **120**(9): p. 1728-35.

15. Evans, J.R., et al., Prevalence of visual impairment in people aged 75 years and older in Britain: results from the MRC trial of assessment and management of older people in the community. Br J Ophthalmol, 2002. **86**(7): p. 795-800.

16. Board of Trustees of the Federal Old-Age and Survivors Insurance and Federal Disability Insurance Trust Funds, 2013 Annual Report, 2013: Washington, D.C.

17. Cuckler, G.A., et al., National Health Expenditure Projections, 2012-22: Slow Growth Until Coverage Expands And Economy Improves. Health Affairs, 2013. **32**(10): p. 1820-1831.

18. Boards of Trustees of the Federal Hospital Insurance and Federal Supplementary Medical Insurance Trust Funds, 2012 Annual Report, 2012: Washington, D.C.