Clear Focus — The economic impact of vision loss in New Zealand in 2009

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VISION 2020 New Zealand is a national body committed to the prevention of avoidable blindness and vision loss in New Zealand. The right to sight, transforming eye health and vision care through early detection, treatment and education.

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AMD	Age related macular degeneration
AWE	Average weekly earnings
BMES	Blue Mountains Eye Study
CERA	Centre for Eye Research Australia
CNV	Choroidal neovascularisation
CPI	Consumer price index
DALY	Disability adjusted life year
DM	Diabetes mellitus
DR	Diabetic retinopathy
DWL	Deadweight loss
GA	Geographic Atrophic
GP	General Practice
HRC	Health Research Council
IVI	Impact of Vision Impairment (Questionnaire)
MD	macular degeneration
MOH	Ministry of Health
NHS	National Health Survey
NZBDS	New Zealand Burden of Disease Study
OECD	Organisation for Economic Co-operation and Development
R&D	Research and development
RE	Refractive error
RNZFB	Royal New Zealand Foundation of the Blind
RPE	Retinal pigment epithelium
RR	Relative risk
VIP	(Melbourne) Visual Impairment Project
VSLY	Value of a statistical life year
WHO	World Health Organisation
WINZ	Work and Income New Zealand
WTP	Willingness-to-pay
YLD	Years lived with disability
YLL	(healthy) years of life lost

Executive Summary

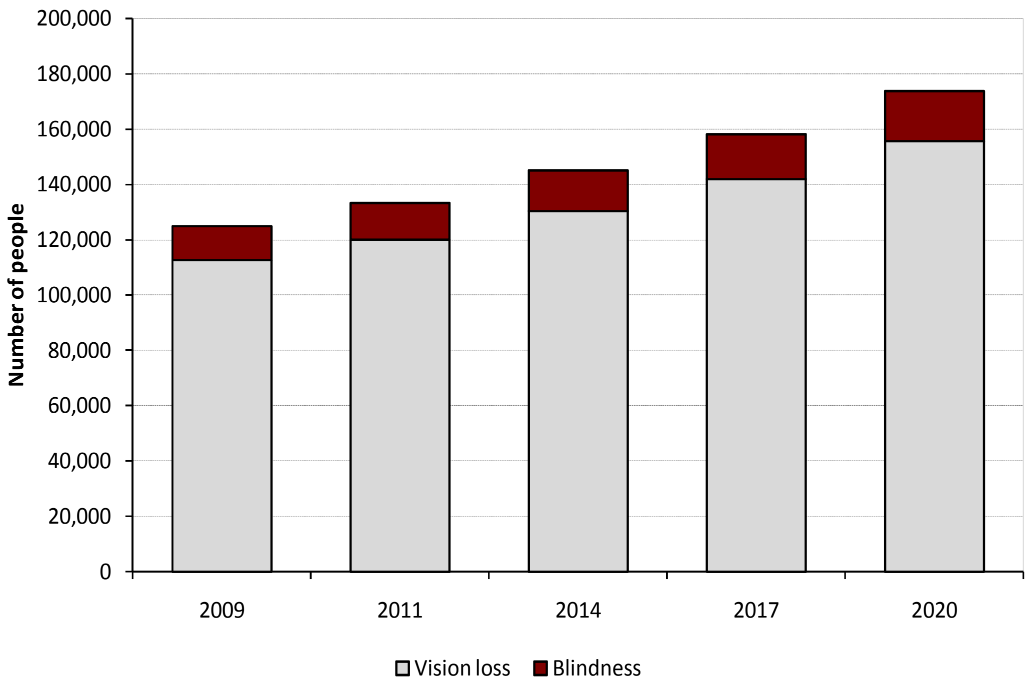
In 2009 there were almost 125,000 New Zealanders aged 40 years or over with vision loss and 67% were over the age of 70. Around 12,000 of those were blind, the largest proportion (86%) aged 70 years or over.

Most vision loss (55%) was caused by uncorrected refractive error (excluding presbyopia). Cataract caused 13%, age-related macular degeneration (AMD) 9%, glaucoma 4% and diabetic retinopathy (DR) 2%. The most common causes of blindness were AMD (48%), glaucoma (16%), and cataract (11%). In addition to the 125,000 people with vision loss, approximately 14,400 people had vision loss due to uncorrected presbyopia[1] in 2009.

Vision loss is associated with a higher than average risk of mortality because it is correlated with a higher risk of falls, motor vehicle accidents and depression (Centre for Eye Research Australia and Access Economics 2004). There were 115 deaths attributable to vision loss in 2009 in New Zealand.

It is projected that the number of people aged 40 or over with vision loss will rise to almost 174,000 by 2020 and those who are blind will rise to 18,302. In addition, the number of people with vision loss due to uncorrected presbyopia is projected to rise to 17,000 by 2020. The projected rise in prevalence reflects demographic ageing, and assumes a policy-neutral environment. The rise in the number of New Zealanders with vision loss is depicted in Chart i.

Chart i: Projections of New Zealanders aged 40 or over with vision loss



Source : Access Economics 2010

[1] Presbyopia (age-related loss of the eye's ability to focus on close objects) prevalence rates have been included in this report as stand alone figures only.

In 2009, the total financial cost of vision loss (excluding loss of wellbeing) was estimated to be $400 million, or $3,206 per person with vision loss aged over 40 years.

- In 2009, total health system expenditure on disorders of the eye and adnexa was estimated at $198 million or $1,583 per person with vision loss aged over 40.
- Productivity losses of those with vision loss were approximately $112 million in 2009. This included losses due to lower than average employment rates (adjusted for age) of those with vision loss, losses resulting from premature mortality, and the 'bring forward' of employer search and hiring costs due to premature mortality
- Productivity losses of family and friends who care for people with vision loss on an unpaid basis were around $21 million. This reflects the opportunity cost of informal carers' time.
- The costs of aids and the 'bring forward' of funeral costs were approximately $30 million in 2009.
- Deadweight losses (the economic cost associated with administering the taxation and transfer system and which also arises because of distortions to behaviour) were estimated to be $39 million in 2009.
- The loss of wellbeing that results from vision loss was estimated using Disability Adjusted Life Years (DALYs),[2] which incorporate the detriment to health, as well as premature mortality. In 2009, vision loss was associated with 11,756 DALYs.
- The monetary value of the loss of well being in 2009 was $2.4 billion. If this is added to the financial costs, the overall cost of vision loss in 2009 was $2.8 billion, or $22,217 per person with vision loss aged over 40.

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2010

[2] Note that the term 'loss of wellbeing' is used throughout this report instead of the well defined concept in health economics, 'burden of disease' as measured by disability adjusted life years (DALYs). It measures the suffering and premature death from a disease or injury and does not imply that people experiencing disease or injury are a burden on society.

1 Background

This report was sponsored by VISION 2020 New Zealand in collaboration with VISION 2020 Australia. It complements a similar report, 'Clear focus: the economic impact of vision loss in Australia in 2009' (Access Economics 2010), and updates a previous report commissioned by the Centre for Eye Research Australia, 'Clear insight: the Economic Impact and Cost of Vision Loss in Australia' (Access Economics 2004). This report estimates the economic impact of vision loss in New Zealand in 2009. The prevalence, direct health system costs, indirect costs and loss of wellbeing are reported, with a focus on the most common sources of vision loss:

- Cataract;
- Diabetic retinopathy;
- Glaucoma;
- Age-related macular degeneration; and
- Uncorrected refractive error - hyperopia, myopia, astigmatism and presbyopia.

Few previous economic studies on vision loss have been undertaken in New Zealand. A 2006 report commissioned by the Royal New Zealand Foundation of the Blind (RNZFB) found the combined cost to society and the individual of moderate vision loss and blindness was between $88.5 million and $816 million in 2004 with most costs borne by the individual and their family. This estimate does not include data collected from all secondary sources such as all government payments and RNZFB costs due to lack of information or consistency in the data received.

Several employment and life satisfaction studies of New Zealanders with vision loss have been completed by La Grow et al (2005, 2007, 2008, 2009) including an analysis of data from the 2006 Health, Work, and Retirement Study. It was found those with vision loss were financially disadvantaged, in worse physical and mental health, and had less social support than individuals with no vision problems (La Grow et al 2009). La Grow and Daye (2005) earlier found 79% of the surveyed RNZFB population aged between 18 and 65 had experienced barriers to gaining and retaining employment. Career advancement was also thought to be restricted. No significant differences were found by sex, age, or degree of vision loss.

This report provides comprehensive data on the overall prevalence of mild to severe vision loss, including blindness, in the non-Māori and Māori populations in 2009. Health system expenditures, productivity losses, informal care costs, the cost of aids, government welfare payments, and loss of wellbeing have then been summed to estimate the overall cost of mild to severe vision loss in New Zealand in 2009.

2 Prevalence rates and projections

This chapter presents estimates of the prevalence of vision loss and blindness from various eye conditions in 2009, as well as projections to 2020. Prevalence estimates are produced for the following common specific eye conditions:

- Cataract;
- Diabetic retinopathy (DR).
- Glaucoma;
- Age-related macular degeneration (AMD); and
- Uncorrected refractive error (RE).

2.1 Definitions - vision loss and blindness

Vision loss can broadly be defined as a limitation in one or more functions of the eye or vision system. This most commonly involves impairment of visual acuity (sharpness or clarity of vision), visual field (the ability to detect objects to either side, above or below the direction of sight), and/or colour vision. Colour blindness, a genetic inability or reduced ability to distinguish differences in hue, is not a subject of this report.

Unimpaired vision is recorded as 6/6 (20/20 in imperial measures). The first number in this ratio is interpreted as the furthermost distance in metres that a particular individual can clearly see an object. The second number is the distance at which an individual with unimpaired vision can clearly see the same object. A figure of 6/12, for example, would indicate that an individual can clearly see at a distance of six metres what a person with unimpaired vision could see at a distance of twelve metres.

Visual field is measured in terms of degrees from the point of fixation. For example, $<10^{o}$ field means that the person can only see in a visual field of less than ten degrees radius from the point of fixation.

Government departments in New Zealand are guided by the World Health Organisation (WHO) International Classification of Diseases when defining vision loss (personal communication, RNZFB 28 April 2010). Low vision is defined as visual acuity of less than 6/18, but equal to or better than 3/60, or a corresponding visual field loss to less than 20 degrees in the better eye with best possible correction. Blindness is defined as visual acuity of less than 3/60, or a corresponding visual field loss to less than 10 degrees in the better eye with best possible correction. RNZFB membership is based on visual acuity not exceeding 6/24 in the better eye with correcting lenses or serious limitations in the field of vision generally not greater than 20 degrees in the widest diameter[3].

This report defines vision loss as being less than driving vision, which is measured as 6/12. Blindness prevalence and projections are estimated by using the definition of visual acuity of less than 6/60 or visual field of less than 10 degrees, or both. The definitions of vision loss used here reflect the epidemiological studies used as the basis for the prevalence estimates as outlined in section 2.3. Notably, they incorporate low vision and blindness as per the WHO

[3] http://www.rnzfb.org.nz/members/become-a-member/membership-criteria

definitions, but include an additional group with milder vision loss (equal to 6/18 but worse than 6/12).

2.2 Studies of the prevalence of vision loss in New Zealand

Literature searches were undertaken in March 2010 for epidemiological evidence of vision loss in New Zealand through the PubMed/MEDLINE database. Search terms and results are listed in Appendix A, Table A.1. Large scale ophthalmological surveys of the prevalence of vision loss in New Zealand were not identified by this review. However, three (non clinical) sources of estimates of the prevalence of vision loss were identified — Statistics New Zealand (2002, 2007), RNZFB (2006) and Ministry of Health (2008).

The 2001 and 2006 New Zealand disability surveys (Statistics New Zealand 2002, 2007) investigated the prevalence of vision loss in the adult population. Survey responses do not necessarily reflect medical diagnoses because respondents nominated their degree of seeing disability from a list of descriptors of severity:

- Can see newspaper print, but with difficulty;
- Cannot see newspaper print;
- Can see someone's face across the room, but with difficulty; and
- Cannot see someone's face across the room.

The estimates from the 2006 disability survey are in Table 2.1.

Table 2.1: Total number of people with a vision loss in New Zealand by ethnicity and age, 2006

Age group	European	Māori	Pacific population	Asian / other	Total (including those not elsewhere included) (a)
0-14 Years	5,700	3,300	*	1,600	11,400
15-24 Years	1,000	*	*	*	2,300
25-44 Years	4,800	3,000	*	*	9,500
45-64 Years	13,300	3,600	1,200	3,000	21,000
65 Years and Over	17,100	*	*	1,600	19,600
Total	46,300	12,100	3,600	9,000	71,000

Source: Higgins et al 2008 * sampling error too high for practical purposes (a) estimates rounded to nearest hundred. Components may not sum to totals.

The RNZFB (RNZFB 2006) estimated the New Zealand blind and vision impaired population, citing three sources - the 2001 disability survey (as defined by a seeing disability explained above), RNZFB membership numbers, and anecdotal estimates from leading New Zealand ophthalmologists. Prevalence estimates ranged from 11,293 to 98,400 people in June 2004. These estimates differ to those calculated in this report (see below). The low estimate excludes individuals with visual acuity greater than 6/12 and less than 6/24 — who are not eligible for RNZFB membership — but who are included as part of the population with vision loss in this report. The high estimate is based on self-report by respondents to the New Zealand disability survey based on the definitions above. The basis for the epidemiological estimates in this report is explained in section 2.3.

The New Zealand Health Survey (Ministry of Health 2008) was last conducted in 2006-07 and involved more than 17,000 New Zealanders. The prevalence of vision loss was only measured in children (Table 2.2). Adults were asked if they had been, 'told by a doctor that their child had (a vision problem) lasting, or expecting to last six months or more'.

Table 2.2: Proportion of children in New Zealand with a permanent vision problem, 2006-07 (%)

Age	0-4	5-9	10-14	Total
Boys	0.2 (0.0 - 0.7)(a)	0.5 (0.1 - 1.4)	1.6 (0.7 - 3.0)	0.8 (0.4 - 1.3)
Girls	1.5 (0.3 - 4.6)	0.6 (0.2 - 1.3)	0.5 (0.1 - 1.5)	0.8 (0.3 - 1.8)
Total	0.8 (0.2 - 2.4)	0.5 (0.2 - 1.0)	1.1 (0.6 - 1.8)	0.8 (0.4 - 1.2)

Source: Ministry of Health 2008 (a) 95% confidence interval

2.3 The basis for epidemiological estimates in this report

In the absence of ophthalmological surveys for New Zealand, internationally regarded, large scale epidemiological surveys from Australia were used as the basis for the New Zealand estimates — adjusted for higher rates of vision loss among the Māori population drawn from the 2006 New Zealand disability survey (Office for Disability Issues and Statistics New Zealand 2010). Identical disease detection and compliance rates have been assumed across the entire New Zealand population.

Two comprehensive and internationally renowned studies of the prevalence of vision loss have been conducted in Australia — the Melbourne Visual Impairment Project (VIP) and the Blue Mountains Eye Study (BMES). These studies provided high quality data on the distribution and impact of vision loss in Australia and are still widely used.

The VIP was the first large population based assessment of vision loss and eye disease in Australia. The study recruited and performed eye tests on 3,271 participants aged 40 years and older from Melbourne, Victoria. The initial baseline study was conducted during the period 1992 to 1994, followed by a 5-year incidence study during 1997 to 1999. The VIP also included representative rural (1,473) and nursing home (403) samples.

The BMES was another population-based study of vision loss in an older community sample of 3,654 residents who were examined during the period 1992 to 1994. A five-year follow-up examination was conducted during 1997 to 1998, with ten-year follow-ups completed in early 2004.

Since these studies are still the most comprehensive and recent prevalence studies on vision loss for Australasia, age-specific prevalence rates from Centre for Eye Research Australia and Access Economics (2004) were applied in this report to the latest population estimates and projections for New Zealand (Statistics New Zealand 2009a).

Refined rates for the prevalence of glaucoma for this report were drawn from Centre for Eye Research Australia and Access Economics (2008) as discussed in Section 2.6. In addition, the age-specific prevalence profile for DR was adjusted to account for differences in the prevalence of diabetes mellitus by ethnicity. This adjustment is detailed in Section 2.5.

Estimates of the prevalence of vision loss among the Māori population were derived by applying a ratio from the 2006 disability survey (Office for Disability Issues and Statistics New Zealand 2010) (Table 2.3). The higher rates of vision loss among Māori reflect their higher rates of disease more generally. The equalisation of rates at age 75 or over may reflect that Māori who live as long as non-Māori are more likely to be healthier than their counterparts who die at younger ages, or may be an artefact of the samples[4]. Notably, for the purposes of this analysis, it has been assumed these self reported rates of vision loss are accurate.

Table 2.3: Rate of vision loss by age and ethnicity, 2006

Age	Māori	non-Māori	Ratio Māori to non-Māori
25-44	1.93%	0.70%	2.74 (a)
45-64	4.17%	1.83%	2.28
65-74	6.21%	2.57%	2.42
75+	9.68%	9.70%	1

Source: Office for Disability Issues and Statistics New Zealand (2010) (a) rate estimates rounded to two decimal places, stated components may not exactly convert to stated ratio

2.3.2 Limitations relating to the estimates of prevalence in this report

The estimates of prevalence in this report were necessarily based on large sample, high quality, internationally reknowned epidemiological studies of vision loss in Australia — where-ever possible, informed by epidemiological data from New Zealand. The approach reflects the absence of large scale, ophthalmologically based epidemiological data on vision loss in New Zealand – a gap which needs to be addressed.

New Zealand and Australia are often grouped together for the purposes of global epidemiological estimates, given the broad similarities between the two countries (e.g. Holden et al 2008). Nevertheless, the approach represents a limitation, in particular because of the lack of knowledge of the epidemiology of the underlying causes of vision loss among Māori and Pacific populations.

The experts who contributed to this report agree that more research is needed to delineate the prevalence of eye disease rates in Māori compared with non-Māori. Equity of access to services is a probable confounding variable. It is also agreed that a New Zealand based epidemiological study of vision loss is a priority.

While use of Australian data is a limitation, the estimate of nearly 125,000 New Zealanders suffering from vision loss in 2009 (see section 2.9) appears sensible. Other estimates for New Zealand suggest prevalence was in the range 11,300 to 98,400 people in 2004 (RNZFB 2006)

[4] The 2006 disability survey sample size for those aged 65 or over was 1,891. While Māori were oversampled, the sub-samples by ethnicity are not publicly available.

and 71,000 in 2006 (Statistics New Zealand 2007). Given the different definitions of vision loss used in these studies (in particular the addition in this study of those with milder vision loss — ie better than 6/24 and worse than 6/12 as explained in section 2.2), the ageing of the New Zealand population, and broad similarities between the New Zealand and Australian populations, the estimate of prevalence here provides a useful base for deriving associated economic and social costs.

2.4 Cataract

A cataract is a crystalline lens that has gone cloudy resulting in a reduction in vision. The lens is made mostly of water and protein, with the protein arranged to let light pass through and focus on the retina. Some of the protein may clump together and cloud an area of the lens. This is a cataract. Over time, the cataract may grow larger and cloud more of the lens, making it harder to see. The most common symptoms of cataract are cloudy or blurry vision; problems with light - headlights that seem too bright, glare from lamps or the sun, or a halo or haze around lights; colours that seem faded; double or multiple vision; and /or frequent changes required in eyeglasses or contact lenses.

There are four main causes of cataract:

- **Age-related cataract:** Most cataracts are related to aging.
- **Congenital cataract:** Some babies are born with cataracts or develop them in childhood, often in both eyes. If they affect vision, they may need to be removed.
- **Secondary cataract:** Cataracts may be linked to certain other health issues, such as diabetes or steroid use.
- **Traumatic cataract:** Cataracts can develop soon after an eye injury, or years later.

Causes of cataract are still uncertain. Detection is through an eye examination including a visual acuity test (eye chart test) and pupil dilation (where the pupil is widened with eye-drops to allow the eye care professional to see more of the lens and look for other eye problems).

2.4.1 Prevalence of vision loss from cataract

Prevalence rates for vision loss and blindness from cataract are presented in Table 2.4. Prior to age 50, cataracts are a relatively rare cause of vision loss. After that, prevalence increases from approximately 0.1% in the 60-69 year age group to over 15% in the population aged over 90.

Table 2.4: Prevalence rates for vision loss and blindness from cataract, 2009

	non-Māori		Māori	
Age group	Vision loss (%) (a)	Blindness (%)	Vision loss (%) (a)	Blindness (%)
50-54	0.04	-	0.10	-
55-59	0.04	-	0.10	-
60-64	0.09	-	0.19	-
65-69	0.09	-	0.21	-
70-74	1.42	0.05	3.44	0.13

	non-Māori		Māori	
75-79	1.42	0.05	1.42	0.05
80-84	6.63	0.75	6.63	0.75
85-89	6.63	0.75	6.63	0.75
90+	15.17	1.51	15.17	1.51

Source: Centre for Eye Research Australia and Access Economics (2004) (from BMES and VIP study data-sets), Office for Disability Issues and Statistics New Zealand 2010 (a) Including blindness

Applying these prevalence rates to the 2009 population (Statistics New Zealand 2010) suggests approximately 14,900 non-Māori people and 742 Māori people had vision loss from cataract and 1,346 non-Māori people and 44 Māori people were blind from cataract (Table 2.5, Table 2.6, Table 2.7 and Table 2.8).

By 2020, nearly 22,800 New Zealanders are projected to have cataract-related vision loss — and around 2,000 are projected to have cataract-related blindness in 2020.

Table 2.5: Vision loss from cataract – projected numbers of non-Māori people

Age group	2009	2011	2014	2017	2020
50-54	110	115	122	120	119
55-59	97	100	108	117	121
60-64	174	185	188	200	216
65-69	136	142	168	180	186
70-74	1,730	1,921	2,128	2,371	2,763
75-79	1,415	1,421	1,543	1,814	1,971
80-84	5,101	5,280	5,366	5,565	6,302
85-89	2,985	3,204	3,489	3,708	3,821
90+	3,125	3,580	4,323	5,112	5,886
Total	14,872	15,948	17,436	19,187	21,383

Source: Centre for Eye Research Australia and Access Economics (2004) (from BMES and VIP study data-sets), Statistics New Zealand 2009a, Office for Disability Issues and Statistics New Zealand 2010

Table 2.6: Vision loss from cataract - projected numbers of Māori people

Age group	2009	2011	2014	2017	2020
50-54	30	33	36	36	36
55-59	23	25	28	32	34
60-64	33	37	42	47	54
65-69	25	26	31	37	41
70-74	289	330	354	396	482
75-79	72	79	95	112	120
80-84	165	192	238	285	351
85-89	60	73	93	126	152
90+	45	61	61	106	136
Total	742	855	977	1,175	1,407

Source: Centre for Eye Research Australia and Access Economics (2004) (from BMES and VIP study data-sets), Statistics New Zealand 2009a, Office for Disability Issues and Statistics New Zealand 2010

Table 2.7: Blindness from cataract - projected numbers of non-Māori people

Age group	2009	2011	2014	2017	2020
50-54	-	-	-	-	-
55-59	-	-	-	-	-
60-64	-	-	-	-	-
65-69	-	-	-	-	-
70-74	65	72	79	88	103
75-79	53	53	58	68	74
80-84	578	598	608	631	714
85-89	338	363	395	420	433
90+	312	357	431	510	587
Total	1,346	1,443	1,572	1,717	1,911

Source: Centre for Eye Research Australia and Access Economics (2004) (from BMES and VIP study data-sets), Statistics New Zealand 2009a, Office for Disability Issues and Statistics New Zealand 2010

Table 2.8: Blindness from cataract - projected numbers of Māori people

Age group	2009	2011	2014	2017	2020
50-54	-	-	-	-	-
55-59	-	-	-	-	-
60-64	-	-	-	-	-
65-69	-	-	-	-	-
70-74	11	12	13	15	18
75-79	3	3	4	4	4
80-84	19	22	27	32	40
85-89	7	8	10	14	17
90+	5	6	6	11	14
Total	44	51	60	76	93

Source: Centre for Eye Research Australia and Access Economics (2004) (from BMES and VIP study data-sets), Statistics New Zealand 2009a, Office for Disability Issues and Statistics New Zealand 2010

2.5 Diabetic retinopathy

DR is an important cause of vision impairment. It occurs when diabetes mellitus (DM) damages the tiny blood vessels inside the retina, and usually affects both eyes. At first, microaneurysms occur. As the disease progresses, some blood vessels that nourish the retina are blocked. There are two ways that vision loss occurs:

- Proliferative retinopathy: if many blood vessels are blocked, and several areas of the retina are deprived of their blood supply, signals are sent to grow new blood vessels, which may be abnormal and fragile, growing along the retina and along the surface of the clear, vitreous gel that fills the inside of the eye. These blood vessels have thin, fragile walls that, if they leak blood into the centre of the eye, can result in blurred vision and blindness.
- Macular oedema: fluid can leak into the centre of the retina – at the macula, causing swelling and blurred vision. This is more likely to occur as the disease progresses. About half of people with proliferative retinopathy also have macular oedema.

In its early stages, DR causes no symptoms. If bleeding occurs, the person may see specks of blood, or spots, “floating” in their vision. Occasionally spots clear without treatment, but haemorrhages tend to happen more than once, often during sleep. The earlier treatment is received, the more likely it is to be effective.

The prevalence of DR is of course highly dependent on the prevalence of DM. The Ministry of Health (2007) projected the prevalence of type 2 diabetes would increase 45% between 2001 and 2011 due to population growth, an ageing population, and growth in the prevalence of obesity. The VIP and BMES prevalence data for DR (Centre for Eye Research Australia and Access Economics 2004) were adjusted upwards to account for the increase in diagnosed diabetes reported by the Australian Bureau of Statistics (2009) between 2004-05 and 2007-08. The age-specific increases in DM prevalence for those aged 35+ were used to develop weightings which were then applied to age-specific DR prevalence rates. The adjusted prevalence rates for vision loss from DR are presented in Table 2.9. It is important to note that Australian data from the VIP and BMES show a very small proportion with vision-threatening DR. This is in stark contrast with US data (Kempen et al, 2004) that estimates that 0.75% of the population over 40 (ie, nearly one quarter of Americans with DR) have vision-threatening DR. The sample data were also inadequate to determine the proportion of those with vision-impairing DR who are blind (hence the lack of estimates for blindness in Table 2.9).

Estimates of the prevalence of diabetic retinopathy (DR) across different ethnic groups vary. The prevalence of diabetes in New Zealand has been estimated at around 4% by the Ministry of Health with rates around three times higher in the Māori and Pacific populations than among other New Zealanders[5]. Simmons et al (2007) found the prevalence of moderate or more severe retinopathy to be 4% of the European type 2 diabetic population compared with 12.9% and 15.8% in the Māori and Pacific populations. Joshy (2006) likewise found a lower disease burden in the European population where vision-threatening retinopathy was observed in 2.5% of Europeans, compared with 4.6%, 4.3% and 4.9% in the Asian, Māori, and Pacific populations respectively.

[5] http://www.moh.govt.nz/diabetes accessed 30 March 2010

Estimates of rates of vision loss for the Māori population have been factored up in this report to reflect their higher rates of disease (as explained in section 2.3 and Table 2.3).

Table 2.9: Prevalence rates for vision loss and blindness from diabetic retinopathy, 2009

	non-Māori		Māori	
Age group	Vision loss (%) (a)	Blindness (%)	Vision loss (%) (a)	Blindness (%)
50-54	0.05	n/a	0.12	n/a
55-59	0.05	n/a	0.12	n/a
60-64	0.18	n/a	0.41	n/a
65-69	0.18	n/a	0.43	n/a
70-74	0.06	n/a	0.14	n/a
75-79	0.06	n/a	0.06	n/a
80-84	0.51	n/a	0.51	n/a
85-89	0.51	n/a	0.51	n/a
90+	0.59	n/a	0.59	n/a

n/a=not available. (a) Including blindness

Source: Centre for Eye Research Australia and Access Economics (2004) (from BMES and VIP study data-sets), Office for Disability Issues and Statistics New Zealand 2010

These prevalence rates were applied to the latest population numbers to obtain an estimate of approximately 2,000 New Zealanders with vision loss from DR in 2009. Prevalence rates were applied to population projections to estimate 2,682 people with DR related vision loss in 2020 (Table 2.10, Table 2.11).

Table 2.10: Vision loss from diabetic retinopathy – projected numbers of non-Māori people

Age group	2009	2011	2014	2017	2020
50-54	132	139	147	145	143
55-59	116	121	130	140	146
60-64	364	388	394	419	452
65-69	284	298	353	376	389
70-74	72	80	89	99	115
75-79	59	59	64	76	82
80-84	390	404	410	426	482
85-89	228	245	267	284	292
90+	121	139	167	198	228
Total	1,767	1,872	2,022	2,162	2,329

Source: Centre for Eye Research Australia and Access Economics (2004) (from BMES and VIP study data-sets), Statistics New Zealand 2009a, Office for Disability Issues and Statistics New Zealand 2010

Table 2.11: Vision loss from diabetic retinopathy - projected numbers of Māori people

Age group	2009	2011	2014	2017	2020
50-54	36	39	43	43	43
55-59	27	30	34	39	41
60-64	68	78	87	98	114
65-69	52	54	65	77	86
70-74	12	14	15	17	20
75-79	3	3	4	5	5
80-84	13	15	18	22	27
85-89	5	6	7	10	12
90+	2	2	2	4	5
Total	218	241	276	314	353

Source: Centre for Eye Research Australia and Access Economics (2004) (from BMES and VIP study data-sets), Statistics New Zealand 2009a, Office for Disability Issues and Statistics New Zealand 2010

2.6 Glaucoma

Glaucoma is a group of diseases that (by definition) lead to damage to the eye's optic nerve and may result in blindness. It has no symptoms at first, but can gradually steal a person's sight. With early treatment, eyes may be protected against serious vision loss and blindness.

The optic nerve comprises over a million nerve fibres connecting the retina with the brain. In the front of the eye is a space called the *anterior chamber* – clear fluid flows in and out of this space, leaving the chamber at the angle where the cornea and iris meet. When the fluid reaches the angle, it flows through a spongy meshwork, like a drain, and leaves the eye.

Open-angle glaucoma, the most common type, occurs when, for unknown reasons, the fluid passes too slowly through the meshwork drain. As the fluid builds up, the pressure inside the eye rises. Unless the pressure at the front of the eye is controlled, it can damage the optic nerve and cause vision loss. At first, vision is normal. If glaucoma remains untreated, people notice that although they see things clearly in front of them, they miss objects to the side and out of the corner of their eye. Without treatment, they may find that they have no side vision. It may seem as though they are looking through a tunnel. Over time, the remaining forward vision may decrease until there is no vision left.

Increased risk for glaucoma occurs with glaucoma elevated intraocular pressure, older age, large cup to disc ratio, thin central cornea, family history and ethnicity (particularly people for African-American decent). A family history of glaucoma increases risk of glaucoma eight times and some glaucoma genes have been identified. Other suspected but not confirmed risk factors include high refractive error, diabetes, sleep apnoea, male, cataract, migraine, optic disc haemorrhage and peripheral vasospasm (Centre for Eye Research Australia and Access Economics 2008).

More than 50% of individuals with glaucoma in the developed world are unaware they have the disease (Quigley, 1996). Based on VIP data, Wensor et al, (1998) found that 50% of those with definite primary open angle glaucoma had not been diagnosed previously, and Wong et al, (2004) examined VIP data and found that 59% of definite cases of open angle glaucoma were undiagnosed in people who had visited an eye care provider in the previous year.

Glaucoma is detected through an eye examination including visual acuity, visual field, measurement of intraocular pressure,, assessment of the angle of the anterior chamber and optic nerve examination. Although there is no cure for glaucoma, early diagnosis and treatment are important to control it and thus protect sight.

2.6.1 Prevalence of vision loss from glaucoma

Prevalence rates for this report were drawn from Centre for Eye Research Australia and Access Economics (2008). While these are for primary open angle glaucoma, this is the most common form of the disease. These rates are preferable as they have been refined to account for small sample sizes of those with glaucoma in the VIP and BMES.

Anecdotal evidence based on attendance at optometry or ophthalmology services suggests the prevalence rate of glaucoma in the Māori population may be lower than that detailed in Table 2.12. However, this may reflect lower utilisation of health services by Māori (as discussed in section 2.3.2). The application of an inflator drawn from the New Zealand disability survey for Māori prevalence rates (described in Table 2.3) results in around 100 *additional i*ndividuals of Māori descent with vision loss from glaucoma.

Glaucoma-related vision loss is strongly age-related (Table 2.12).

Table 2.12: Prevalence rates for vision loss and blindness from glaucoma

	non-Māori		Māori	
Age group	**Vision loss (%) (a)**	**Blindness (%)**	**Vision loss (%) (a)**	**Blindness (%)**
50-54	-	-	-	-
55-59	-	-	-	-
60-64	0.10	0.10	0.23	0.23
65-69	0.10	0.10	0.24	0.24
70-74	0.50	0.10	1.21	0.24
75-79	0.50	0.10	0.50	0.10
80-84	1.50	0.30	1.50	0.30
85-89	1.50	0.30	1.50	0.30
90+	6.10	4.30	6.10	4.30

Source: Centre for Eye Research Australia and Access Economics (2004) (from BMES and VIP study data-sets), Office for Disability Issues and Statistics New Zealand 2010 (a) including blindness

These prevalence rates were applied to the latest population numbers to obtain an estimate of 4,556 non-Māori and 264 Māori people with vision loss from glaucoma in 2009. Of these, 1,837 and 116 respectively were blind. In 2020, the projected number of people with vision loss from glaucoma is 7,287, 3,147 of whom would be blind (Table 2.13, Table 2.14, Table 2.15 and Table 2.16).

Table 2.13: Vision loss from glaucoma – projected numbers of non-Māori people

Age group	2009	2011	2014	2017	2020
50-54	-	-	-	-	-
55-59	-	-	-	-	-
60-64	204	218	221	235	254
65-69	159	167	198	211	218
70-74	609	676	749	835	973
75-79	498	500	543	639	694
80-84	1,154	1,194	1,214	1,259	1,425
85-89	675	725	789	839	864
90+	1,257	1,440	1,739	2,056	2,367
Total	4,556	4,919	5,452	6,072	6,794

Source: Centre for Eye Research Australia and Access Economics (2004) (from BMES and VIP study data-sets), Statistics New Zealand 2009a, Office for Disability Issues and Statistics New Zealand 2010

Table 2.14: Vision loss from glaucoma - projected numbers of Māori people

Age group	2009	2011	2014	2017	2020
50-54	-	-	-	-	-
55-59	-	-	-	-	-
60-64	38	44	49	55	64
65-69	29	30	37	43	48
70-74	102	116	125	139	169
75-79	25	28	33	39	42
80-84	37	43	54	64	79
85-89	13	16	21	28	34
90+	18	24	24	43	55
Total	264	302	343	413	493

Source: Centre for Eye Research Australia and Access Economics (2004) (from BMES and VIP study data-sets), Statistics New Zealand 2009a, Office for Disability Issues and Statistics New Zealand 2010

Table 2.15: Blindness from glaucoma - projected numbers of non-Māori people

Age group	2009	2011	2014	2017	2020
50-54	-	-	-	-	-
55-59	-	-	-	-	-
60-64	204	218	221	235	254
65-69	159	167	198	211	218
70-74	122	135	150	167	195
75-79	100	100	109	128	139
80-84	231	239	243	252	285
85-89	135	145	158	168	173
90+	886	1,015	1,226	1,449	1,668
Total	1,837	2,018	2,303	2,609	2,931

Source: Centre for Eye Research Australia and Access Economics (2004) (from BMES and VIP study data-sets), Statistics New Zealand 2009a, Office for Disability Issues and Statistics New Zealand 2010

Table 2.16: Blindness from glaucoma - projected numbers of Māori people

Age group	2009	2011	2014	2017	2020
50-54	-	-	-	-	-
55-59	-	-	-	-	-
60-64	38	44	49	55	64
65-69	29	30	37	43	48
70-74	20	23	25	28	34
75-79	5	6	7	8	8
80-84	7	9	11	13	16
85-89	3	3	4	6	7
90+	13	17	17	30	39
Total	116	132	149	183	216

Source: Centre for Eye Research Australia and Access Economics (2004) (from BMES and VIP study data-sets), Statistics New Zealand 2009a, Office for Disability Issues and Statistics New Zealand 2010

2.7 Age-related macular degeneration

AMD is an eye disease that usually develops after 50 years of age, progressively destroying the macula, the central portion of the retina and impairing central vision. Changes to the central area of the macula responsible for detailed vision can be rapid, impacting severely on day to day life. AMD can be classified as 'early AMD' (less severe) or 'late AMD' (varying severity). Clinicians distinguish between two forms of late AMD: wet and dry form.

In the early stages of AMD, pale yellow spots caused by distinct lesions consisting of lipids and protein (known as drusen) accumulate as deposits within Bruch's membrane[6] and beneath the retinal pigment epithelium (RPE). Early AMD most commonly progresses to dry AMD (geographic atrophic) but can lead to wet AMD (exudative or neovascular). Both forms (dry and wet) can precipitate a decrease in visual acuity although it more frequently occurs with wet AMD.

Geographic Atrophic (GA) results in atrophy of the retinal pigment epithelial (RPE) layer; there is no scarring. . People with GA AMD have extensive medium-sized drusen or one or more large drusen in one or both eyes. At this stage, people with GA AMD will often have relatively good distance visual acuity but a substantially decreased capacity for near visual tasks as central vision deteriorates. Severe central vision loss can occur once a person develops GA AMD.

In the wet form of AMD, exudative or neovascular AMD is caused by blood vessels reproducing in the choroid in a process called choroidal neovascularisation (CNV). Chorio-retinal scarring is one of the endpoints of wet AMD. The new choroidal vessels leak or bleed into the underlying retina, damaging the retina, including the central macula region. The blood and fluid can also

[6] Bruch's membrane is the innermost layer of the choroid. The choroid is the layer between the white of the eye (sclera) and the inner surface of the eye (retina).

cause macular scarring or the detachment of either the retinal pigment epithelium or sensory retina.

In all types, wet AMD is characterised by the appearance of central visual blurring and distortion, with straight lines appearing crooked or wavy. It can occur in one eye without any symptoms being recognised by the person, although symptoms become more noticeable once the second eye is affected.

Progression of AMD will usually occur less rapidly if lifestyle risk factors are addressed. Epidemiological studies have identified several risk factors that can increase the risk of developing AMD and increase the speed at which the disease progresses. Cigarette smoking is the main lifestyle risk factor for AMD, although alcohol consumption and obesity have been shown to be associated with an increase in developing AMD. Control of these modifiable risk factors could reduce the risk of developing AMD by half (45%) (Tomany et al, 2004).

Progression of AMD will also occur more slowly if protective measures are taken. Nutrition, or more specifically dietary antioxidants, plays an important role in the occurrence, prevention and treatment of AMD. Recent research has shown that some foods such spinach, egg yolks, seafood (especially oysters), seeds, nuts, whole grains and fatty fish can decrease a person's risk for the disease by up to 65% (Tan et al, 2008). Since there is currently no effective treatment for GA AMD, prevention is the first approach to reducing vision loss.

For neovascular AMD, substantial progress has been made in the development of new and effective treatments. Ranibizumab (Lucentis®) and bevacizumab (Avastin®), anti-VEGF agents, are new therapies that can slow the progression of neovascular AMD and in some cases restore some vision to the individual.

2.7.1 Prevalence of vision loss from AMD

The prevalence rates for vision loss and blindness from AMD are presented in Table 2.17.

As with glaucoma, the dearth of epidemiological data on vision loss in New Zealand leads to some uncertainty in relation to the estimates. The best available data have been used. While anecdotal evidence based on attendance at optometry or ophthalmology services suggests the prevalence rate of AMD in the Māori population could be lower than suggested by Table 2.17, this may reflect a reduced utilisation of health services by the Māori population (As discussed in section 2.3.2). In the absence of better data, ratios based on the New Zealand disability survey have again been applied here resulting in an additional 43 individuals from the Māori population with vision loss due to AMD.

Table 2.17: Prevalence rates for vision loss and blindness from AMD

	non-Māori		Māori (b)	
Age group	Vision loss (%) (a)	Blindness (%)	Vision loss (%) (a)	Blindness (%)
50-54	0.05	-	0.11	-
55-59	0.05	-	0.11	-
60-64	0.04	-	0.09	-
65-69	0.04	-	0.10	-

	non-Māori		Māori (b)	
70-74	0.85	0.28	2.05	0.69
75-79	0.85	0.28	0.85	0.28
80-84	4.60	2.37	4.60	2.37
85-89	4.60	2.37	4.60	2.37
90+	12.97	10.68	12.97	10.68

Source: Centre for Eye Research Australia and Access Economics (2004) (from BMES and VIP study data-sets), Statistics New Zealand 2009a, Office for Disability Issues (a) including blindness (b) estimates based on Australian research as outlined in section 2.3 due to inadequate local data. Anecdotal evidence suggests prevalence rates for AMD in the older Māori population may be lower than those reported here.

Approximately 11,000 people had vision loss from AMD in 2009. Of these, 5,896 were blind. By 2020, the number with vision loss from AMD is projected to be 16,280 of whom around 9,100 would be blind.

Table 2.18: Vision loss from AMD – projected numbers of non-Māori people

Age group	2009	2011	2014	2017	2020
50-54	124	130	138	136	134
55-59	109	114	122	132	137
60-64	81	87	88	94	101
65-69	63	66	79	84	87
70-74	1,031	1,144	1,268	1,413	1,646
75-79	843	846	919	1,081	1,174
80-84	3,537	3,661	3,721	3,859	4,370
85-89	2,070	2,222	2,419	2,571	2,649
90+	2,673	3,062	3,697	4,372	5,034
Total	10,532	11,332	12,452	13,741	15,332

Source: Centre for Eye Research Australia and Access Economics (2004) (from BMES and VIP study data-sets), Statistics New Zealand 2009a, Office for Disability Issues and Statistics New Zealand 2010

Table 2.19: Vision loss from AMD - projected numbers of Māori people

Age group	2009	2011	2014	2017	2020
50-54	34	37	41	40	41
55-59	26	28	32	36	39
60-64	15	17	19	22	25
65-69	12	12	15	17	19
70-74	172	197	211	236	287
75-79	43	47	57	67	72
80-84	115	133	165	197	243
85-89	41	50	64	87	106
90+	39	52	52	91	116
Total	497	574	655	794	948

Source: Centre for Eye Research Australia and Access Economics (2004) (from BMES and VIP study data-sets), Statistics New Zealand 2009a, Office for Disability Issues and Statistics New Zealand 2010

Table 2.20: Blindness from AMD - projected numbers of non-Māori people

Age group	2009	2011	2014	2017	2020
50-54	-	-	-	-	-
55-59	-	-	-	-	-
60-64	-	-	-	-	-
65-69	-	-	-	-	-
70-74	345	382	424	472	550
75-79	282	283	307	361	392
80-84	1,820	1,884	1,915	1,986	2,249
85-89	1,065	1,143	1,245	1,323	1,363
90+	2,200	2,521	3,044	3,600	4,145
Total	5,712	6,214	6,935	7,742	8,699

Source: Centre for Eye Research Australia and Access Economics (2004) (from BMES and VIP study data-sets), Statistics New Zealand 2009a, Office for Disability Issues and Statistics New Zealand 2010

Table 2.21: Blindness from AMD - projected numbers of Māori people

Age group	2009	2011	2014	2017	2020
50-54	-	-	-	-	-
55-59	-	-	-	-	-
60-64	-	-	-	-	-
65-69	-	-	-	-	-
70-74	58	66	71	79	96
75-79	14	16	19	22	24
80-84	59	68	85	102	125
85-89	21	26	33	45	54
90+	32	43	43	75	96
Total	184	219	250	322	395

Source: Centre for Eye Research Australia and Access Economics (2004) (from BMES and VIP study data-sets), Statistics New Zealand 2009a, Office for Disability Issues and Statistics New Zealand 2010

2.8 Refractive error

More than half of vision loss is caused by uncorrected refractive error, which means that the image of the object a person is looking at is not focussed properly onto the retina (the light sensitive tissue in the back of the eye). Symptoms include blurred vision, eye strain, tiredness, reduced concentration and headaches, as the eyes try without success to correct the blur and because there is a tendency to screw up the eyes to try to see better, producing muscle discomfort in the eyelid and face. There are three main types of refractive errors, which can affect people at any age, diagnosed through a simple vision test, and managed through wearing glasses or contact lenses (hard or soft). These three affect distance vision:

- Myopia - short-sightedness; the light focuses in front of the retina so distant images are blurred. Myopia is caused either by excessively steep curvature of the cornea (the front surface of the eye) or excessive axial length of the eye, or both. There is some genetic influence and some evidence for environmental influence, such as excessive amounts of near work. Spectacles or contact lenses (concave) enable clear vision by diverging incoming light rays, so they are properly focussed on the retina, as per the diagram.

- Hyperopia - long-sightedness; the light focuses behind the retina so close images are blurred. The average person is a little hyperopic, however significant hyperopia cannot be accommodated and is thought to be genetic (the eyeball may be a little smaller than average). Retinoscopy and refraction tests are required for diagnosis, with correction through a convex lens, which converge the light rays, as per the diagram.
- Astigmatism - is focusing error that causes asymmetric blur at all distances, mostly caused by the shape of the cornea or by slight tilting of the lens – either inherited or a normal variation accompanying growth. Non-spherical curvatures result in light focusing at two different locations, rather than to a point. Most people have at least very slight astigmatism, again correctable through wearing spectacles and lenses. Sometimes correction of astigmatism can cause change in the apparent size and shape of objects and may affect judgement of distance. A person may feel taller or shorter, or walls may appear to slope and floors curve. In most cases, adjustment to these side effects takes only a week or so. However, astigmatism correction may thus involve a compromise between optimal clarity and visual discomfort. There is also a fourth type of related eye focussing disorder which affects distance vision. It is related to age, and essentially affects everyone over the age of forty.
- Uncorrected presbyopia - is age-related vision difficulty at normal reading distance. In youth, to focus on close objects, a muscle in the eye changes the shape of the lens, called accommodation. With ageing, the lens loses its flexibility and is less able to change shape. Although, like stiffening joints or greying hair, presbyopia cannot be prevented, it can be corrected by spectacles or lenses, such as bifocal prescriptions, with distant vision in the top half of the lens and near vision in the lower half. Other options include `look-overs' or half-glasses, trifocals, progressive lenses and some special contact lenses. Presbyopia is usually first noticed around the age of 40-45 years (although in reality the process has been occurring since childhood) and continues changing vision to about age 65; from 65 onwards, there are unlikely to be any further significant vision changes. Between the ages of 45 and 65, reading glasses may need to be changed every few years for optimal correction.

2.8.1 Prevalence of vision loss from refractive error

Uncorrected refractive error occurs when a person's vision is reduced because they either need glasses and do not have them, or their current glasses need to be changed to give them their clearest vision. The prevalence rates for vision loss and blindness from uncorrected refractive error are presented in Table 2.22. These rates exclude presbyopia, but are the same as those used in Centre for Eye Research Australia and Access Economics (2004). Estimates for presbyopia are presented separately in Section 2.8.1.

Table 2.22: Prevalence rates for vision loss and blindness from uncorrected refractive error(a)

	non-Māori		Māori	
Age group	Vision loss (%) (b)	Blindness (%)	Vision loss (%) (b)	Blindness (%)
40-44	0.48	-	1.30	-

	non-Māori		Māori	
45-49	0.48	-	1.08	-
50-54	1.84	-	4.21	-
55-59	1.84	-	4.21	-
60-64	3.92	0.04	8.93	0.09
65-69	3.92	0.04	9.49	0.10
70-74	7.81	0.01	18.91	0.02
75-79	7.81	0.01	7.81	0.01
80-84	13.01	0.18	13.01	0.18
85-89	13.01	0.18	13.01	0.18
90+	7.86	0.00	7.86	0.00

(a) Excluding presbyopia. (b) including blindness

Source: Centre for Eye Research Australia and Access Economics (2004) (from BMES and VIP study data-sets), Office for Disability Issues and Statistics New Zealand 2010

These prevalence rates were applied to the latest population numbers to obtain an estimate of 68,850 persons with vision loss from uncorrected refractive error in 2009. Of these, 420 were estimated to be blind from uncorrected refractive error. Prevalence rates were applied to population projections to estimate around 92,900 persons with uncorrected refractive error related vision loss and 554 persons with uncorrected refractive error related blindness in 2020.

Table 2.23: Vision loss from uncorrected refractive error – projected numbers of non-Māori people

Age group	2009	2011	2014	2017	2020
40-44	1,306	1,319	1,308	1,220	1,199
45-49	1,360	1,351	1,317	1,341	1,300
50-54	4,698	4,936	5,239	5,148	5,091
55-59	4,145	4,302	4,634	5,003	5,187
60-64	8,003	8,528	8,649	9,209	9,938
65-69	6,240	6,542	7,756	8,265	8,543
70-74	9,512	10,558	11,699	13,034	15,189
75-79	7,778	7,810	8,481	9,973	10,832
80-84	10,007	10,359	10,528	10,918	12,363
85-89	5,856	6,285	6,845	7,274	7,496
90+	1,619	1,855	2,240	2,649	3,050
Total	60,524	63,845	68,696	74,034	80,187

Source: Centre for Eye Research Australia and Access Economics (2004) (from BMES and VIP study data-sets), Statistics New Zealand 2009a, Office for Disability Issues and Statistics New Zealand 2010

Table 2.24: Vision loss from uncorrected refractive error - projected numbers of Māori people

Age group	2009	2011	2014	2017	2020
40-44	515	531	536	510	495
45-49	419	419	413	429	426

Age group	2009	2011	2014	2017	2020
50-54	1,283	1,405	1,543	1,531	1,535
55-59	976	1,051	1,207	1,379	1,468
60-64	1,515	1,732	1,930	2,183	2,526
65-69	1,159	1,198	1,447	1,715	1,916
70-74	1,590	1,817	1,949	2,176	2,650
75-79	398	437	522	616	663
80-84	329	382	474	566	698
85-89	119	145	184	250	303
90+	24	31	31	55	71
Total	8,326	9,147	10,238	11,411	12,749

Source: Centre for Eye Research Australia and Access Economics (2004) (from BMES and VIP study data-sets), Statistics New Zealand 2009a, Office for Disability Issues and Statistics New Zealand 2010

Table 2.25: Blindness from uncorrected refractive error - projected numbers of non-Māori people

Age group	2009	2011	2014	2017	2020
40-44	-	-	-	-	-
45-49	-	-	-	-	-
50-54	-	-	-	-	-
55-59	-	-	-	-	-
60-64	81	87	88	94	101
65-69	63	66	79	84	87
70-74	8	9	10	11	13
75-79	7	7	7	9	9
80-84	142	147	150	155	176
85-89	83	89	97	103	106
90+	0	0	0	0	0
Total	385	405	431	456	492

Source: Centre for Eye Research Australia and Access Economics (2004) (from BMES and VIP study data-sets), Statistics New Zealand 2009a, Office for Disability Issues and Statistics New Zealand 2010

Table 2.26: Blindness from uncorrected refractive error - projected numbers of Māori people

Age group	2009	2011	2014	2017	2020
40-44	-	-	-	-	-
45-49	-	-	-	-	-
50-54	-	-	-	-	-
55-59	-	-	-	-	-
60-64	15	17	19	22	25
65-69	12	12	15	17	19
70-74	1	2	2	2	2
75-79	0	0	0	1	1
80-84	5	5	7	8	10

Age group	2009	2011	2014	2017	2020
85-89	2	2	3	4	4
90+	0	0	0	0	0
Total	35	39	45	53	62

Source: Centre for Eye Research Australia and Access Economics (2004) (from BMES and VIP study data-sets), Statistics New Zealand 2009a, Office for Disability Issues and Statistics New Zealand 2010

2.8.1 Prevalence of presbyopia

Presbyopia is not included in the World Health Organisation's reported prevalence of uncorrected refractive error (Holden et al 2008) and is not included in overall prevalence of vision loss in this report (Section 2.9). Nevertheless, estimates of the number of people affected have been added here because of the large expected impact given New Zealand's ageing population. Holden et al (2008) used a Brazillian study (conducted in the country's far southern temperate region with 81% of the study participants being white) to estimate a presbyopia prevalence in New Zealand of 83% and an age at onset of 45 years.

Near vision can be assessed using an N notation chart, with presbyopia in those with normal distance vision being defined as binocular near vision worse than N8 reading size in subjects aged over 35, with visual acuity of 6/12 or better (Marmamula 2009). Taylor et al (1997) reported near-vision measurement estimates for the 40 and over age group from the VIP sample, which enabled presbyopia prevalence to be derived. In the VIP study, functional near vision was measured with a log MAR word reading card, designed for use at 25 centimetres, although the test was performed at the participant's preferred reading distance. Vision correction devices/spectacles were worn for testing, if the participant normally used them. Thus, prevalence estimates derived here represents uncorrected presbyopia (ie, those who either do not have vision correction aids for presbyopia and need them, or those whose current vision correction aids need to be changed to give them their clearest vision). Of the total VIP sample of 3,271 participants aged over 40, 3,261 participants had full near-vision testing performed.

Of the VIP near-vision sample, 24 participants who had normal distance vision were identified with near vision impairment due to uncorrected presbyopia, using the definition of worse than N8 near vision, and visual acuity of 6/12 or better. The derived prevalence rate was thus 0.74%. Age specific prevalence rates were not available. Application of the derived prevalence rate to the New Zealand population aged 40 and over in 2009 suggests approximately 14,400 people have vision loss due to uncorrected presbyopia and normal distance vision. It is estimated that this will rise to 17,000 people aged over 40 by 2020 (Table 2.27).

Table 2.27: Near vision loss due to uncorrected presbyopia in those with normal distance vision - number of people(a)

Age group	2009	2011	2014	2017	2020
40 and over	14,394	14,968	15,761	16,422	17,068

Source: Access Economics from VIP (Taylor et al, 1997), Statistics New Zealand 2009a, Office for Disability Issues

(a) defined as worse than N8 near vision and >6/12 distance visual acuity.

The health system costs in this report are for diseases of the eye and adnexa (rather than vision loss *per se*) and thus include any direct costs associated with presbyopia (corrected or uncorrected). However, uncorrected presbyopia was not able to be included in estimates of indirect financial costs or loss of wellbeing.

Uncorrected presbyopia is unlikely to result in substantial indirect financial costs in developed countries such as New Zealand, but in less developed countries it could lead to significant losses in productivity. For example, Patel et al (2010) demonstrated the marked improvement in function resulting from correction of presbyopia with spectacles in Tanzania. Uncorrected presbyopia can also affect wellbeing (see chapter 6).

2.9 Overall prevalence of vision loss and projections

The prevalence rates for overall vision loss and blindness (from all causes excluding presbyopia) are presented in Table 2.28. The rates in the table include the major causes of vision loss discussed above (cataract, diabetic retinopathy, glaucoma, AMD and uncorrected refractive error) as well as other causes of vision loss such as retinal causes, neuro-ophthalmic causes, corneal and other causes.

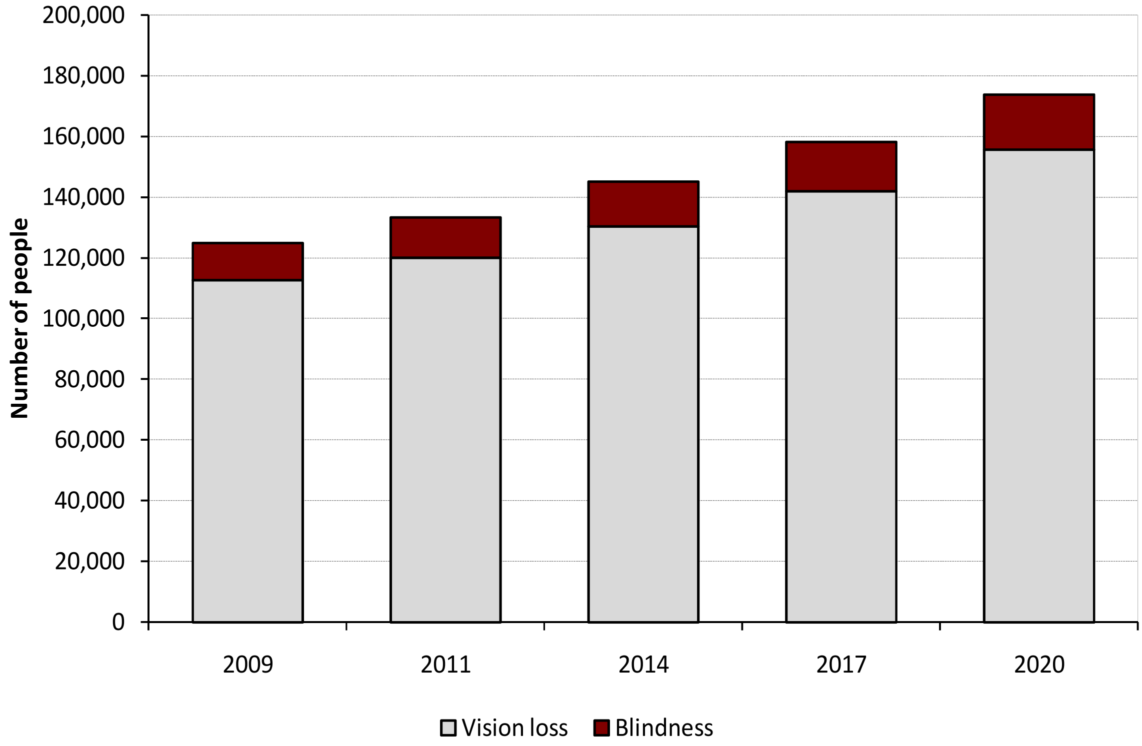
Table 2.28: Prevalence rates for overall vision loss and blindness (b)

	non-Māori		Māori	
Age group	**Vision loss (%) (a)**	**Blindness (%)**	**Vision loss (%) (a)**	**Blindness (%)**
40-44	0.63	-	1.74	-
45-49	0.63	-	1.45	-
50-54	2.33	0.09	5.31	0.19
55-59	2.33	0.09	5.31	0.19
60-64	4.70	0.27	10.71	0.62
65-69	4.70	0.27	11.37	0.65
70-74	11.39	0.65	27.58	1.57
75-79	11.39	0.65	11.36	0.65
80-84	28.71	4.28	28.71	4.28
85-89	28.71	4.28	28.71	4.28
90+	45.13	17.18	45.13	17.18

Source: Centre for Eye Research Australia and Access Economics (2004) (from BMES and VIP study data-sets), Statistics New Zealand 2009a, Office for Disability Issues (a) including blindness (b) excluding presbyopia

These prevalence rates were applied to the latest population numbers to obtain an estimate of approximately 125,000 persons with vision loss in 2009. Of these, 12,230 were estimated to be blind. Prevalence rates were applied to population projections to estimate nearly 174,000 persons with vision loss and 18,300 persons with blindness in 2020 (Chart 2.1).

Chart 2.1: Projections of New Zealanders (aged 40 or over) with vision loss, 2009



Source: Source: Centre for Eye Research Australia and Access Economics (2004) (from BMES and VIP study data-sets), Statistics New Zealand 2009a, Office for Disability Issues and Statistics New Zealand 2010

These estimates and projections are presented in Table 2.29, Table 2.30, Table 2.31 and Table 2.32.

The estimates here are higher than previous estimates of vision loss in New Zealand (discussed in section 2.2). The disparity between reports is due to different definitions of vision loss, differences in collection methodologies (self-report versus ophthalmological test), the ages of the populations included in the estimates, and the year for data collection. For instance, RNZFB (2006) used the 2001 disability survey for their upper prevalence estimate (98,400 people in June 2004) whereas the current report calculates 2009 prevalence estimates and includes milder vision loss (see section 2.2) is thus influenced by population growth and demographic ageing (documented by Cornwall and Davey, 2004) in the intervening years.

Table 2.29: Overall vision loss - numbers of non-Māori people (a)

Age group	2009	2011	2014	2017	2020
40-44	1,741	1,759	1,745	1,627	1,599
45-49	1,813	1,802	1,757	1,788	1,733
50-54	6,154	6,465	6,861	6,743	6,668
55-59	5,429	5,634	6,069	6,552	6,794
60-64	10,148	10,814	10,968	11,678	12,602
65-69	7,913	8,295	9,835	10,481	10,833
70-74	14,662	16,275	18,032	20,091	23,413

Age group	2009	2011	2014	2017	2020
75-79	11,989	12,038	13,073	15,372	16,696
80-84	25,369	26,260	26,689	27,678	31,340
85-89	14,845	15,934	17,353	18,441	19,002
90+	12,837	14,707	17,760	21,001	24,179
Total	112,901	119,983	130,141	141,452	154,860

Source: Centre for Eye Research Australia and Access Economics (2004) (from BMES and VIP study data-sets), Statistics New Zealand 2009a, Office for Disability Issues and Statistics New Zealand 2010 (a) excluding presbyopia

Table 2.30: Overall vision loss - numbers of Māori people (a)

Age group	2009	2011	2014	2017	2020
40-44	687	708	715	680	660
45-49	558	558	551	573	568
50-54	1,680	1,840	2,021	2,005	2,010
55-59	1,278	1,377	1,581	1,807	1,922
60-64	1,902	2,174	2,423	2,740	3,171
65-69	1,455	1,503	1,816	2,153	2,405
70-74	2,448	2,798	3,002	3,352	4,081
75-79	612	673	805	949	1,021
80-84	825	957	1,188	1,419	1,748
85-89	297	363	462	627	759
90+	187	249	249	436	561
Total	11,930	13,200	14,813	16,740	18,906

Source: Centre for Eye Research Australia and Access Economics (2004) (from BMES and VIP study data-sets), Statistics New Zealand 2009a, Office for Disability Issues and Statistics New Zealand 2010 (a) excluding presbyopia

Table 2.31: Overall blindness – numbers of non-Māori people

Age group	2009	2011	2014	2017	2020
40-44	-	-	-	-	-
45-49	-	-	-	-	-
50-54	218	229	243	238	236
55-59	192	199	215	232	240
60-64	552	588	597	635	685
65-69	430	451	535	570	589
70-74	790	876	971	1,082	1,261
75-79	646	648	704	828	899
80-84	3,289	3,405	3,460	3,589	4,064
85-89	1,925	2,066	2,250	2,391	2,464
90+	3,540	4,055	4,898	5,791	6,668
Total	11,581	12,518	13,872	15,356	17,105

Source: Centre for Eye Research Australia and Access Economics (2004) (from BMES and VIP study data-sets), Statistics New Zealand 2009a, Office for Disability Issues and Statistics New Zealand 2010

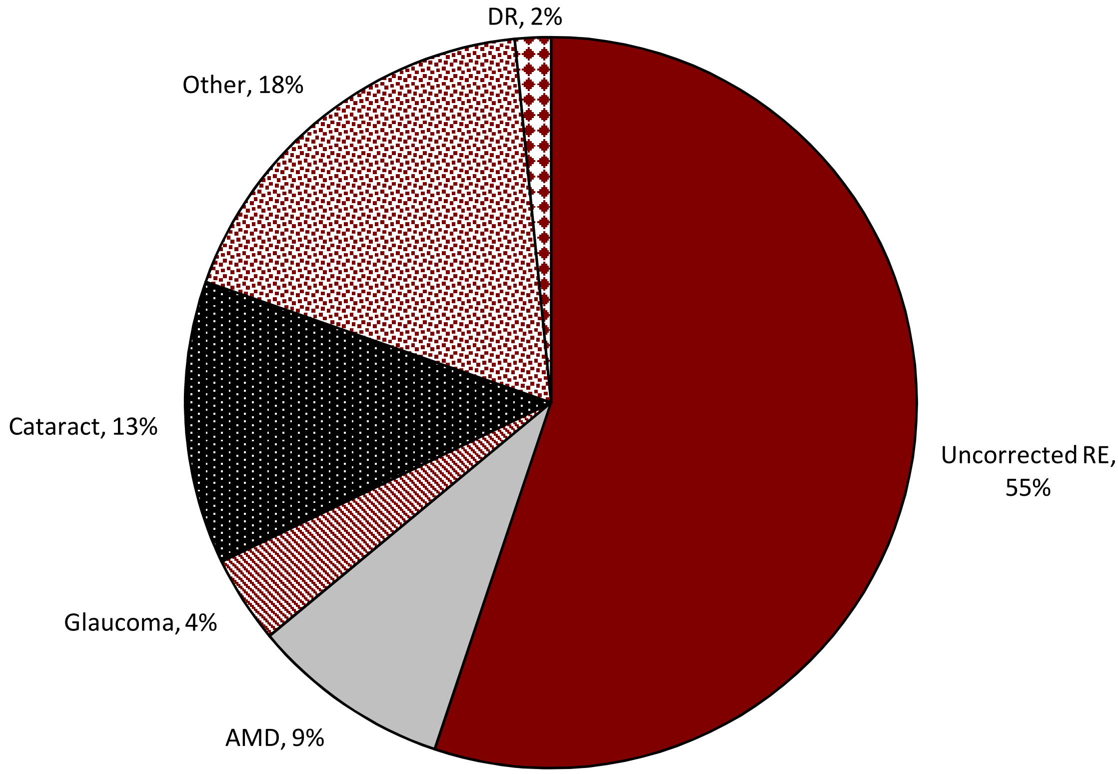
Table 2.32: Overall blindness – numbers of Māori people

Age group	2009	2011	2014	2017	2020
40-44	-	-	-	-	-
45-49	-	-	-	-	-
50-54	59	65	71	71	71
55-59	45	49	56	64	68
60-64	103	118	132	149	172
65-69	79	82	99	117	131
70-74	132	151	162	180	220
75-79	33	36	43	51	55
80-84	107	124	154	184	227
85-89	38	47	60	81	98
90+	52	69	69	120	155
Total	649	740	846	1,018	1,197

Source: Centre for Eye Research Australia and Access Economics (2004) (from BMES and VIP study data-sets), Statistics New Zealand 2009a, Office for Disability Issues and Statistics New Zealand 2010

Most vision loss was caused by uncorrected refractive error (55%, Chart 2.2). The 'Other' category includes other retinal causes, neuro-ophthalmic causes, corneal and other causes.

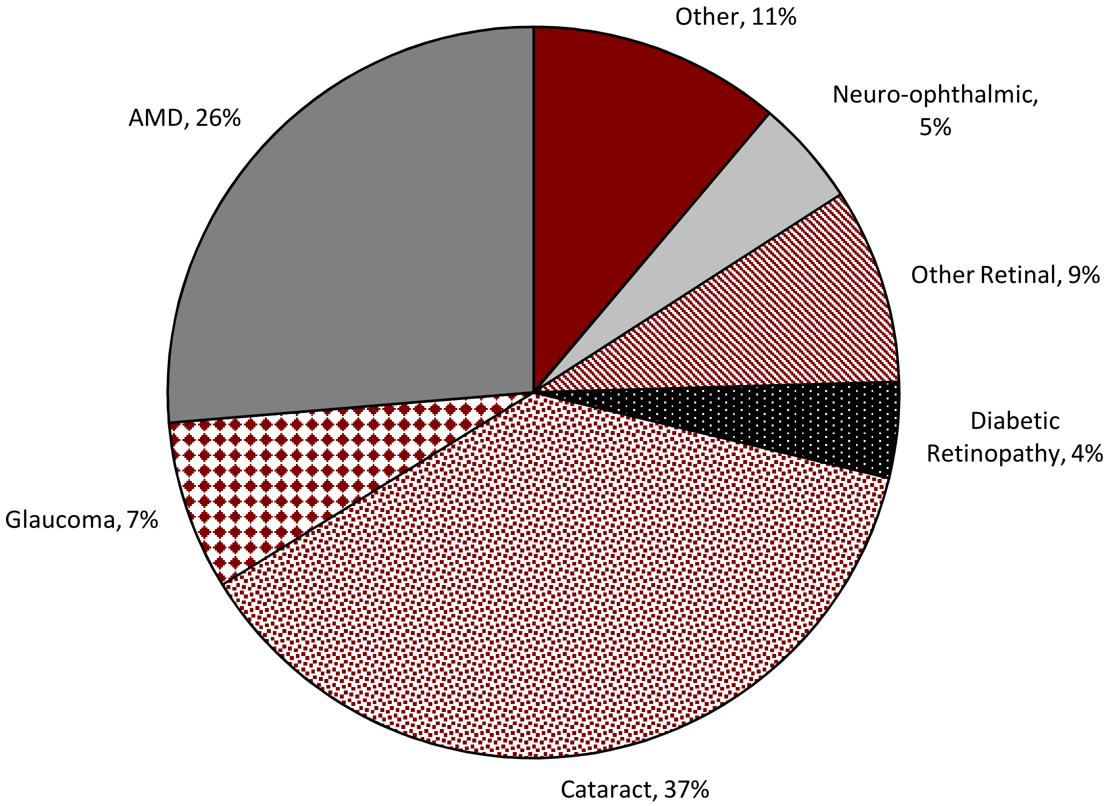
Chart 2.2: Vision loss by cause among New Zealanders aged 40 or over, 2009(a)



Source: Centre for Eye Research Australia and Access Economics (2004) (from BMES and VIP study data-sets), Statistics New Zealand 2009a, Office for Disability Issues and Statistics New Zealand 2010 (a) Excluding presbyopia

If the uncorrected RE is removed, cataract becomes the leading cause of vision loss followed by AMD as documented in an earlier (Australian) report (Access Economics 2004).

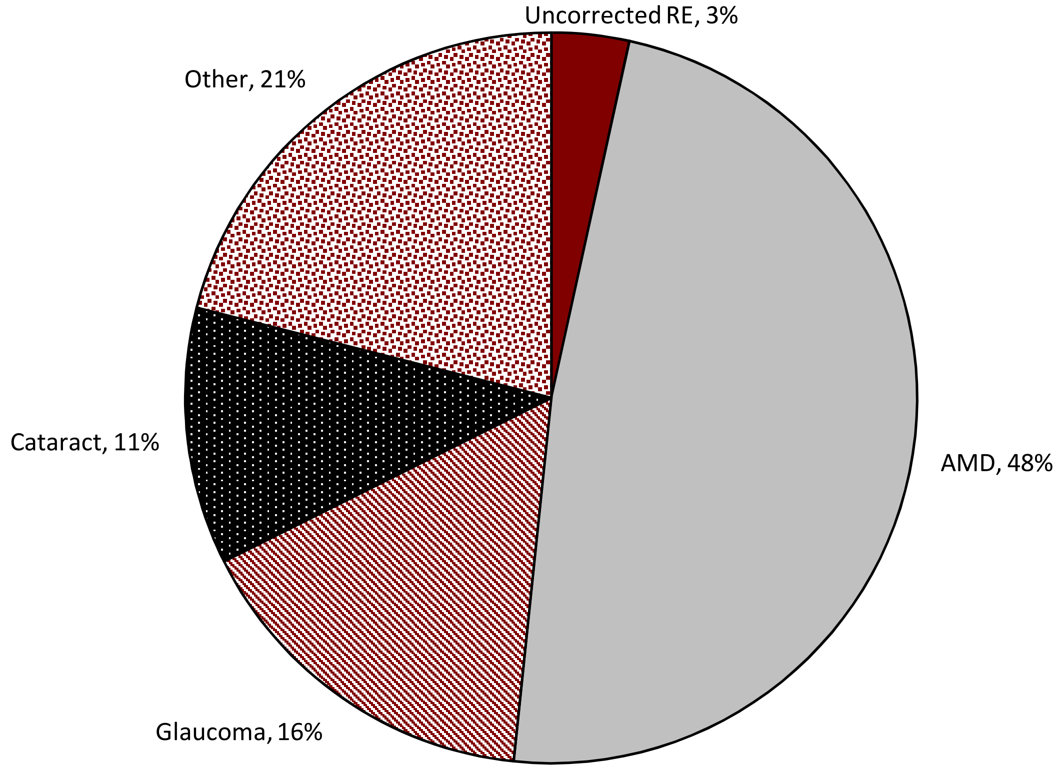
Chart 2.3: Vision loss not correctable by refraction, by cause among Australians aged 40 or over, 2004



Source: Access Economics (2004)

Almost half of blindness in 2009 could be attributed to AMD (Chart 2.4), with the next largest category being 'Other' diseases. Glaucoma and cataract, respectively, were the third and fourth leading causes of estimated blindness. It should be noted that blindness from DR could not be estimated, due to limited data on prevalence.

Chart 2.4: Blindness by cause among New Zealanders aged 50 or over, 2009



Source: Centre for Eye Research Australia and Access Economics (2004) (from BMES and VIP study data-sets), Statistics New Zealand 2009a, Office for Disability Issues and Statistics New Zealand 2010

3 Mortality

Vision loss is associated with a higher than average risk of mortality (McCarty et al 2001, Wang et al 2001, and Klein et al 1995). The vision loss itself does not directly cause death, but it is correlated with a higher risk of falls, motor vehicle accidents and depression (Centre for Eye Research Australia and Access Economics 2004).

New Zealand mortality statistics attributed only two deaths (both non-Māori) to diseases of the eye and adnexa in the five years 2002 to 2006 (Ministry of Health[7]). However these estimates are unlikely to reflect deaths associated with vision loss. For this report, the relative risk of death from vision loss from VIP (McCarty et al 2001) was used, together with the attributable fraction from Australian mortality data (1.38% from Access Economics 2010). Based on this methodology, there were four deaths among Māori people, and 111 deaths among non-Māori people attributable to vision loss in 2009.

3.1 Co-morbidities

3.1.1 Falls and fractures

Vision aids our balance through complex neurological pathways. Several studies have found a significant link between falls and vision loss, particularly among older people. Evidence includes:

- 1.5 to twice the risk of falls in the vision impaired (Ivers et al, 1998, Black et al, 2005);
- four to eight times the risk of hip fractures for vision impaired individuals (Klein et al, 1998 and Ivers et al, 2003);
- the risk of recurrent falls related to the degree of visual field loss (Coleman et al, 2004).

Stronger evidence exists for a link between vision loss and fractures than for vision loss and falls possibly because of the more accurate reporting of fractures which generally require medical attention (Black et al 2005). Lamoureux et al (2010) suggested visual acuity, contrast sensitivity, depth perception, visual field, main cause of vision loss, and duration of the disability are not significantly associated with falls ($p>0.05$), rather physical inactivity was the only variable independently associated with falls. Overall, vision impaired people were three times more likely to fall if they were physically inactive.[8]

3.1.2 Depression

Vision impaired individuals are more like to suffer from depression in comparison to the general population, particularly the older population. The relative risk of depression among those with vision impairment is likely to be in the order of 3.5 times higher (Centre for Eye

[7] http://www.moh.govt.nz/moh.nsf/indexmh/mortality-demographic-series accessed May 2010.

[8] http://gateway.nlm.nih.gov/gw/Cmd?linkVars=BROWSER_STATE%3DGMResults%26SessionID%3D10050402211205005406261047%26GM2K_FORM%3DGMResults%26sb_action%3DExpand%2BItem%2B%253A%2B3%26LAST_HIDDEN_TIMESTAMP%3D1272955713301%26UserSearchText%3Dvision%2Bimpairment%2Band%2Bfalls%26HIDDEN_TIMESTAMP%3D1272955729180%26ORBagentPort%3D14610

Research Australia and Access Economics 2006). However, comparisons are difficult because of differences in the definition of vision impairment and depression, and the nature of the base population. In addition, some studies have found that the longer the duration of vision loss, the less it is associated with emotional distress.

A UK GP based study involving 1,742 vision impaired individuals (out of a population of 13,900) aged 75 years and older investigated the association between visual impairment and depression and anxiety (Evans et al, 2007). A higher prevalence of depression was observed in the vision impaired population in comparison to those with visual acuity of 6/6 or better. Of vision impaired older people, 13.5% were depressed compared with 4.6% of people with good vision (relative risk of 2.9).

Rees et al (2010) identified vision-specific distress as the strongest unique predictor of depressive symptoms (alongside physical health and a negative life event) using the Impact of Vision Impairment (IVI) Questionnaire.

4 Health costs

This chapter estimates the direct health system costs of vision loss in New Zealand for the year 2009, disaggregated by cost components.

Direct financial costs to the New Zealand health system include the relevant proportion of the costs of running hospitals and nursing homes (buildings, care, consumables), GP and specialist medical services (subsidised and private), the cost of prescription pharmaceuticals (subsidised and private), allied health services, research and "other" direct costs (such as administration).

4.1.1 Use of health services by ethnicity

Utilisation of health services by Māori and non-Māori differ. A summary of health service utilisation rates, based on 2006-07 New Zealand Health survey responses (Ministry of Health 2008), is in Table 4.1. Use of optometrists, pharmacists, and specialists at private hospitals were lower than average for Māori whereas use of hospitals (both public and private) was higher than average for Māori people. Differences in patterns of services use reflect differences in disease and socioeconomic factors. Since Māori tend to experience higher rates of disease than non-Māori (Ministry of Health 2010[9]), the rates in Table 4.1 suggest underutilisation of health services by Māori.

There is a paucity of data with the necessary granularity to enable adjustment of the health system costs in this report for differences in health services use by ethnicity. The cost estimates in this report are based on average utilisation rates and are not able to be provided by ethnicity.

Table 4.1: Health service use, age-standardised, by gender and ethnicity, 2006-07

Health service	Use by Māori population %	Use by overall population %
GP	80.3	80.1
Optometrist	7.7	12.0
Pharmacist	15.1	18.5
Specialist at public hospital	62.7	44.2
Specialist at private hospital	4.9	8.1
Inpatient at public hospital	11.6	7.5
Inpatient at private hospital	40.3	33.8

Source: Ministry of Health 2008

4.2 Hospital inpatient

4.2.1 Public hospitals

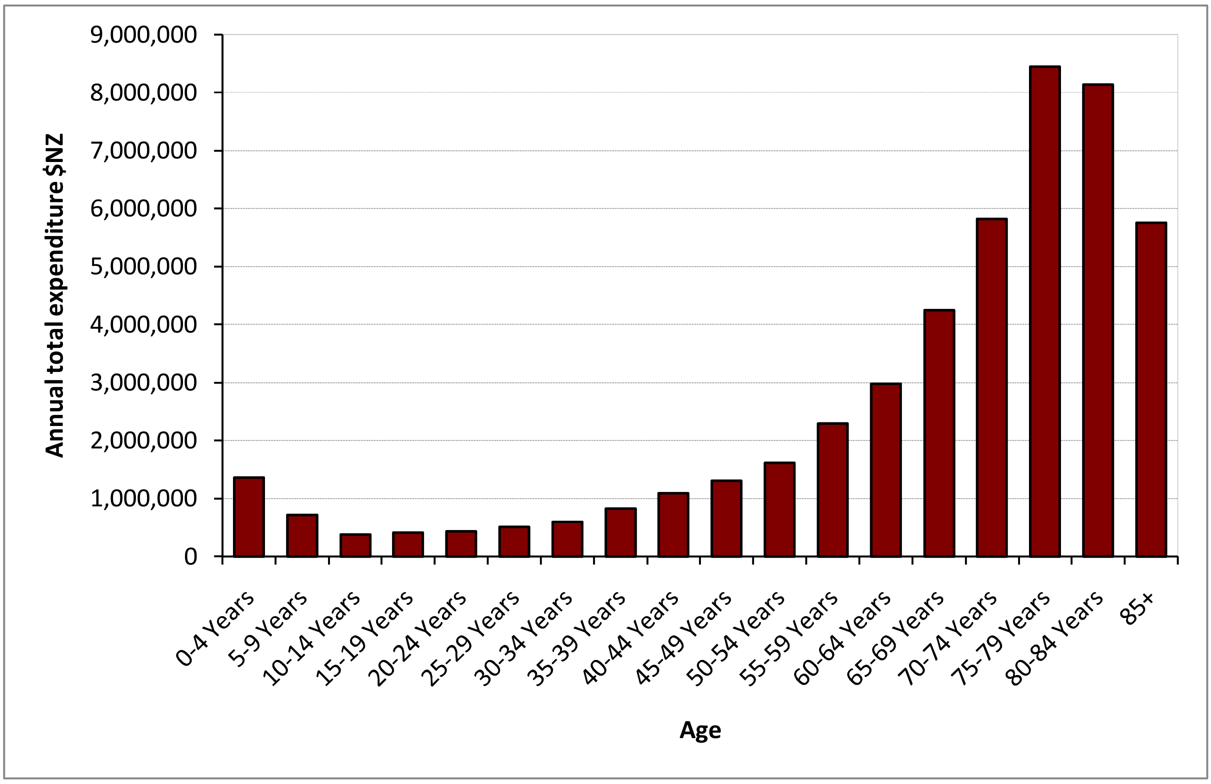
Top-down, projected District Health Board estimates of public inpatient hospital expenditure for 2009-10 from the Ministry of Health, (special request) are reported. It should be noted

[9] http://www.Māorihealth.govt.nz/

that while the prevalence data presented earlier related to *vision loss*, the cost data in this section reflect *disorders of the eye and adnexa*.

In total $46.9 million was spent on public inpatient and day stay services in 2009-10, with a spread by age in Chart 4.1, and by disease in Chart 4.2.

Chart 4.1: Annual public hospital inpatient and day stay expenditure on diseases of the eye and adnexa, by age, 2009-10 ($)



Source: Ministry of Health 2009

Disease specific discharge rates from public hospitals for 2006-07 (most recent available) are in Table 4.2.

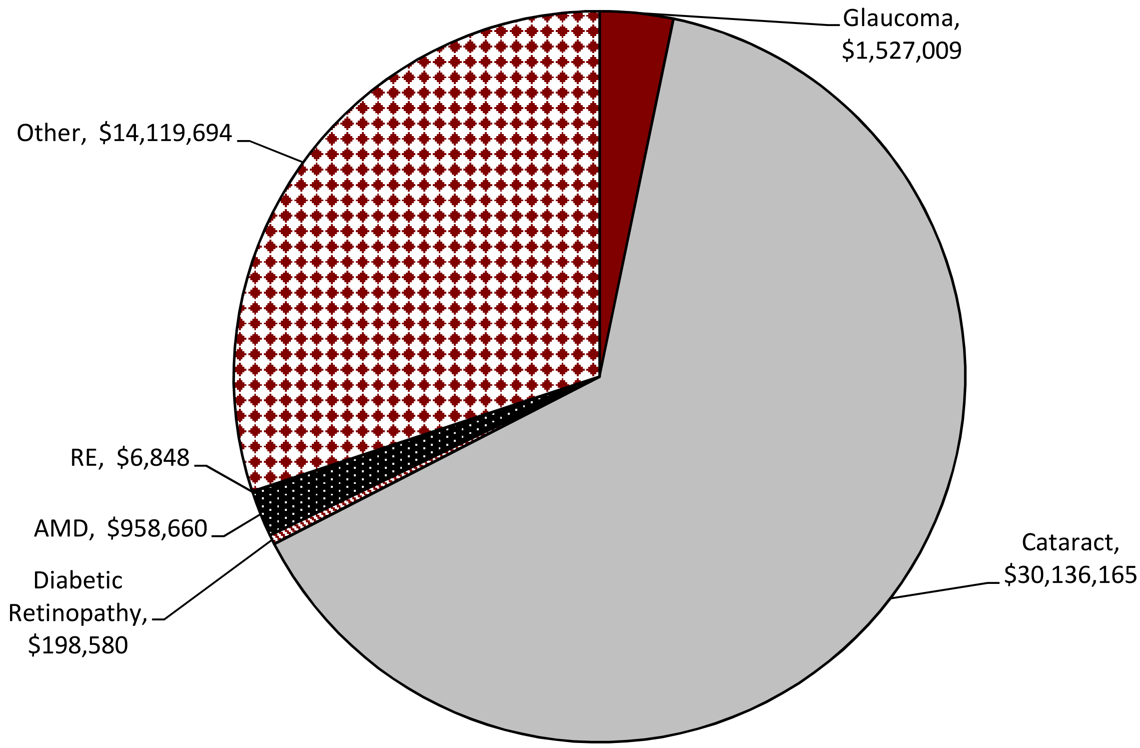
Cataract surgery increased by 60% in between 2006-07 and 2007-08 from 7,545 to 12,088 operations (personal communication, Ministry of Health, 13 May 2010). In preparing the cost estimates for 2009 reported in Chart 4.2, the cataract discharge rates in Table 4.2 were therefore factored up to reflect the newer 2007-08 cataract surgeries.

Table 4.2: Public hospital inpatient and day stay discharge rates per 1,000 people, 2006-07

	Cataract	DR	Glaucoma	MD(a)	RE
40 to 44	0.2	0.0	0.1	0.0	0.0
45 to 49	0.3	0.0	0.1	0.0	0.0
50 to 54	0.7	0.0	0.1	0.0	0.0
55 to 59	1.2	0.0	0.2	0.0	0.0
60 to 64	2.0	0.0	0.3	0.1	0.0
65 to 69	4.2	0.1	0.5	0.2	0.0
70 to 74	8.6	0.1	0.7	0.4	0.0
75 to 79	15.7	0.1	1.1	0.8	0.0
80 to 84	20.6	0.0	1.3	1.3	0.0
85 to 89	18.8	0.0	1.0	1.3	0.0
90 to 94	0.0	0.0	0.5	1.3	0.0

(a) Overall macular degeneration data was supplied in place of age-related macular degeneration rates as the latter were unavailable.

Chart 4.2: Public hospital inpatient and day stay expenditure by disease, 2009



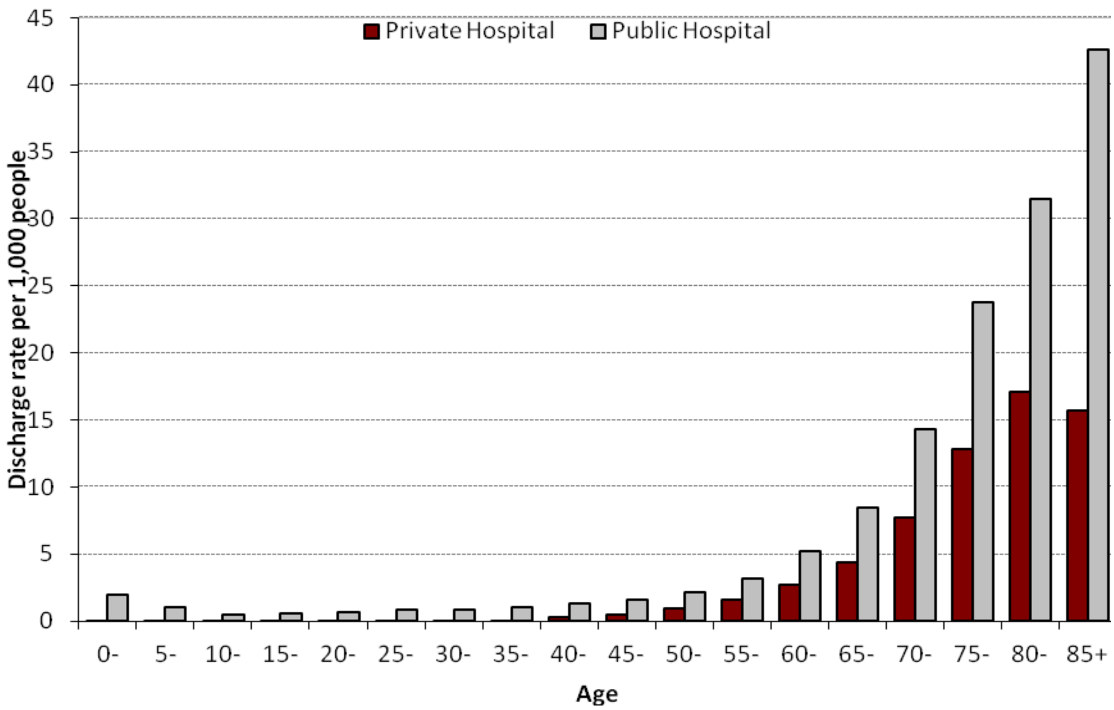
Source: Ministry of Health special request 2010

4.2.2 Private hospitals

The most recent data available for private hospital discharge rates for diseases of the eye and adnexa are for 2004-05 (Ministry of Health 2009a). These rates were applied to the 2009 New Zealand population to estimate the number of discharges from private hospitals in 2009-10. It should be noted that reporting of hospital discharge data is not mandated for private hospitals and so reported rates may underestimate actual rates. Additionally, private hospital cost data are not collected by the Ministry of Health and so public hospital charges were applied to the estimated number of discharges to estimate private hospital inpatient costs.

In total, $15.6 million was spent on private inpatient and day stay services for diseases of the eye and adnexa in 2009.

Chart 4.3: Hospital discharge rates for diseases of the eye and adnexa per 1,000 people (a)



Source: Ministry of Health special request 2009a (a) most recent discharge rates used; 2006-07 for public hospitals, 2004-05 for private hospitals.

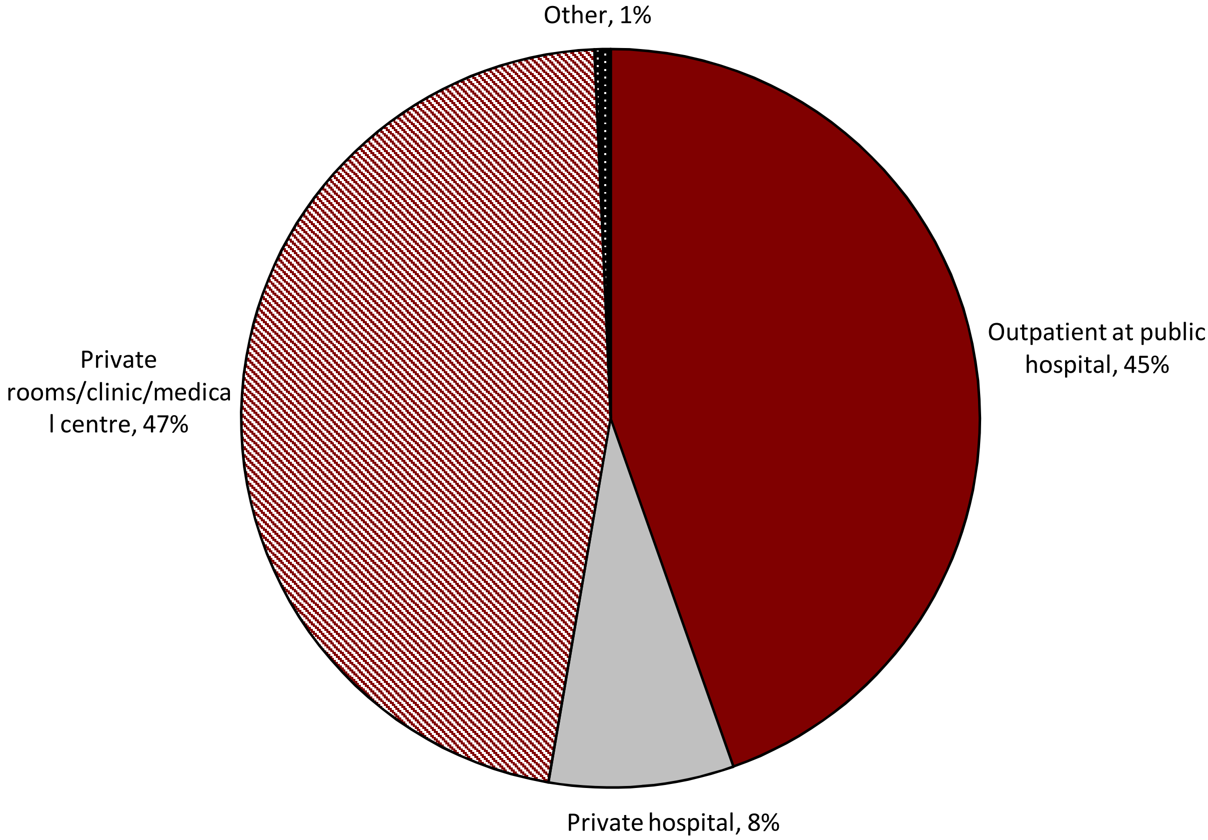
4.3 Hospital outpatient

The 2006-07 New Zealand Health Survey (Ministry of Health 2008) results were used to estimate the proportion of public and private outpatient appointments for diseases of the eye and adnexa during 2009. The location of medical specialist appointments from the Survey is depicted in Chart 4.4. It has been assumed that the individual consultation costs (from Ministry of Health special request 2010) are identical across the public and private systems.

In total,

- $18.8 million was spent on public hospital outpatient services (Ministry of Health special request 2010);
- $23.4 million was spent on outpatient services provided by private hospitals, or in private rooms, or other.

Chart 4.4: Location of medical specialist appointment for adults 2006-07



Source: Ministry of Health 2008

4.3.2 Argon Laser surgery

The cost of argon laser surgery funded by the Ministry of Health in 2009 was $978,423 (Ministry of Health special request 2010). Based on advice from New Zealand ophthalmologists[10] , the vast majority of these services are attributable to the treatment of DR. Data were not available to estimate the costs of argon laser surgery performed at private hospitals.

4.4 Summary of hospital costs

In total in 2009, hospital related expenditure on diseases of the eye and adnexa was $105,757,892.

[10] Personal communication, D Squirrell and G Duff, dated 12 May 2010

Table 4.3: Overall hospital costs, 2009

Cost component	Estimated cost
Public inpatient and day stay	$46,946,955
Public outpatients	$18,821,439
Private inpatient and day stay	$15,631,978
Private outpatients	$23,379,097
Argon Laser surgery	$978,423
Total	**$105,757,892**

Source : Ministry of Health 2008, 2009a, special request 2010

4.5 General Practice (GP)

Results from the RNZFB survey (RNZFB 2006) were used to estimate the total number of GP visits for vision related problems in 2009. The Survey included only those with visual acuity 6/24 or worse (ie moderate to severe vision loss). The number of GP visits per annum by people with visual acuity 6/24 or worse from the Survey is in Table 4.4.

Table 4.4: Number of vision related GP visits, RNZFB survey population, 2006

Proportion of respondents	Number of vision related GP visits per annum
67%	0
13%	1-2
17%	3-5
3%	>6

Source: RNZFB 2006

RNZFB survey respondents who visited a GP for vision related problems spent an average of $42.11 per appointment (inflated to $NZ 2009 using Statistics New Zealand, 2009).

The government contributed around $527.7 million towards visits to GPs at Primary Health Organisations[11] in 2009 (Ministry of Health special request 2010). The average amount contributed per visit was calculated using the average number of GP appointments per person (based on 2006-07 Health Survey results, Ministry of Health 2008) and total New Zealand population (Statistics New Zealand 2009a). The sum of individual and government contributions for each GP visit was found to be $80.27. This combined per visit payment and the frequency of GP visits for vision problems (Table 4.4) was applied to the population aged 50 years and above with visual acuity greater than or equal to 6/24 (Foran et al 2000) to calculate the total amount spent on GP visits in 2009.

Using this methodology, total expenditure on GP services in 2009 for vision related consultations was $2.3 million (Table 4.5), or 0.2% of total spend on GP services (Ministry of

[11] Per MoH special data request (2010), $576,636,011.92 (excluding GST) was provided to Primary Health Organisations for services relating to enrolment of the population ('First contact care'), health promotion, and services to improve access in 2009. According to 2007-08 distribution of GP funds, approximately 71% was attributed to 'First Contact' payments for patient visits (MoH 2010).

Health special request 2010). Notably, the Survey included only those with moderate and severe vision loss, so expenditure on GP services by those with mild vision loss is excluded. Insufficient data was available to estimate expenditure on vision related GP visits for the population with mild vision loss (visual acuity 6/12 to 6/24).

Table 4.5: Total spend on vision related GP appointments, moderately and severely vision impaired population (visual acuity ≥ 6/24), 2009

Age	Number of people with visual acuity ≥ 6/24	Number GP visits	Expenditure
50-55	636	671	$53,874
55-59	552	582	$46,737
60-65	2,646	2791	$224,066
65-69	2,060	2173	$174,427
70-75	3,298	3480	$279,306
75-79	2,608	2751	$220,837
80-85	8,734	9215	$739,661
85-89	4,861	5128	$411,615
90+	2,118	2235	$179,383
Total	27,512	29,026	$2,329,905

Source: RNZFB 2006, Statistics New Zealand 2009a, Ministry of Health 2008

4.6 Pharmaceuticals

Subsidised

Expenditure on subsidised pharmaceuticals for glaucoma was $8,238,568 in 2009 according to Pharmaceutical Management Agency of New Zealand (PHARMAC) (special request, Table 4.6). Based on ophthalmologists' advice, other ophthalmic agents listed on the Pharmaceutical Schedule are not commonly used to treat eye conditions related to vision loss and have not been included in this report.

Table 4.6: PHARMAC subsidised glaucoma medications, volume of prescriptions and expenditure, 2009 (a)

Medication	Drug cost (excl GST)	Scripts
Betaxolol hydrochloride	$120,843	3,374
Levobunolol	$41,294	1,852
Timolol maleate	$219,244	24,958
Acetazolamide	$37,985	4,641
Brinzolamide	$326,098	9,928
Dorzolamide hydrochloride	$44,714	1,516
Dorzolamide hydrochloride with timolol maleate (b)	$1,188,980	18,745
Bimatoprost	$1,018,586	16,649
Latanoprost	$3,723,895	62,096
Travoprost	$824,541	12,726
Brimonidine tartrate	$209,083	8,414
Brimonidine tartrate with timolol maleate	$439,969	7,613
Pilocarpine	$43,335	3,001
Total	**$8,238,568**	

Source: PHARMAC 2010 (a) Does not include patient contributions (b) A confidential rebate agreement exists between the manufacturer of dorzolamide hydrochloride with timolol maleate and PHARMAC. Listed drug cost may not exactly represent government spend on this agent during 2009.

Private

Ranibizumab (Lucentis®) and bevacizumab (Avastin®) are used to treat neovascular or wet AMD. In New Zealand, these agents are not funded through PHARMAC. Bevacizumab is supplied and funded by most District Health Boards (and therefore used more commonly). Ranibizumab is generally available through private ophthalmic clinics although a few specific District Health Board grants for it exist (personal communication, D Squirrell, 24 May 2010). Based on Centre for Eye Research Australia and Access Economics (2006), it has been assumed that 67% of the total (late) AMD population who experience vision loss have wet AMD (Table 4.7).

Table 4.7: Prevalence of wet AMD (vision impaired population), 2009

Age	Māori	Non-Māori
50-54	23	83
55-59	17	73
60-64	10	54
65-69	8	42
70-74	115	691
75-79	29	565
80-84	77	2,370
85-89	28	1,387
90+	26	1,791

Age	Māori	Non-Māori
Total	**333**	**7,056**

Source : Centre for Eye Research Australia and Access Economics 2006, Access Economics 2010

The cost of dosing each wet AMD patient at five injections per year has been calculated for each agent (Table 4.8). This dosing regime is based on the 'Prospective Optical Coherence Tomography Imaging of Patients With Neovascular AMD Treated With Intra-Ocular Lucentis® (ranibizumab)' (PrONTO) study results (Lalwani 2009) which showed that an average of 9.9 injections over 24 months, or approximately 5 injections per patient per annum achieved acceptable clinical outcomes. The cost of bevacizumab has been estimated at $72.28 (an average of public hospital and private figures[12], deflated to 2009 dollars), and ranibizumab at $1,949 per treatment (estimate provided for this project by a New Zealand public hospital, deflated to 2009 dollars). A combination dosing schedule has also been costed where 95% of the wet AMD population receive bevacizumab and 5% receive ranibizumab. This reflects anecdotal evidence (from ophthalmologist D Squirrell 12 May 2010) which suggests around 5% of the wet AMD population do not respond to bevacizumab and require secondary treatment with ranibizumab.

Assuming all New Zealanders with wet AMD are treated using the protocols described above, the cost would be approximately $6.1 million (Table 4.8). If these treatments were subsidised by PHARMAC it is likely that the costs would be lower because of price capping or discounts observed in other subsidised markets including Canada and Australia.

Table 4.8: Expenditure on bevacizumab, ranibizumab, and combination of the two agents, 2009 (a)

Age	All ranibizumab	All bevacizumab	95% receive bevacizumab, 5% receive ranibizumab
50-54	$1,033,134	$38,308	$88,050
55-59	$877,190	$32,526	$74,759
60-64	$623,779	$23,130	$53,162
65-69	$487,328	$18,070	$41,533
70-74	$7,855,719	$291,288	$669,510
75-79	$5,789,451	$214,672	$493,411
80-84	$23,849,808	$884,346	$2,032,619
85-89	$13,791,368	$511,381	$1,175,380
90+	$17,709,481	$656,664	$1,509,305
Total	**$72,017,258**	**$2,670,385**	**$6,137,728**

(a) Does not include any patient contributions

Other private prescription costs and over the counter medications have not been included in this analysis given the small market share they represent[13].

[12] Personal communication with specialist ophthalmologists D Squirrell and D Sharp dated 24 May 2010 and 26 May 2010.

[13] Personal communication with specialist ophthalmologists D Squirrell dated 03 May 2010

4.7 Allied health

According to the RNZFB survey (RNZFB 2006), 29% of respondents (remembering the survey covered those with visual acuity 6/24 or worse) had seen an optometrist in the past 12 months. This equates to 7,979 individuals with moderate to severe vision loss.

Statistics New Zealand (2010) estimated patients typically paid $69.64 per optometry appointment in December 2009 leading to an annual spend of $555,658 for those with moderate to severe vision loss. This is probably an underestimation because it excludes people with visual acuity better than 6/24.

Frames cost an average of $228, and standard lenses, $164 in 2009[14]. Rein et al (2006) estimated glasses are changed once every 3.4 years, equating to an average annual spend of $115. The 2001 New Zealand Household Disability Survey (Statistics New Zealand 2002) reported that 58% of those with a seeing disability (94,700) used glasses or contact lenses (Ministry of Health 2004) so in 2009, if all used glasses, the average annual expenditure would be $6.31 million.

4.8 Research

The Health Research Council (HRC) of New Zealand estimated public sector expenditure on vision related research to be $350,598 in 2009. The database review conducted by the Health Research Council of New Zealand in March 2010 used the following search terms: vision, eye, eyesight and visual. This figure includes payments to the institution for laboratory use and equipment, plus staff.

Table 4.9: HRC research projects relating to vision loss, 2009, $

Title	$	Length	$/ year
Growing up kāpo Māori: Accessing paediatric ophthalmology services	501,216	24 months	250,608
Studying eye diseases of Māori, Pacific and the elderly using animal models	150,000	36 months	50,000
Promoting neural plasticity to recover visual function in amblyopia	149,971	36 months	49,990
Total			**350,598**

Source: Communication with Health Research Council of New Zealand, March 2010

Private sector research expenditure was based on Organisation for Economic Co-operation and Development (OECD) estimates of health research and development (R&D) in New Zealand and other member countries (OECD 2004). A ratio of private health R&D in NZ as 1.33 times public health R&D was observed, with private R&D expenditure in 2009 estimated as $466,296.

In total, expenditure on public and private research was $816,894 in 2009.

[14] Personal communication with New Zealand optometrist M Frith dated 17 May 2010, price deflated using Consumer Price Index 2009 (Statistics New Zealand 2010)

4.9 Aged care

Vision impairment compounds the presence of other disabling conditions, leading to an increased likelihood of utilising institutionalised aged care. Drawing on data from the BMES, Wang et al (2003) found the relative risk (RR) of nursing home admission for a person with vision impairment after best correction was 1.8 among persons with 'correctable' vision loss. This RR was applied to the general probability of being in an aged care facility, and the average cost per year of $40,500 from Ministry of Health (2010[15]) to calculate additional expenditure on aged care due to vision loss in 2009.

The Ministry of Health (personal communication from Population Health Directorate, Ministry of Health, 26 May 2010) estimated there were approximately 10,000 new residents entering aged care in 2009. It is estimated $67 million of aged care costs can be attributed to vision loss (Table 4.10).

Table 4.10: Probability of Residing in an Aged Care Facility due to vision loss and associated per annum costs, 2009

Age	% of general population in aged care	% vision loss population in aged care (a)	no. people in aged care due to vision loss	Expenditure ($)
60–64	0.00	0.00	4	$178,575
65-69	0.00	0.01	10	$399,503
70–74	0.01	0.01	45	$1,813,608
75-79	0.02	0.03	76	$3,075,981
80-84	0.04	0.07	355	$14,393,555
85-89	0.10	0.18	436	$17,659,047
90+	0.26	0.47	738	$29,881,716
Total				**$67,401,985**

Source: Wang 2003, Statistics New Zealand 2010, Ministry of Health 2010 (a) figures have been rounded, components may not exactly sum to totals

4.10 Health costs summary

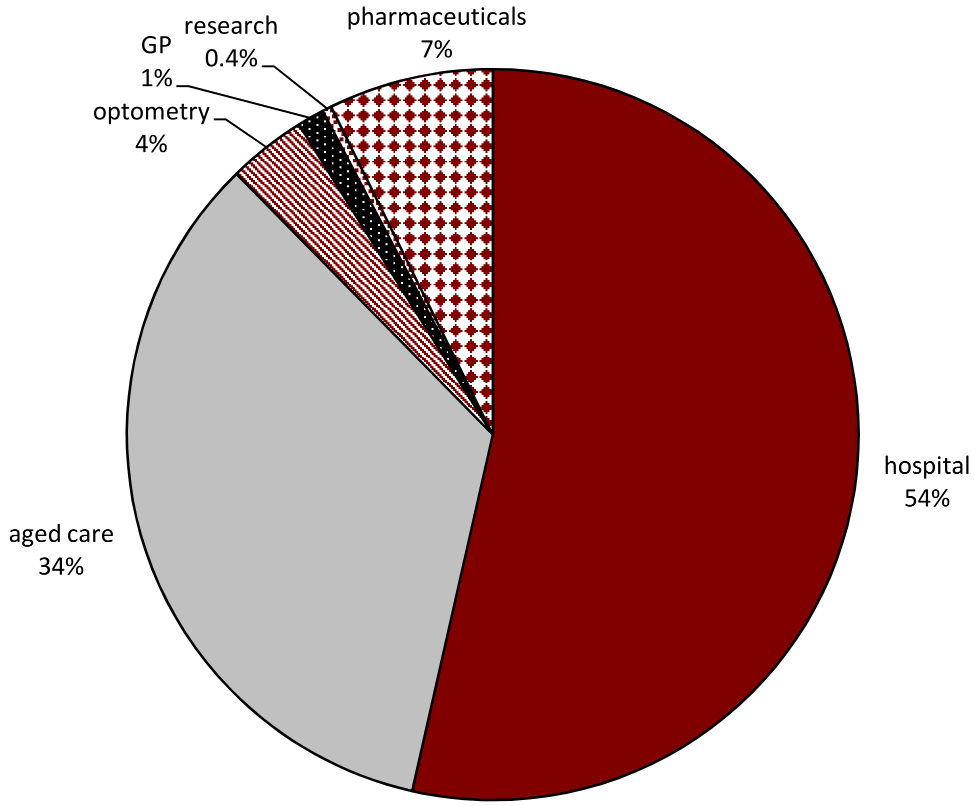
In 2009, total health system expenditure on disorders of the eye and adnexa was estimated at $197,555,120 which equates to approximately $1,583 per person with vision loss aged over 40. The composition of health system costs in 2009 is shown in Chart 4.5 and Table 4.11. As GP and optometrist consultations were only able to be calculated for individuals with moderate to severe vision loss, it is likely $198 million is an underestimation of total health costs. Even accounting for five year growth in population and health costs, this is much greater than RNZFB (2006) which estimated health system expenditure to be between $2.8 and $21.1 million in 2004. The estimate here reflects a broader scope of costs including extra components such as aged care, research, private outpatient services, and pharmaceuticals funded by District Health Boards.

As discussed in the section below on health expenditure projections, key drivers of health system costs include population growth and ageing, prevalence of disease, income per head,

[15] Prices for Rest Home Care (GST inclusive)

community expectations and knowledge, technological advances and changes in government policy. As inferred in Godfrey and Brunning (2009), lower than average utilisation of health services by the Maori and Pacific Islander population, or by people with vision loss (in turn affected by financial constraints, knowledge, geographic location and other factors) influences the estimates of health expenditure derived in reports of this nature.

Chart 4.5: Health system expenditure, 2009 (total $198 million) (a) (b)



Source: Access Economics (2010) using Ministry of Health special request expenditure data, PHARMAC data 2009, Ministry of Health discharge rates (2009), Statistics New Zealand (2009, 2009a) (a) GP and optometrist consultation costs only able to be estimated for individuals with moderate to severe vision loss (b) including presbyopia

Table 4.11: Health system costs, 2009 (a)

Health component	Expenditure	Proportion of health system costs
hospital	$105,757,892	54%
aged care	$67,401,985	34%
optometry	$6,872,148	3%
GP	$2,329,905	1%
research	$816,894	0.4%

Health component	Expenditure	Proportion of health system costs
pharmaceuticals (b)	$14,376,296	7%
Total	**$197,555,120**	**100%**

Source: Access Economics (2010) using Ministry of Health special request expenditure data, PHARMAC data (2009), Ministry of Health discharge rates (2009), Statistics New Zealand (2009, 2009a) (a) GP and optometrist consultation costs only able to be estimated for individuals with moderate to severe vision loss (b) 95%:5% bevacizumab: ranibizumab dosing estimated as detailed in Table 4.8

4.11 Health expenditure projections to 2020

4.11.1 Factors that affect projections of health expenditure

The projections presented here are based on health inflation and demographic projections. Projected rises in spending are largely driven by population ageing.

Demographic ageing of New Zealand's population has been a significant contributor to health care spending in the past, and is projected to drive overall future spending, given the demand for health care is highly correlated with age (Cornwell and Davey 2004). The projections of health spending in this report reflect current knowledge and clinical approaches, and do not make assumptions about advances in medical technology. The impact of technological change is difficult to predict. It may add to the set of services available, and/or replace some. Innovation in prevention may reduce the prevalence of vision loss. Improvements in effectiveness may reduce the need for further care at later stages of disease, or limit the need for repeat procedures over time. Improvements in quality or effectiveness may also be associated with higher unit service costs. Consumer expectations may also change, for example, becoming more aware of what is available, or demanding procedures at earlier stages of disease.

Changes in eye health care implemented on a wide scale before 2020, or evolution in consumer expectations would necessitate a re-estimate of these projections.

At any given point in time, use of health services reflects current policy settings, including funding arrangements, patient co-payments and government subsidies, service quality standards, and other factors affecting access to services. Changes to the structure of the health system, may also affect the veracity of the projections in this report, if they lead to substantial changes in either volumes of services provided or in the unit cost of those services between now and 2020.

4.11.2 Projections

In 2009, there were approximately 125,000 New Zealanders aged 40 years and over with vision loss from all causes, growing to 173,766 New Zealanders aged 40 years and over with vision loss in 2020 (section 2.9). This is an increase of approximately 39% over an 11 year period. Over the same period, the total population (all ages) is estimated to increase by only 11%, while the over 40 population is estimated to increase 19%.

The following health expenditure projections were estimated by

- applying a health inflation rate of 1.06% per annum, based on historical trend health inflation over the past decade from 2006 to 2009 (Statistics New Zealand 2009); and
- applying projected population growth rates between 2009 and 2020 in each age and gender category (Statistics New Zealand 2009a).

Thus, projections reflect a continuation of past trends and should be interpreted with caution.

Table 4.12 presents total health system costs by component in 2009 and 2020. Overall, health system costs are estimated to rise to $523 million by 2020 or $3,008 per person with vision loss. This compares to a total cost of $198 million in 2009 ($1,583 per person with vision loss).

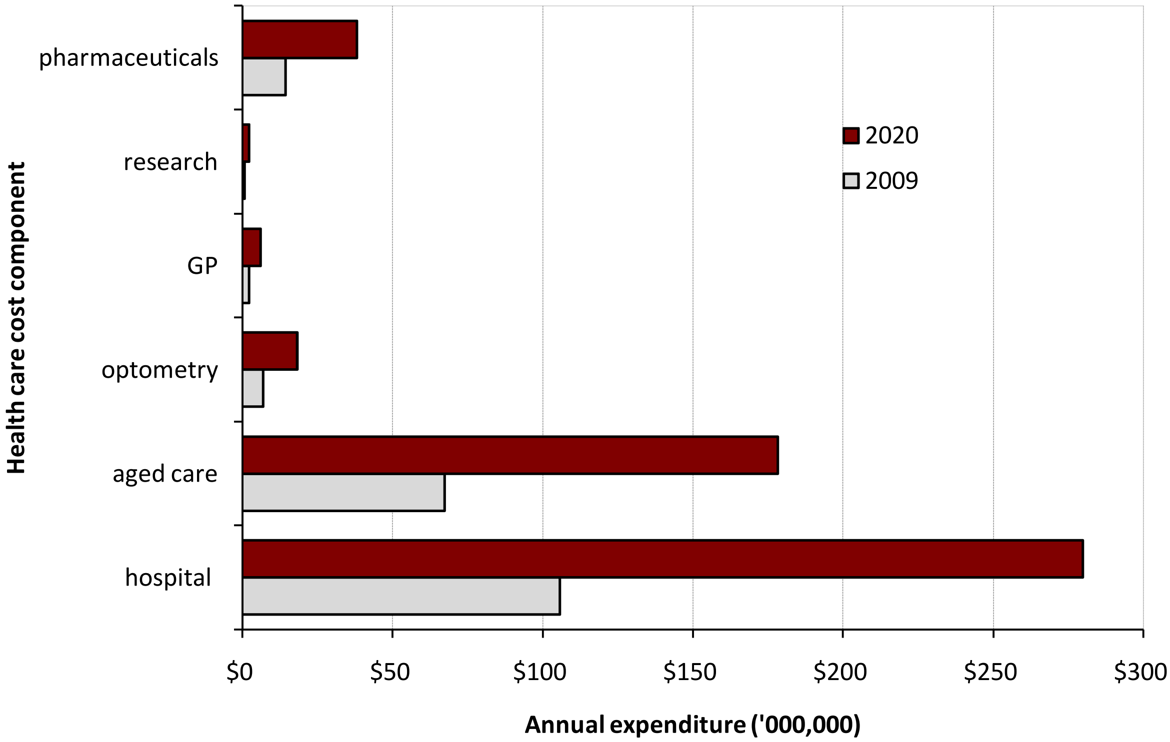
Table 4.12: Health system costs - projections to 2020

Cost component	2009 health system costs	2020 health system costs
hospital	$105,757,892	$279,773,679
aged care	$67,401,985	$178,306,327
optometry	$6,872,148	$18,179,694
GP	$2,329,905	$6,163,569
research	$816,894	$2,161,025
pharmaceuticals	$14,376,296	$38,031,291
Total	**$197,555,120**	**$522,615,586**

Source: Access Economics (2010) calculations using Statistics New Zealand (2010) population growth estimates, using Ministry of Health special request expenditure data 2010, PHARMAC data 2010 and National Health Survey data (Ministry of Health 2008).

Chart 4.6 further illustrates the projected increase in health system costs between 2009 and 2020.

Chart 4.6: Health system costs ($), 2009 and 2020



Source: Access Economics (2010) calculations using Statistics New Zealand (2010) population growth estimates, using Ministry of Health special request expenditure data 2010, PHARMAC data (2010) and National Health Survey data (Ministry of Health 2008).

5 Other financial costs

5.1 Productivity losses

In this report, productivity losses include those associated with differences in employment rates for those living with vision loss, and earnings foregone because of premature death attributable to vision loss. Illness and disease more generally may lead to productivity losses where they result in higher than average absenteeism, and lower than average productivity at work ('presenteeism costs'). These elements of potential productivity losses are typically difficult to measure and studies with comparative data were not available for this report.

Access Economics adopts a human capital approach to the estimation of productivity losses in developed countries.

5.1.1 Studies of the impact of vision loss on employment in New Zealand

Disability survey

According to the 2001 Disability Survey (Statistics New Zealand 2002), 8% of people who were seeing disabled were unemployed (an unemployment rate of 15.4% of the labour force) (Table 5.1). This unemployment rate compares to 5.7% of the general population in June 2001 (Statistics New Zealand 2001).

Table 5.1: Labour force status of adults aged 15–64 with a seeing disability living in households

Disability type in adults aged 15-64	In labour force		Not in labour force (%)	Total (%)
	Employed (%)	Unemployed (%)		
Seeing	44	8	48	100

Source: Statistics New Zealand 2002

RNZFB employment survey

La Grow (2003) surveyed 150 randomly selected RNZFB members of working age. (The sample was drawn from the 12,900 members who had visual acuity of 6/24 or worse.) On average 39.3% of the surveyed RNZFB population were currently in paid employment. Of those with no usable vision, 26% were in paid employment compared with 35% who had a little usable vision; and 64% who had a lot of usable vision.

Two thirds of those in paid employment stated that the amount they worked was about right, with 24% saying they would like to work more hours and 10% stating they would like to work fewer hours. The unemployment rate was 14% of individuals considered to be in the labour force, and projected to be 24% if discouraged workers were included.

5.1.2 Employment participation

Lower than average employment rates for people with vision loss represents a real cost to the economy, through a loss in earnings (and consequently, taxation revenue). To derive productivity losses from lower employment, the employment difference parameters outlined above from disability survey data (owing to a greater sample size than the RNZFB survey) were applied to estimates of the 2009 population with vision loss in each age group and the latest age-specific average weekly earnings (AWE) data (Statistics New Zealand, 2010). A maximum working age of 64 was assumed.

AWE data from 2008 (latest available) was inflated to 2009 dollars, using the consumer price index between June 2008 and June 2009 (Statistics New Zealand, 2010). AWE estimates for all workers (full-time and part-time) are presented in Table 5.2

Table 5.2: AWE for full-time and part-time employed in 2009

Age group	Māori male AWE ($)	Māori female AWE ($)	non-Māori male AWE ($)	non-Māori female AWE ($)
40-44	936	668	1146	743
45-49	936	668	1146	743
50-54	936	668	1146	743
55-59	936	668	1146	743
60-64	936	668	1146	743

Source: Access Economics (2010) calculations using Statistics New Zealand data (2010)

Productivity losses reflecting the impact of vision loss on the likelihood of employment compared with the average in 2009 were approximately $110 million (Table 5.3).

Table 5.3: Productivity loss due to lower employment, 2009

Age group	Māori male ($)	Māori female ($)	non-Māori male ($)	non-Māori female ($)
40-44	1,138,542	784,345	4,371,703	2,632,239
45-49	906,498	675,615	4,573,535	2,842,652
50-54	2,745,755	1,934,359	15,480,961	9,248,472
55-59	2,101,923	1,370,676	13,690,898	7,626,866
60-64	2,751,664	1,641,558	22,580,911	11,433,722
Subtotal	**9,644,382**	**6,406,553**	**60,698,008**	**33,783,951**
Total				**110,532,894**

Source: Access Economics calculations using Statistics New Zealand (2001, 2002, 2010)

5.1.3 Premature death

Calculations in section 3 suggest there were 115 deaths attributable to vision loss in 2009. Based on this case mortality risk, and incorporating employment rates and estimates of average lifetime earnings for different age-gender groups, the present value of lost earnings due to premature mortality was estimated to be $1.7 million in 2009 (at a discount rate of 3% per annum) (Table 5.4).

Table 5.4: Lost lifetime earnings due to premature death, 2009

Age group	Māori ($)	non-Māori ($)	Total ($)
40-44	9,334	34,041	43,374
45-49	9,453	44,662	54,115
50-54	37,056	195,389	232,445
55-59	33,434	202,286	235,721
60-64	51,615	385,272	436,887
65-69	32,426	227,773	260,199
70-74	48,099	374,854	422,952
Total	**221,417**	**1,464,276**	**1,685,693**

5.1.4 Distribution of productivity losses

Different productivity loss components were imposed on different sections of society, with employees and employers bearing most of the burden through lost lifetime earnings totalling almost $75 million.

Reduced earnings from lower employment participation and premature death result in reduced taxation revenue collected by the Government. As well as forgone income (personal) taxation, there is also a fall in indirect (consumption) tax, as those with lower incomes spend less on the consumption of goods and services. Lost taxation revenue to the Government was estimated by applying an average personal income tax rate and average indirect taxation rate to lost earnings. Rates in 2009 were 19.1% and 12.5%, respectively (Statistics New Zealand 2009). Lost taxation revenue from vision loss in 2009 was $34.6 million.

The distribution of estimated productivity losses by age group is provided in Table 5.5. Overall, productivity losses were $110 million.

Table 5.5: Productivity loss due to lower employment, 2009

Age group	Incurred by employee and employer ($)	Incurred by government ($)
40-44	6,139,053	2,831,248
45-49	6,428,480	2,964,727
50-54	18,380,729	8,476,942
55-59	16,050,728	7,402,377
60-64	24,866,248	11,467,975
65-69	1,479,013	682,101
70-74	1,581,227	729,240
Total	**74,925,478**	**34,554,610**

5.2 Informal care costs

Informal carers are people who provide informal care to others in need of assistance or support. Most informal carers are family or friends of the person receiving care. Carers may take time off work to accompany people with vision loss to medical appointments, stay with them in hospital, or care for them at home. Carers may also take time off work to undertake many of the unpaid tasks that the person with vision loss would do if they did not have vision loss and were able to do these tasks.

Informal care is distinguished from services provided by people employed in the health and community sectors (formal care) because the care is generally provided free of charge to the recipient and is not regulated by the government. While informal care is provided free of charge, it is not free in an economic sense, as time spent caring is time that cannot be directed to other activities such as paid work, unpaid work (such as housework or yard work) or leisure. As such, informal care is a use of economic resources.

There are three potential methodologies that can be used to place a dollar value on the informal care provided:

- **The opportunity cost method** values earnings foregone by the carer, in caring for the person with vision loss. The time devoted to caring responsibilities is time that cannot be spent in the paid workforce
- **The replacement valuation method** estimates the cost of buying a similar amount of services from the formal care sector.
- **The self valuation method** sums the costs of what carers themselves feel they should be paid for the care provided to the person with vision loss.

The opportunity cost method has been used for this report because of the nature of data available.

It is calculated as the number of people with vision loss who require some level of care, multiplied by the average number of hours of care required, multiplied by an average hourly rate for the wage forgone by the carer, which is weighted by age, gender and the probability of alternative employment.

According to the 2006 Disability survey (Statistics New Zealand 2009b), around 23% of adults with a seeing disability received help from informal carers for everyday activities (one or more of personal care, meal preparation, shopping, everyday housework, heavy housework, and personal finances) as outlined in Table 5.6. Of seeing disabled individuals aged 15-64, 13% needed help from informal carers compared with 38% aged 65 years and above.

Table 5.6: Assistance needed by adults with a seeing disability, 2006

	Personal care	Meal preparation	Shopping	Everyday housework	Heavy housework	Personal finances
Seeing disability	n/a	n/a	3,400 (14%)	n/a	3,900 (16%)	2,800 (12%)

Source: Statistics New Zealand 2009b

The RNZFB (2006) also reported on unpaid assistance provided by family members to people with moderate to severe vision loss (visual acuity worse than 6/24), and results are summarised in Table 5.7. Approximately 3.5 hours of informal care was provided per survey respondent.

Table 5.7: Assistance provided to individuals with vision loss (visual acuity worse than 6/24), 2006

Type of assistance provided	% requiring assistance	% of assistance provided by family members	Average no. minutes (unpaid) assistance per week if required	Total mins per 1,000 individuals per week	Total hours per 1000 individuals per week
Domestic tasks	50%[a]	62%	290	89,900	1,498.3
Shopping with	69%	61%	116	48,824	813.7
Shopping for	22%	72%	140	22,176	369.6
Leisure and Recreation activities	51%	39%	239	47,537	792.3
Attending ophthalmologist appts	12% [b]	100%	216	124.8	2.1
Attending GP appts	5% [b]	100%	59	49.5	0.8
Attending podiatry appts	4%	100%	38	40	0.7
Volunteer work	31%	25%	52	77.5	1.3
Total					**3,478.8**

a – estimate, b – proportion of those attending appointment in previous 12 months needing assistance

Source: RNZFB 2006

The age distribution of informal carers was taken from 2006 census data (Renwick 2008) and associated age-gender specific AWEs for 2009c applied to estimate lost earnings of carers per person with vision loss in 2009.

The value of informal care per RNZFB respondent with moderate to severe vision loss was $3,179.30 per year. The total opportunity cost of informal care for individuals with moderate to severe vision loss was $21 million in 2009 (Table 5.8). Of this, $14.4 million was incurred by informal carers and around $6.6 million borne by government in the form of lost tax revenue (using taxation rates from New Zealand Treasury). This may underestimate the value of informal care because care for individuals aged below 50 years is not included. There was insufficient data to calculate the opportunity cost of informal care for those with mild vision loss.

Table 5.8: Opportunity cost of informal care for those with moderate to severe vision loss, 2009

Age group	Incurred by carer (family/friends) ($)	Incurred by government (lost tax revenue) ($)	Total cost ($)
50-54	995,414	459,071	1,454,485
55-59	863,550	398,257	1,261,807
60-64	4,140,024	1,909,323	6,049,346
65-69	3,222,858	1,486,338	4,709,196
70-74	5,160,697	2,380,043	7,540,740
Total	**14,382,542**	**6,633,033**	**21,015,575**

Source: Access Economics (2010) calculations

5.3 Funeral costs

The 'additional' cost of funerals borne by family and friends of people with vision loss is based on the additional likelihood of death associated with vision loss (Section 3) in the period that the person experiences it. However, some patients (particularly older patients) would have died during this time anyway. Eventually everyone must die and thus incur funeral expenses – so the true cost is the cost brought forward (adjusted for the likelihood of dying anyway in a given year).

The Australian Bureau of Transport and Road Economics (2000) calculated a weighted average cost of a funeral across all states and territories, to estimate an Australian total average cost of $A 3,200 per person for 1996, or **$NZ 4,825 per person who died in 2009**.

The bring forward of funeral costs associated with premature death for people with vision loss was estimated to be around $83,610 in 2009.

5.4 Aids and home modifications

The 2001 disability survey found equipment or services for the seeing disabled were used by 71% of adults with a seeing disability and 6% of children (Ministry of Health 2004). The survey also estimated an unmet equipment or service need for 20% adults with a seeing disability.

Table 5.9: Equipment, technology or services used by individuals with a seeing disability, 2001

Equipment	Use (%)
Magnifiers	26
Large print reading material	18
Audio reading materials	8
White canes	6
Readers	4
Computers, including voice synthesis computers	3
Recording equipment	2

Source: Ministry of Health 2004

Results from the RNZFB survey (2006) reveal a higher use of aids owing to members having greater vision loss than most disability survey respondents.

Table 5.10: Equipment, technology or services used by RNZFB members, 2006

Equipment	Use (%)
Magnifying equipment	75
Talking book	67
Tape recorders	29
Computer	23
Adaptive telephone equipment	36
Computer screen magnification	42(of computer users)
Special glasses	69
Mobility canes	62
Adaptive clocks, watches or alarms	43
Special lights or lighting equipment	27

Source: RNZFB 2006

The annual cost to the individual and society of these aids was calculated to be $5.3 million for the RNZFB population in 2004 and $43.6 million for the whole seeing disabled population as defined and recorded by the 2001 disability survey (Statistics New Zealand 2002). Applying inflation derived from the consumer price index (Statistics New Zealand 2009) and population growth estimates brings the estimated 2009 expenditure on aids to between $6.6 and $54 million. It is likely that the true expenditure on aids and equipment is somewhere between these because people with mild vision loss are less likely to use aids and equipment, so we have applied the average — $30.3 million.

5.5 Welfare payments

People with low vision or blindness are eligible for various types of welfare payments (Table 5.11).

Table 5.11: Welfare benefits for the vision impaired, April 2009

Benefit type	Funding source	Description	Maximum Amount ($)
Carer support	Ministry of Health (MoH)	Contributes towards the cost of a support carer to provide a break for full-time carers.	Informal family carers: 72.29/36.14 (full/half day), Formal carers: 81.32/40.66 (a)
Sickness Benefit	Work and Income (WINZ)	Available to individuals who are sick, injured, disabled or pregnant and have had to reduce their working hours.	217.59/ 362.62 (single/couple) weekly gross rate
Invalid's Benefit (possibly with blind subsidy)	WINZ	Available to people who are severely limited in their ability to work on a permanent basis because of sickness, injury or disability.	272.26/ 453.28 weekly
Disability allowance	WINZ	For individuals with a disability lasting six months or more.	55.88 weekly
Domestic Purposes Benefit – Care of Sick or Infirm	WINZ	Assists carers providing full-time care at home for an individual (other than their partner) who would otherwise need hospital care, rest home care, residential disability care, extended care services etc.	278.16/462.18 weekly
Children's Spectacle Subsidy	Enable New Zealand for MoH	Available to children with vision problems in low-income families to subsidise the cost of glasses and eye examinations.	268 per annum
Contact Lens Subsidy	MoH	Available to optometrists who fit contact lenses to individuals who are unable to wear glasses	Variable, depending on type of contact lens

Source : WINZ 2010, MoH 2010 (a) 2010 rates deflated to 2009 dollars using CPI data (Statistics New Zealand (2010)

At December 2009, the total gross weekly payments being made by Work and Income (WINZ) to clients in receipt of Sickness Benefit or Invalids' Benefit where the primary incapacity was blindness or vision loss was $489,172 (personal communication with WINZ dated 30 April 2010). Assuming expenditure was steady throughout 2009, annual expenditure on these payments would be $25,436,944. The total gross weekly Disability Allowance payments made to clients where their primary incapacity is blindness was $42,721, or $2,221,492 annually (personal communication with WINZ dated 30 April 2010). Some of these clients concurrently have other incapacities thus affecting the welfare benefit received. The Ministry of Health contributed $414,067.30 towards the cost of caring for individuals with vision loss under the carer support scheme (personal communication MoH, 20 May 2010).

Domestic Purposes Benefit data were not available, but expenditure on these payments is unlikely to be significant given the benefit relates to full time informal care, and as detailed in section 5.2, on average around three hours of informal care was needed by individuals with vision loss per week.

Spectacle and contact lens subsidy information was also unavailable for 2009.

Table 5.12: Welfare payments made to vision impaired individuals or their carers, 2009

Benefit type	Expenditure($)
Carer support	414,067(a)
Sickness Benefit	25,436,944
Invalid's Benefit (possible with blind subsidy)	
Disability allowance	2,221,492
Domestic Purposes Benefit – Care of Sick or Infirm	(b)
Children's Spectacle Subsidy	(b)
Contact Lens Subsidy	(b)
Total	**28,072,503**

Source: MoH, WINZ special request 2010

(a) carer support and respite care 08/09, proportion of total sensory payment for eye diseases is reflective of 2001 disability survey responses, Ministry of Health 2002

(b) data not available from welfare agencies

The total value of vision impaired-related disability payments in 2009 is estimated to be $28 million.

Such benefits are transfers, not real costs, and should not be included in the estimation of total costs. As with taxation forgone, welfare payments do, however, have associated real dead weight losses (DWLs) due to the distortions they impose on production patterns and the need to fund the administration of the welfare system.

5.6 Deadweight losses from transfers

Welfare payments are, like taxation revenue losses, not themselves economic costs but rather a financial transfer from taxpayers to the income support recipients. The real resource cost of these transfer payments is only the associated DWL.

DWLs refer to the costs of administering welfare pensions and raising additional taxation revenues. Although invalid and sickness benefits and forgone taxation are transfers, not real costs (so should not be included in the estimation of total costs), it is still worthwhile estimating them as that helps us understand how the total costs of vision loss are shared between the taxpayer, the individual and other financiers.

Transfer payments (government payments/services and taxes) are not a net cost to society as they represent a shift of consumption power from one group of individuals to another in society. If the act of taxation did not create distortions and inefficiencies in the economy, then transfers could be made without a net cost to society. However, through these distortions, taxation does impose a DWL on the economy.

In New Zealand, studies by Diewert and Lawrence (1994, 1995, 1996) found in 1991 the efficiency cost (or DWL) associated with personal income tax was 18% and for consumption taxes around 14%. They also noted that the DWLs associated with labour taxation increased from 5% to over 18% in the 20 years up to 1991.

In this report an estimate of 18% for the deadweight losses has been used, noting this may be a conservative estimate in view of another study (McKeown and Woodfield, 1995) based on 1988 data that generated estimates ranging from 24.6% to 146.2% of taxes raised.

Neither estimate includes possible DWLs from the taxation of income earned on capital (appropriate in this application), or administration and compliance costs (unfortunate in this application). The use of 18% balances the upside risk that the DWLs have continued to increase since 1991 against the downside risk that tax raised from non-labour sources has lower associated DWLs.

The total extra tax dollars required to be collected include:

- Lost taxation revenue as a result of vision loss, including $35 million for persons with vision loss and $6.6 million for carers;
- The value of government welfare payments paid out to carers and to those with vision loss, estimated at $28 million; and
- The government funded component of health system costs, estimated to be approximately $147 million

Summing these components and applying the DWL rate of 18% results in a DWL estimate of $39 million in 2009, associated with vision loss.

5.7 Summary of other financial costs

Other financial costs associated with vision loss were estimated to be approximately $203 million in 2009, with the breakdown presented in Table 5.13.

Table 5.13: Summary of other financial costs associated with vision loss in 2009

Cost type	Total cost ($)
Productivity losses	112,218,587
Carer opportunity costs	21,015,575

Cost type	Total cost ($)
Funeral costs	83,610
Aids	30,345,381
DWL	38,997,595
Total	**202,660,748**

Source: Access Economics (2010) calculations

6 Loss of wellbeing

Loss of wellbeing refers to qualitative and quantitative analysis of the intangible costs of pain and suffering from a particular condition. These costs of disability, loss of wellbeing and premature death from vision loss are more difficult to measure. Note – the term 'loss of well being' is used throughout this report instead of the well-defined concept in health economics, 'burden of disease' as measured by disability adjusted life years (DALYs). It measures the suffering and premature death from a disease or injury and does not imply that people experiencing disease or injury are a burden on society.

This section estimates the loss of wellbeing in 2009 resulting from vision disorders for persons aged 40 or over. An imputed value of a statistical life year (VSLY) allows us to compare non-financial costs such as loss of wellbeing with the estimated financial costs of vision loss.

6.1 Methodology

In the last decade, a non-financial approach to valuing human life has been derived, where loss of wellbeing and premature mortality, are measured in terms of Disability Adjusted Life Years (DALYs). This approach was developed by the WHO, the World Bank and Harvard University for a study that provided a comprehensive assessment of mortality and disability from diseases, injuries and risk factors in 1990, projected to 2020 (Murray and Lopez, 1996). Methods and data sources are detailed further in Murray et al (2001) and the WHO continues to revisit the estimates for later years.

A DALY of 0 represents a year of perfect health, while a DALY of 1 represents death. Other health states are attributed values between 0 and 1 as assessed by experts on the basis of literature and other evidence of the quality of life in relative health states. For example, the *disability weight* of 0.18 for a broken wrist can be interpreted as losing 18% of a person's quality of life relative to perfect health, because of the inflicted injury. Total DALYs lost from a condition are the sum of the mortality and morbidity components – the Year(s) of Life Lost due to premature death (YLLs) and the Year(s) of healthy life Lost due to Disability (YLDs).

> Martin Tobias and the New Zealand Burden of Disease Study (NZBDS) team utilised the global and Australian studies to estimate the burden of disease for New Zealand (Ministry of Health, 2001). Estimates of YLL, YLD and DALYs for over 100 conditions in nine age groups for both genders and two major ethnic groups (Māori and non-Māori) were provided for the year 1996.

The DALY approach has been successful in avoiding the subjectivity of individual valuation and is capable of overcoming the problem of comparability between individuals and between nations, although some nations have subsequently adopted variations in weighting systems, for example age-weighting for older people. This report treats the value of a life year as equal throughout the lifespan.

As these approaches are not financial, they are not directly comparable with most other cost and benefit measures. In public policy making, it is often desirable to apply a monetary conversion to ascertain the cost of an injury, disease or fatality or the value of a preventive health intervention, for example, in cost benefit analysis. Such financial conversions tend to utilise 'willingness to pay' or risk-based labour market studies as described in the next section.

6.1.1 Willingness to pay and the value of a statistical life year

The burden of disease as measured in DALYs can be converted into a dollar figure using an estimate of the **Value of a 'Statistical' Life** (VSL). As the name suggests, the VSL is an estimate of the value society places on an anonymous life. Since Schelling's (1968) discussion of the economics of life saving, the economic literature has focused on **willingness to pay** (WTP) – or, conversely, willingness to accept – measures of mortality and morbidity, in order to develop estimates of the VSL.

Estimates may be derived from observing people's choices in situations where they rank or trade off various states of wellbeing (loss or gain) either against each other or for dollar amounts e.g. stated choice models of people's WTP for interventions that enhance health or willingness to accept poorer health outcomes or the risk of such states. Alternatively, risk studies use evidence of market trade-offs between risk and money, including numerous labour market and other studies (such as installing smoke detectors, wearing seatbelts or bike helmets and so on).

The extensive literature in this field mostly uses econometric analysis to value mortality risk and the 'hedonic wage' by estimating compensating differentials for on-the-job risk exposure in labour markets; in other words, determining what dollar amount would be accepted by an individual to induce him/her to increase the probability of death or morbidity by a particular percentage. Viscusi and Aldy (2002), in a summary of mortality studies, found the VSL ranged between US$4 million and US$9 million with a median of US$7 million (in year 2000 US dollars), similar but marginally higher than the VSL derived from studies of US product and housing markets. They also reviewed a parallel literature on the implicit value of the risk of non-fatal injuries.

Weaknesses in the WTP approach, as with human capital approaches to valuing life and wellbeing, are that there can be substantial variation between individuals. Extraneous influences in labour markets such as imperfect information, income/wealth or power asymmetries can cause difficulty in correctly perceiving the risk or in negotiating an acceptably higher wage in wage-risk trade off studies, for example.

As DALYs are enumerated in years of life rather than in whole lives it is necessary to calculate the **Value of a 'Statistical' Life Year (VSLY)** based on the VSL. This is done using the formula:[16]

$$VSLY = VSL / \Sigma_{i=0,\dots,n-1}(1+r)^i$$

Where: n = years of remaining life, and
r = discount rate

Clearly there is a need to know *n* (the years of remaining life), and to determine an appropriate value for *r* (the discount rate). There is a substantial body of literature, which often provides

[16] The formula is derived from the definition:
VSL = ΣVSLYi/(1+r)^i where i=0,1,2….n
where VSLY is assumed to be constant (ie. no variation with age).

conflicting advice, on the appropriate mechanism by which costs should be discounted over time, properly taking into account risks, inflation, positive time preference and expected productivity gains.

Access Economics (2008) recommended an average VSL of $6.0 million in 2006 Australian dollars ($A3.7 million to $A8.1 million). This equates to an average VSLY in 2006 of $A252,014 ($A155,409 to $A340,219), using a discount rate of 3% over an estimated 40 years remaining life expectancy. However, from this gross value, Access Economics deducts all costs borne by the individual, reflecting the source study VSL estimates, to avoid double counting. This provides a different net VSLY for different conditions (and for different age-gender groups).

Since Access Economics (2008) was published, the Australian Department of Finance and Deregulation (2009) have also provided an estimate of the VSLY, which appears to represent a fixed estimate of the net VSLY. This estimate was $A151,000 in 2006, which inflates to $A161,751 in 2009 or $NZ201,864 (using a purchasing power parity of 1.25 from OECD (2010)) which is used for calculations in modelling here. A webs search for VSLY estimates for NZ was conducted and the NZ Treasury was contacted. There does not appear to be an 'official' VSLY for New Zealand.

6.1.2 Discount rate

In reviewing the literature, Access Economics (2008) found the most common rate used to discount healthy life was 3% and this had a strong rationale.

Choosing an appropriate discount rate is a subject of some debate, as it varies depending on what type of future income or cost stream is being considered. The discount rate needs to appropriately take into account risks, inflation and positive time preference. The minimum option that one can adopt in discounting future expected healthy life streams and other costs is to set future values on the basis of a risk free assessment about the future i.e. assume the future flows are similar to the certain flows attaching to a long term Government bond. In 2009, the ten year nominal bond rate averaged 5.5% per annum (Reserve Bank of New Zealand, Statistics[17]).

If there were no positive time preference, people would be indifferent between having something now or a long way off in the future, which applies to all goods and services.

The Reserve Bank of New Zealand has a clear mandate to pursue a monetary policy that delivers 1% to 3% inflation over the course of the economic cycle[18]. This is a realistic longer run goal and an inflation rate in this range (2.5%) is used in arriving at the discount rate for healthy life below. It is important to allow for inflation in order to derive a real rather than nominal rate.

[17] http://www.rbnz.govt.nz/statistics/exandint/b2/data.html?sheet=1 accessed 31 May 2010

[18] ibid

In discounting healthy life and other costs, a real discount rate for New Zealand of 3% is thus suggested (calculated as 5.5% - 2.5% = 3%).

6.2 Loss of wellbeing from vision disorders in 2009

Disease weights used to calculate YLDs in this report are drawn from Begg et al, (2007). This study estimated the YLDs and prevalence of the following vision disorders in 2003:

- glaucoma-related blindness;
- cataract-related blindness;
- macular degeneration; and
- Uncorrected refractive errors.

Additionally, the Australian Institute of Health and Welfare also provided estimates of YLDs and prevalence in 2003 for diabetes mellitus, with a YLD breakdown for DR. As such, the burden of disease from DR is also estimated in this report.

Begg et al (2007) did not provide estimates of YLLs, basing their work on an assumption that no-one dies prematurely from vision disorders. Due to this, YLLs were derived from the estimates of premature death attributable to vision loss, calculated in Section Table 5.4 of this report.

Begg et al (2007) also provided a specific age breakdown for YLDs and prevalence, and thus DALYs could be estimated specifically for the 40 and over age group.

6.2.1 Disability weights and YLDs in 2009

One of the main costs of vision loss is the loss of wellbeing and quality of life that it entails. This can be estimated by initially allocating disability weights to vision disorders that cause vision loss. The Burden of Disease and Injury in New Zealand (2001) report used Dutch (Stouthard et al 1997) disability weights for disorders of vision. For the purpose of this report, disability weights were derived by dividing estimated DALYs in 2003 by estimated prevalence (cases) in 2003 for each vision disorder, both of which were taken from Begg et al (2007) (which also used the Stouthard et a 1997 weights).

Begg et al (2007) provided an estimate of YLDs resulting from DR in 2003, at approximately 1,060 YLDs for all persons aged over 40 in Australia. Centre for Eye Research Australia (CERA) and Access Economics (2004) estimated that 2.9% of persons with DM had vision-threatening DR. To estimate prevalence of DR in 2003, the Australian Institute of Health and Welfare estimated prevalence of DM in Australia in 2003 was multiplied by this fraction of 2.9%.

Estimated disability weights of vision disorders in 2003 are presented in Table 6.1 by age group. The disability weights reflect adjustments for comorbidities — and the likelihood of having comorbidities increases with age. A multiplicative model is used to adjust for comorbidities to ensure that the disability weights do not sum to more than one. For further information see Begg et al, (2007).

Table 6.1: Vision disorders - derived disability weights(a)

Vision disorder	Age group 40-49	50-59	60-69	70-79	80-89	90+
Glaucoma	1.65	1.11	0.49	0.14	0.05	0.01
Cataract	0.04	0.04	0.03	0.03	0.04	0.06
MD	0.00	0.00	1.03	0.47	0.16	0.08
RE (b)	0.05	0.06	0.07	0.09	0.08	0.06
DR	0.06	0.04	0.03	0.02	0.02	0.01
All vision disorders	**0.06**	**0.07**	**0.08**	**0.11**	**0.09**	**0.06**

(a) Calculated as YLDs in 2003/estimated prevalence in 2003 (b) Including presbyopia
Source: Access Economics calculations using Begg et al (2007)

YLDs in 2009 were estimated by multiplying the set of disability weights for all vision disorders by the prevalence of vision loss from each vision disorder, excluding presbyopia (as estimated in Section 2.9). Estimated YLDs from all vision disorders excluding presbyopia in 2009 are presented in Table 6.2, by age group. It is estimated that overall, there were approximately 11,000 YLDs in 2009 from vision disorders (excluding presbyopia), for those aged over 40.

Table 6.2: Estimated YLDs from vision disorders in 2009 (a) (b)

Age group	Disability weight	Māori	non-Māori	Total
40-44	0.06	38	98	136
45-49	0.06	31	102	133
50-54	0.07	119	437	556
55-59	0.07	91	385	476
60-64	0.08	162	863	1,024
65-69	0.08	124	673	796
70-74	0.11	279	1,671	1,951
75-79	0.11	70	1,367	1,437
80-84	0.09	75	2,309	2,384
85-89	0.09	27	1,351	1,378
90+	0.06	12	822	834
Total		1,028	10,076	11,104

Source: Access Economics calculations using Begg et al (2007) (a) estimates rounded, components may not sum to totals (b) excluding presbyopia

6.2.2 YLDs from presbyopia

In 2009, vision loss due to uncorrected presbyopia affected approximately 14,400 people aged over 40 (Section 2.8.1). Age specific prevalence rates for presbyopia were not available. Applying the aggregate disability weight for vision disorders in 2009 (0.08) overestimates the impact of presbyopia on wellbeing because by definition, the disability weights describe the impact on wellbeing of low vision and blindness in people with visual acuity worse than 6/12, whereas presbyopia is defined as binocular near vision worse than N8 reading size with visual acuity of 6/12 or better (Marmamula 2009). Research is needed to enable the impact of presbyopia on wellbeing to be incorporated in estimates of the loss of wellbeing from vision loss in terms of DALYs.

In Zanzibar, Laviers et al (2010) assessed the impact of correcting presbyopia on vision related quality of life (but also including family relations, level of confidence and general health) after a six month follow-up. They found an effect size of 2.90, ranging from 1.15 to 3.90 (based on a score out of 100) which was significant (P<0.001).

6.2.3 YLLs in 2009

In Section 3 it was estimated that there were 115 deaths in the above 40 age group, attributable to vision loss in 2009.

In total, there were approximately 651 YLLS in 2009, from vision loss (Table 6.3).

Table 6.3: Estimated YLLs from vision disorders in 2009 (a)

Age group	Māori	non-Māori	Total
40-44	0	1	1
45-49	0	1	2
50-54	1	6	7
55-59	1	7	9
60-64	3	19	22
65-69	3	21	24
70-74	7	55	62
75-79	2	59	62
80-84	4	169	173
85-89	2	128	130
90+	2	156	158
Total	28	623	651

Source: Access Economics calculations (a) estimates rounded, components may not sum to totals.

6.2.4 DALYs in 2009

Summing the YLD (excluding presbyopia) and YLL components results in an estimated 11,756 DALYS in 2009, from vision disorders (Table 6.4).

Table 6.4: Estimated DALYs from vision disorders in 2009 (a)

Age group	YLDs	YLLs	Total
40-44	136	1	137
45-49	133	2	134
50-54	556	7	564
55-59	476	9	485
60-64	1,024	22	1,047
65-69	796	24	821
70-74	1,951	62	2,012
75-79	1,437	62	1,498
80-84	2,384	173	2,557

Age group	YLDs	YLLs	Total
85-89	1,378	130	1,508
90+	834	158	992
Total	**11,104**	**651**	**11,756**

Source: Access Economics calculations (a) estimates rounded, components may not sum to totals.

Multiplying the total number of DALYs by the VSLY in 2009 ($201,864) provides an estimate of the dollar value loss of wellbeing from vision loss.

The estimated monetary value of the lost wellbeing from vision disorders for those aged over 40 was $2.4 billion in 2009.

7 The total cost of vision loss in New Zealand

In 2009, the total financial cost of vision loss was estimated to be $400 million, or $3,206 per person with vision loss. Of this total:

- $198 million was estimated health system costs;
- $112 million was estimated productivity losses of those with vision loss;
- $30 million was estimated other indirect costs (aids and bring forward of funeral expenses);
- $39 million was estimated deadweight losses from transfers and lost taxation; and
- $21 million was estimated carer (opportunity) costs.

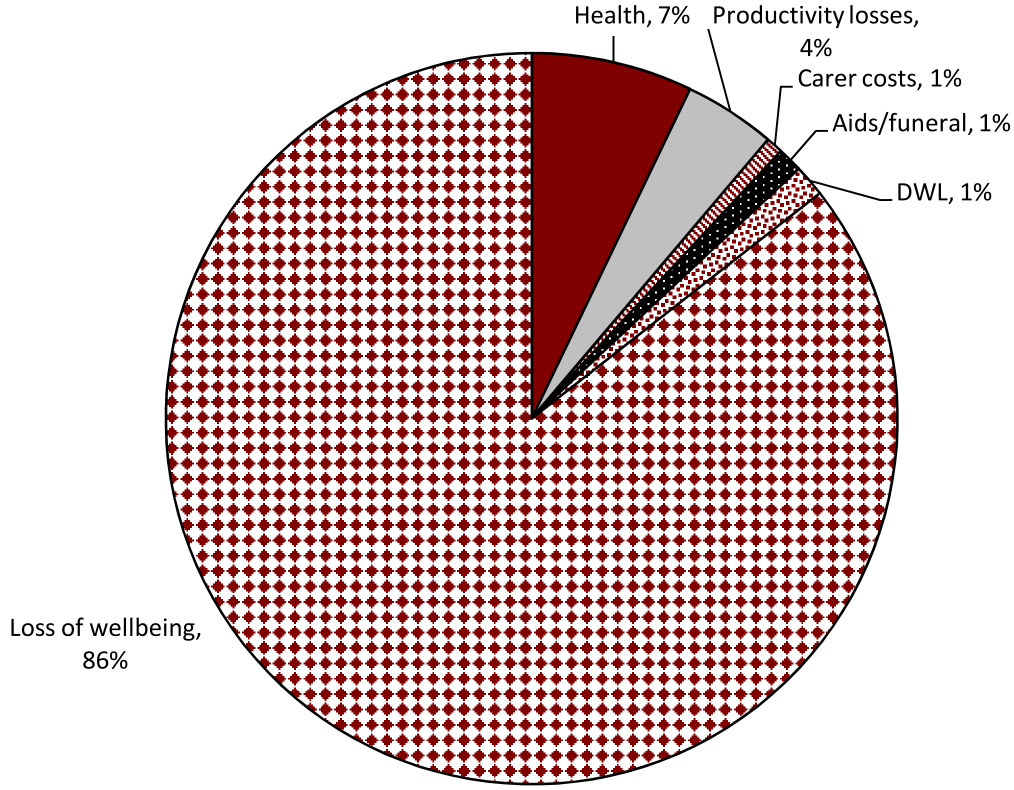
The value of lost wellbeing (disability and premature death), from vision loss was estimated to be $2.4 billion in 2009. Adding this to total financial costs produces an estimate of $2.8 billion as the costs of vision loss in 2009. A cost breakdown is provided in Table 7.1 and Chart 7.1.

Table 7.1: Summary of total cost of vision loss in 2009 by cost type

Cost type	Total cost ($)
Health system costs (a)	**197,555,120**
Productivity losses	112,218,587
Carer opportunity costs	21,015,575
Other indirect (aids/ bring forward of funeral)	30,428,991
DWL	38,997,595
Total other financial costs (b)	**202,660,748**
Total financial costs (a) + (b)	**400,215,868**
Loss of wellbeing (c)	**2,373,113,184**
Total economic cost (a) + (b) + (c)	**2,773,329,052**

Source: Access Economics calculations

Chart 7.1: Components of total economic cost of vision loss in 2009 (total $2.8 billion)



Source: Access Economics calculations

The estimated economic cost of vision loss in 2009 was approximately $2.8 billion, with the majority (85%) representing the monetary value of the loss of wellbeing. This is equivalent to a cost of $22,217 per person with vision loss in 2009.

8 International comparisons

Information is presented below for the cost of vision loss worldwide, and for Australia, the United Kingdom, Canada and US.

8.1.1 Worldwide

The most recent study of the costs of vision loss and blindness worldwide was released in 2010 (Access Economics 2010). It was estimated that, including vision loss due to uncorrected RE (URE), the worldwide number of visually impaired people (VA < 6/12) is 733 million in 2010. Of these, the number who are blind (VA < 6/60) is 156 million. Projections suggest the number of people with vision loss will rise to 929 million in 2020, with 200 million blind in 2020.

If vision loss due to URE is not included, the number of vision impaired people is projected to increase from 347 million in 2010 to 452 million in 2020. The number of blind people is projected to increase from 91 million in 2010 to 119 million in 2020.

These prevalence numbers are consistent with the findings of previous studies (Resnikoff et al, 2004, Resnikoff et al, 2008).

The prevalence of vision loss was calculated by multiplying the prevalence rates (in Table 8.1) by the population in each WHO subregion five-year age group for 2010, 2015, 2020. In the absence of time-series data the prevalence of vision loss and the distribution of vision loss by cause (excluding URE) are assumed constant to 2020. However, due to forecast population growth, the number of visually impaired people is projected to increase over time. This approach is in line with previous global burden of disease studies for vision loss (Frick and Foster, 2003; Smith et al 2009). Prevalence rates used were derived from Resnikoff et al (2004) and adjusted for differences in VA definitions and URE (Access Economics 2010).

Table 8.1: Prevalence rates for vision loss (%)

WHO subregion	Blindness (VA < 6/60)			Moderate low vision (6/60 ≤ VA < 6/18)			Mild low vision (6/18 ≤ VA < 6/12)		
	<15 years	15-49 years	50+ years	<15 years	15-49 years	50+ years	<15 years	15-49 years	50+ years
AFR-D	0.30	0.49	21.27	0.43	0.70	25.59	0.58	0.94	34.55
AFR-E	0.30	0.49	21.27	0.43	0.69	25.59	0.58	0.93	34.55
AMR-A	0.38	0.62	2.16	0.83	1.26	4.24	1.13	1.69	5.72
AMR-B	0.33	0.60	5.57	0.64	1.10	9.56	0.86	1.48	12.90
AMR-D	0.34	0.70	8.49	0.67	1.21	12.37	0.90	1.63	16.70
EMR-B	0.31	0.49	13.23	0.57	0.81	16.75	0.76	1.09	22.61
EMR-D	0.31	0.57	15.61	0.56	0.89	19.11	0.75	1.21	25.80
EUR-A	0.38	0.64	2.51	0.84	1.30	4.84	1.14	1.76	6.53
EUR-B1	0.40	0.65	3.34	0.84	1.21	5.16	1.14	1.63	6.96
EUR-B2	0.40	0.64	3.52	0.84	1.18	5.35	1.13	1.60	7.22

WHO subregion	Blindness (VA < 6/60)			Moderate low vision (6/60 ≤ VA < 6/18)			Mild low vision (6/18 ≤ VA < 6/12)		
EUR-C	0.41	0.69	3.61	0.87	1.30	5.79	1.17	1.75	7.82
SEAR-B	0.37	0.54	12.47	0.70	0.94	14.24	0.94	1.27	19.23
SEAR-D	0.34	0.74	15.40	0.63	1.31	24.40	0.86	1.76	32.94
WPR-A1	0.12	0.28	1.89	0.23	0.42	3.10	0.31	0.57	4.19
WPR-A2	0.12	0.28	1.89	0.23	0.42	3.10	0.31	0.57	4.19
WPR-B1	0.86	1.16	7.63	1.95	2.43	12.20	2.63	3.28	16.46
WPR-B2	0.37	0.54	11.15	0.70	0.93	12.89	0.94	1.26	17.40
WPR-B3	0.41	0.60	6.53	0.79	1.09	9.94	1.07	1.47	13.42

Source: Access Economics (2010).

The distribution of vision loss prevalence by cause, using best-corrected VA only (i.e. excluding vision loss due to URE), is detailed for the year 2002 in Table 8.2[19]. Cataract and glaucoma are the major causes of vision loss in developing regions. In developed regions, particularly AMR-A and EUR-A, AMD and DR contribute greater proportions of all vision loss. This reflects the higher prevalence of diabetes and longer life expectancy in more developed countries.

Table 8.2: Distribution of vision impairment based on best-corrected visual acuity by cause (%)

WHO subregion	Cataract	Glaucoma	AMD	Corneal opacities	Diabetic retinopathy	Childhood blindness	Trachoma	Onchocerciasis	Other	Total
AFR-D	50.0	15.0	0.0	8.0	0.0	5.2	6.2	6.0	9.6	100.0
AFR-E	55.0	15.0	0.0	12.0	0.0	5.5	7.4	2.0	3.1	100.0
AMR-A	5.0	18.0	50.0	3.0	17.0	3.1	0.0	0.0	3.9	100.0
AMR-B	40.0	15.0	5.0	5.0	7.0	6.4	0.8	0.0	20.8	100.0
AMR-D	58.5	8.0	4.0	3.0	7.0	5.3	0.5	0.0	13.7	100.0
EMR-B	49.0	10.0	3.0	5.5	3.0	4.1	3.2	0.0	22.2	100.0
EMR-D	49.0	11.0	2.0	5.0	3.0	3.2	5.5	0.0	21.3	100.0
EUR-A	5.0	18.0	50.0	3.0	17.0	2.4	0.0	0.0	4.6	100.0
EUR-B1	28.5	15.0	15.0	8.0	15.0	3.5	0.0	0.0	15.0	100.0
EUR-B2	35.5	16.0	15.0	5.0	15.0	6.9	0.0	0.0	6.6	100.0
EUR-C	24.0	20.0	15.0	5.0	15.0	2.4	0.0	0.0	18.6	100.0
SEAR-B	58.0	14.0	3.0	5.0	3.0	2.6	0.0	0.0	14.4	100.0
SEAR-D	51.0	9.0	5.0	3.0	3.0	4.8	1.7	0.0	22.5	100.0
WPR-A1	5.0	18.0	50.0	3.0	17.0	1.9	0.0	0.0	5.1	100.0
WPR-A2	5.0	18.0	50.0	3.0	17.0	1.9	0.0	0.0	5.1	100.0
WPR-B1	48.5	11.0	15.0	3.0	7.0	2.3	6.4	0.0	6.8	100.0
WPR-B2	65.0	6.0	5.0	7.0	3.0	3.6	3.5	0.0	6.9	100.0

[19] For subregion WPR-A, the proportion of vision loss due to other causes is increased from 5.0% as reported by Resnikoff et al (2004) to 5.1% in order for the proportions to sum to 100%.

WPR-B3	65.0	6.0	3.0	3.0	5.0	9.5	4.3	0.0	4.2	100.0

Source: Resnikoff et al, 2004.

In 2010, the estimated health system costs of vision loss were $US2.3 trillion in 2010, with an expected DWL of $US238 billion, productivity loss of $US168 billion and an estimated informal care burden of $US246 billion. In total the global cost of vision loss was estimated as $US3.0 trillion. The burden of disease is projected to increase over time with population growth (Table 8.3).

Table 8.3: Summary of global results for the burden of disease study in vision impairment, (USD)

	2010	2015	2020
Prevalence of vision loss(million)	733	826	929
Direct cost ($ billion)	2,302	2,529	2,767
DWL ($ billion)	238	259	280
Productivity loss ($ billion)	168	175	178
Informal care ($ billion)	246	273	302
DALYs (million)	118	133	150

Source: Access Economics calculations. All costs expressed in 2008 US dollars.

Five Strategies were identified to reduce the global burden of visual impairment:

1. Coordinate greater screening of high-risk groups including people with diabetes and the elderly; the prevalence of visual impairment due to longevity (AMD) and non-communicable chronic diseases is increasing, particularly in developed regions.
2. Provide more training in cataract surgery for doctors working in developing regions; access to cataract surgery is a major barrier to managing sight loss in the developing world.
3. Make corrective eye wear more available and more affordable - over half of all sight loss is caused by uncorrected refractive error, which could easily be reversed using spectacles or contact lenses.
4. Fund and distribute medications to treat river blindness (onchocerciasis) and trachoma in affected populations.
5. Target early treatment of childhood eye diseases, including cataract and glaucoma.

Worldwide, Holden et al (2008) estimated the worldwide effect of uncorrected presbyopia by combining prevalence figures with spectacle coverage rates. These authors estimated that 1.04 billion people needed significant optical correction for presbyopia in 2005, but 517 million were without adequate near vision correction. The majority live in less developed countries.

8.1.2 United Kingdom

In the UK in 2008, 1.8 million people were blind or partially sighted (Table 8.4). The associated economic costs were £22.0 billion in 2008 (Table 8.5). Health care system costs amount to £2.14 billion and other costs were £4.34 billion. In addition, the loss of healthy life and the loss of life due to premature death associated with partial sight and blindness also impose a cost on society through a reduction in the stock of health capital. This reduction was estimated at £15.51 billion in 2008.

Table 8.4: Vision loss in the UK, 2008

	AMD	Cataract	DR	Glaucoma	RE	Other	Total
Males	89,941	75,527	36,511	41,482	371,408	49,190	664,059
Females	209,945	170,035	25,952	53,727	589,350	83,921	1,132,931
Total	299,886	245,562	62,463	95,209	960,758	133,110	1,796,990
%	17%	14%	3%	5%	53%	7%	100%

Source: Access Economics (2009)

Table 8.5: Summary of costs associated with partial sight and blindness in UK adults 2008

	£ million
Health system costs	2,144.89
Lower employment	1626.70
Absenteeism	79.85
Premature mortality	2.38
Informal care costs	2,029.70
Devices and modifications	336.50
Deadweight loss	268.59
Total – Indirect costs	4,343.72
Total – Burden of disease costs	15,509.10
Total –Costs	21,997.71

Source: Access Economics (2009)

In addition to estimating the economic cost of partial sight and blindness in the UK adult population, four hypothetical eye care interventions were evaluated to estimate their potential cost effectiveness. These focused on four areas identified as most relevant for current UK policy:

- promote the prevention of eye injuries;
- improve access to integrated low vision and rehabilitation services;
- increase regular eye tests for the older population (≥60 years); and
- increase access to eye care services for minority ethnic groups (MEGs).

The results suggested the most effective campaign was that focusing on MEGs because of the lack of access of MEGs to eye care services compared with the population average, and undetected eye conditions in this community are more likely to be severe. It was estimated that an educational campaign using media and an educational road show to ten locations heavily populated with MEGs throughout the UK could result in a cost effectiveness ratio of £1,230 per DALY avoided (90% confidence interval of £1,032 per DALY avoided to £1,559 per DALY avoided).

Results of the other three economic evaluations show there are gains to be made in investing in the promotion of eye care services. In summary the results indicated the following.

- A cost effectiveness ratio of £24,200 per DALY avoided for a campaign that targets older people (≥60 years) to take up regular eye examinations (90% confidence interval of £17,000 per DALY avoided to £41,200 per DALY avoided).
- A cost effectiveness ratio of £100,857 per DALY avoided for a campaign that encourages those with recognised partial sight and blindness to use low vision services (90% confidence interval of £73,900 per DALY avoided to £152,900 per DALY avoided).
- A benefit/cost ratio of 1.62 for a campaign that promotes the use of eye protection to avoid eye injuries (90% confidence interval of 1.32 to 2.25).

8.1.3 Canada

In 2007, there were an estimated 979,510 Canadians with vision loss (Access Economics 2008a). Cataract was the main source of vision loss. The prevalence of vision loss is projected to double in absolute numbers, an increase from 3.0% in 2008 of the population in 2007 to 5.2% in 2032.

Table 8.6: Prevalence of vision loss, Canada, 2007

	Number	% total
AMD	222,170	22.7%
Cataract	574,747	58.7%
DR	54,906	5.6%
Glaucoma	35,729	3.6%
RE/Other	91,957	9.4%
All vision loss	979,510	100.0%

Source: Access Economics (2008a)

In 2007, the financial cost of vision loss was $12.2 billion. Of this:

- $7.2 billion (59.0%) was direct health system expenditure;
- $2.1 billion (17.6%) was productivity lost due to lower employment, absenteeism and premature death of Australians with vision loss;
- $1.3 billion (10.7%) was the DWL from transfers including welfare payments and taxation forgone;
- $1.2 billion (9.7%) was the value of the care for people with vision loss; and
- $366 million (3.0%) was other indirect costs such as direct program services, aids and home modifications and the bring-forward of funeral costs.

Additionally, the value of the lost wellbeing (disability and premature death) was a further $25.8 billion.

8.1.4 United States

At least two studies have been released about the cost of vision loss in the US since the release of the original Australian report (Access Economics 2004).

Rein et al (2006) estimated the societal economic burden, and the governmental budgetary impact of visual impairment, blindness, refractive error, age related macular degeneration, cataracts, diabetic retinopathy, and primary open-angle glaucoma among US adults aged 40 years and older. The scope of costs included medical care, the costs of nursing home care attributable to vision loss, government purchase programs, and guide dogs for the blind, and productivity losses.

For 2004, the total financial cost of major visual disorders among US residents aged 40 years or older was $US35.4 billion: $US16.2 billion in direct medical costs, $US11.1 billion in other direct costs, and $US8 billion in productivity losses.

Outpatient and pharmaceutical services comprised the majority of direct medical costs, with inpatient costs accounting for virtually no costs. The direct medical costs for each condition were roughly $US6.8 billion for cataracts, $US5.5 billion for refractive error, $US2.9 billion for glaucoma, $US575 million for AMD, and $US493 million for diabetic retinopathy. For people with vision loss aged 40 or over, 75.6% of direct medical costs were attributable to cataracts and refractive error, with another 17.8% attributable to glaucoma.

Among Americans aged 65 years or older, 16% of those who are vision impaired and 40% of those who are blind resided in nursing homes, compared with only 4.3% of those in the general population. Around 424,801 more visually impaired and blind Americans reside in nursing homes than would be expected if these same individuals had normal vision. Nursing homes costs were $US11 billion, government purchase programs cost $US94 million and guide dogs cost $US62 million.

Lost productivity annually was $US6.3 billion reflecting an estimated 115,583 vision impaired and 74,133 blind people who did not work and who would have worked if fully sighted. Rein et al (2006) also estimated that 125,882 visually impaired and 40,671 blind people participated in the labour force but earned less than people with normal vision, with a wage differential of $US9,851 for the vision impaired and $US12,121 for the blind. Productivity losses due to decreased earnings were $US1.7 billion. This element of productivity losses is not commonly included in estimates of the cost of vision loss.

In 2004, the total governmental budgetary impact of adult visual disorders was $US13.7 billion (Rein et al 2006).

A study by Frick et al (2007) added value by estimating the value of home care provided by agencies that was not covered by insurers, personal care services paid for by the individual with visual impairment or his or her family, and informal care. Medical Expenditure Panel Survey data from 1996 to 2002 were pooled to estimate the relationship of visual impairment and blindness with total medical expenditures, components of expenditures, days of informal care received, and health utility. Statistical analysis accounted for confounders such as comorbidities and demographics. Blindness and visual impairment were significantly associated with higher medical care expenditures, a greater number of informal care days, and a decrease in health utility (measured in terms of QALYs — although the sample for health utility estimates was relatively small).

Individuals with blindness had significantly higher odds of positive home health care expenditures (OR, 2.1; 95% confidence interval, 1.6-2.8). Individuals with blindness who used home health agencies had expenditures that were $4900 more than those for individuals without visual impairment who had home health agency expenditures (P=.005). Individuals with blindness who used private home health providers had expenditures that were $1200 more than those for individuals without visual impairment who used private home health providers (although not statistically significantly [P=.60]).

Interestingly, individuals with blindness who were admitted for inpatient care had lower expenditures than individuals without visual impairment who were admitted for inpatient care. Frick et al (2007) suggested this reflected that individuals with blindness may be admitted for less serious conditions for which they do not have sufficient care to remain in the home, resulting in a lower average expenditure per admission. Frick et al (2007) concluded that excess expenditures (including medical and home care) for those who were vision impaired or blind were $US5.1 billion, primarily owing to home care. The total value of informal care (based on an additional 5.2 days per year for a blind person and 1.2 days for a vision impaired person) was $0.4 billion. The total monetary cost was therefore $5.5 billion. While the impact on QALYs lost (0.07 per blind person and 0.05 per person with vision loss) were lower than for other studies, Frick et al (2007) cited potential differences in short and long term impacts of losing vision as those affected adapt over time, and suggested the need for further research.

8.1.5 Australia

In Australia in 2009, there were almost 575,000 Australians aged 40 or over with vision loss in 2009, 5.8% of the Australian population in that age group (Access Economics 2010[20]). Around 66,500 people were blind. The largest proportion were aged 70 or over (nearly 70%).

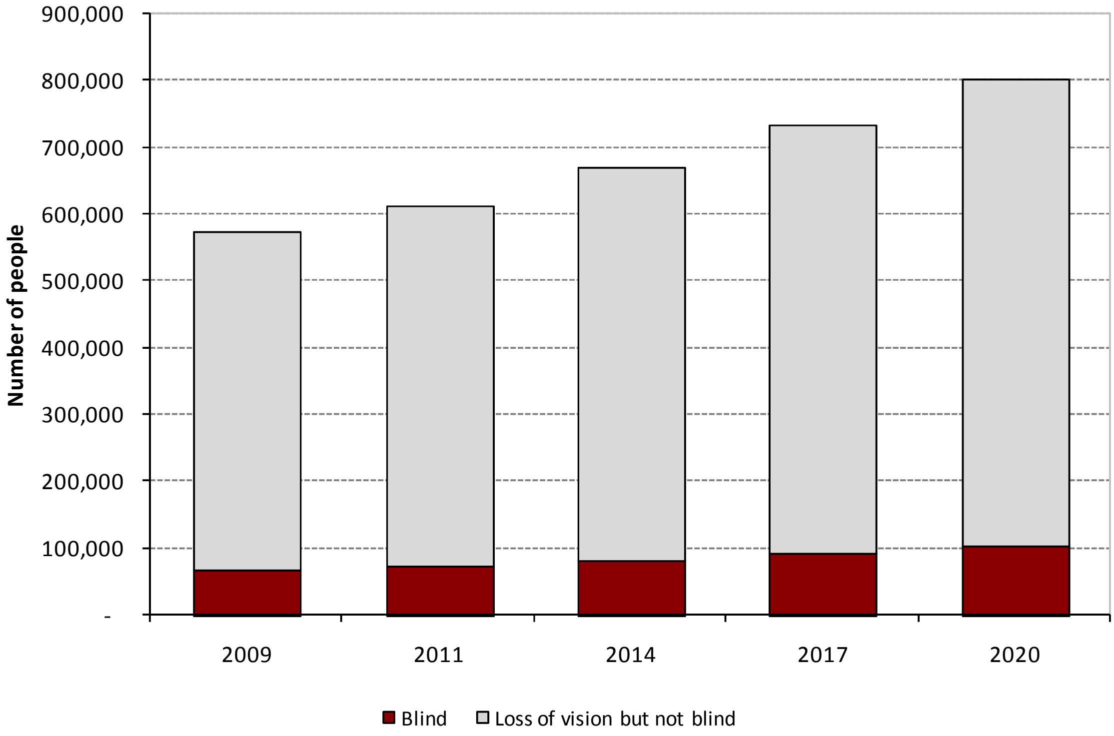
Most vision loss was caused by uncorrected refractive error (over 341,000 people). Cataract caused 15% of vision loss, AMD 10%, glaucoma 5% and DR 2%. The most common causes of blindness were AMD (50%), glaucoma (16%) and cataract (12%).

Vision loss is associated with a higher than average risk of mortality because it is correlated with a higher risk of falls, motor vehicle accidents and depression (Centre for Eye Research Australia and Access Economics 2004). Over 1,000 deaths were attributable to vision loss in 2009.

It is projected that the number of people aged 40 or over with vision loss will rise to almost 801,000 by 2020 and those who are blind will rise to 102,750. The projected rise in prevalence reflects demographic ageing, and assumes a policy-neutral environment. The rise in the number of Australians is depicted in Table 8.1.

[20] Subsequent estimations also sourced from Access Economics 2010 unless otherwise stated

Chart 8.1: Projections of Australians aged 40 or over with vision loss



Source : Access Economics 2010

In 2009, the total financial cost of vision loss (excluding loss of wellbeing) was estimated to be $7.2 billion, or $12,545 per person with vision loss.

- In 2009, total health system expenditure on disorders of the eye and adnexa was estimated at $2.98 billion or $5,183 per person with vision loss aged over 40. The component of health system costs that can be allocated to specific diseases are alone projected to rise from $2,580 million in 2009 to $4,766 million by 2020.
- Productivity losses of those with vision loss were approximately $2.3 billion in 2009. This included losses due to lower than average employment rates (adjusted for age) of those with vision loss, losses resulting from premature mortality, and the 'bring forward' of employer search and hiring costs due to premature mortality
- Productivity losses of family and friends who care for people with vision loss on an unpaid basis were around $251 million. This reflects the opportunity cost of informal carers' time.
- The costs of aids, home modifications, other types of care and the 'bring forward' of funeral costs were approximately $839 million in 2009.
- Deadweight losses (the economic cost associated with administering the taxation and transfer system and which also arises because of distortions to behaviour) were estimated to be $868 million in 2009.

The loss of wellbeing that results from vision loss was estimated using DALYs. In 2009, vision loss was associated with 58,150 DALYs — 6738 years of life lost due to premature death and 51,409 years of life lived with disability. The overall monetary value of the loss of wellbeing in

2009 was $9.4 billion. If this is added to the financial costs, the overall cost of vision loss in 2009 was $16.6 billion.

8.1.6 Comparing Australia and New Zealand

The Australian estimate is significantly higher than that for New Zealand ($2.8 billion), reflecting different data sources and availability of data. Table 8.7 outlines some reasons for this difference.

Table 8.7: Comparing the economic impact of vision loss in Australia and New Zealand, 2009

Component	Australia ($A per person with vision loss)	New Zealand ($ per person with vision loss)	Comment
Health costs	5,183	1,583	■ 'Other health professionals' category included in Australian report due to (extra) available information. ■ Substantially higher spend on research into vision loss in Australia. ■ Significantly higher spend on pharmaceuticals and optometry in Australia.
Loss of productivity	3,964	899	■ Difference in employment rates between those with and without vision loss higher in New Zealand — drawn from a New Zealand data source. ■ Ages 65-74 included in Australian report due to the availability of data (New Zealand data only available to age 65).
Aids/funeral costs	1,459	244	■ Reflect differences in scope and different data sources.
DWL	1512	312	■ DWL rate is 18% in New Zealand and 28.75% in Australia, and ■ components such as government funded health costs are higher in Australia leading to a higher DWL.

Source: Access Economics (2010)

9 New Zealand health policy in context

This report highlights the substantial economic impact of vision loss in New Zealand. In 2009 there were almost 125,000 New Zealanders aged 40 years or over with vision loss — 67% aged 70 or over. Around 12,000 of these people were blind. Based on these prevalence estimates, the costs of vision loss in 2009 were $400 million — around $198 million in health expenditure and the rest due to productivity losses of those with vision loss and their unpaid carers, aids and equipment and deadweight losses resulting from transfer payments. Moreover, there are the substantial effects on wellbeing — estimated in this report as having a monetary value of around $2.4 billion.

Most cases of vision loss and blindness are avoidable, through evidence based, effective interventions across the spectrum from prevention, early intervention, and treatment.

- Cataract surgery has been found to be a very cost effective way to restore sight (Busbee 2002, Busbee 2003, Kobelt et al, 2002, Baltussen et al, 2004, and Lansingh 2006).
- Pharmaceuticals and/or laser therapy can slow the progress of primary open angle glaucoma. The Ocular Hypertension Treatment Study and the Early Manifest Glaucoma Trial showed that the rate of progression of primary open angle glaucoma can be delayed by half with these interventions. Detection and early intervention is important because once vision has been lost it cannot be restored.
- Diabetic retinopathy can be prevented through prevention or control of diabetes. In particular, control of blood lipids (Keech et al, 2007), blood pressure (Mohamed et al, 2007) and glycaemic control (Diabetes Control and Complications Trial 1993; United Kingdom Prospective Diabetes Study 2004 and 1998) are effective in reducing the risk of DR among people with diabetes.
- Regular eye examinations for people with diabetes to detect early diabetic retinopathy, and appropriately timed laser treatment can prevent 90% of severe vision loss (Ferris 1993).
- Age related macular degeneration of the wet form can be treated to preserve vision. Tobacco smoking is a risk factor for AMD, and a further reason to reduce New Zealand smoking rates. The pharmaceuticals such as Lucentis and anti-VEGF treatments slow the progress of wet AMD and in a number of cases restore some vision.

Moreover, quality of life and independence can be improved through rehabilitation, aids and equipment which enhance vision and improve functionality of those with low vision.

Many New Zealanders are needlessly experiencing vision loss. Improving awareness about how to avoid vision loss, and ensuring access to eye care services, including prevention, treatment and rehabilitation services, are important.

9.1.1 New Zealand health policy in context

Prevention of vision loss, its early detection, treatment, education and rehabilitation are comparatively low cost interventions that depend on integration into existing health policies and priorities. Their effective delivery in the public sector, eye health and vision care programmes must rely on Ministry of health guidelines and need the backing of 21 District Health Boards for their delivery in specific districts.

VISION 2020 New Zealand is committed to:

- eliminating avoidable vision loss within existing health priorities;
- developing an evidence base to support progressive eye health policy, service delivery and monitoring mechanisms; and
- to collaborate with public, private and NGO elements of the eye health and vision care sector to gain these ends.

Eye health could be embedded within New Zealand health policy through inclusion in the annual targets set by the Ministry. For example, the 2010-11 targets for District Health Boards include shorter stays in emergency departments, improved access to elective surgery, shorter waits for cancer treatment, increased immunisation, better help for smokers to quit and better diabetes and cardiovascular services.21 Eye health could be included in the justification for selection of targets (such as reducing tobacco smoking or prevention and better care of diabetes) or inclusion as a target in its own right. What is needed is a greater awareness of vision loss as a core determinant of overall health, acknowledgement of the economic and social costs of vision loss, and the active integration of vision care into existing programmes.

9.1.2 VISION 2020 initiatives

2009 health spending on disorders of the eye for those over 40 was estimated at $198 million or $1,583 per person. This spending has gone some way to limiting vision loss. However, there are huge gains yet to be made through a comprehensive cross-sectoral “National Eye Health Plan” to further reduce the incidence of avoidable blindness. Actions needed are:

- a political commitment to eliminating avoidable blindness;
- preparation of evidence-based standards and guidelines for cost-effective interventions;
- the sharing of best practice lessons; and
- the strengthening of partnerships and coordination among all stakeholders.

In 2002 the Minister of Health, the Hon Annette King, signed New Zealand up to the WHO global initiative, VISION 2020, aimed at eliminating avoidable blindness and vision loss by year 2020. Since then, New Zealand Governments have all voted at successive World Health Assemblies to affirm the objects of VISION 2020 and have subscribed to action plans that set targets for member states ensuring that avoidable vision impairment and blindness is addressed. These action plans urge all member states to develop a National VISION 2020 plan in collaboration with non-governmental organisations and the private sector.

Implementing action and monitoring progress in the elimination of avoidable blindness at national, regional and global levels call for the gathering of robust population-based evidence on interventions, and raising the awareness and understanding of eye health among the public — especially those caring for children, the elderly, smokers, the obese and those exposed to outdoor ultraviolet radiation.

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[21] New Zealand Ministry of Health website http://www.moh.govt.nz/moh.nsf/indexmh/healthtargets-targets accessed September 2010.

The key actions sought are: risk reduction; enhanced early detection; workforce development and coordination; equity of access to eye health and vision care services; improved systems for the delivery of eye care; and the gathering and dissemination of quality evidence.

9.1.3 Eye health and vision care policy

The report highlights a number of actions warranting urgent attention as we work towards the goal of eliminating avoidable blindness by 2020.

VISION 2020 New Zealand makes the following recommendations and pledges to work with all Governments to help achieve the World Health Assembly objectives set out above.

In line with World Health Assembly and VISION 2020 commitments on eye health, there is need for a comprehensive National Eye Health Plan with measurable targets. With regard to eye health, there is need for inter-sectoral and intra-sectoral collaboration around health, disability, aged care and chronic disease policies and funding, particularly for those programmes targeting vulnerable groups. At risk are Māori, Pacific, and high needs populations, children, the elderly, smokers, the obese and people with low vision and blindness. Eye health and vision care are key determinants of health and wellbeing. As such, funding prevention of blindness will return improvements to the wellbeing and productivity of New Zealanders.

9.1.4 Establishing population oriented evidence and monitoring

The literature review conducted for this study revealed the dearth of data on vision loss in New Zealand based on large scale, ophthalmologically based epidemiological surveys. It was therefore necessary for this report to use two large, high quality, internationally renowned studies of the prevalence of vision loss in Australia to derive estimates of the prevalence of vision loss in New Zealand. While New Zealand and Australia are often grouped together for the purposes of global epidemiological estimates, and several (non clinical) New Zealand surveys of vision loss were used to inform the Australian epidemiological estimates, the lack of New Zealand specific data mean the prevalence estimates here need to be viewed with care.

More broadly, the paucity of epidemiological surveys of vision loss in New Zealand represents a significant gap in knowledge which needs to be addressed. The non clinical New Zealand surveys suggest there are considerable disparities in eye health between the Māori and Pacific populations and others, with evidence of worse eye health particularly among Māori. These need to be explored more fully to identify the extent of the problem and possible reasons to inform strategies to improve eye health among disadvantaged and high prevalence groups in the community. In 2006, self-reported rates of vision loss among Māori were more than twice those of non-Māori for people aged younger than 75 years (Office for Disability Issues and Statistics New Zealand 2010). More understanding is needed about the complexities that lie behind high prevalence rates of vision loss among Māori and barriers to early detection and treatment in such groups.

Further, mechanisms are needed to gauge New Zealand's success in reducing avoidable blindness. Ongoing quality research into the clinical, economic, population and service delivery aspects of eye care is strongly recommended. Given current data, it is not possible to assess the effectiveness of prevention measures. Equity of access for ethnic and remote communities deserves special attention in this regard.

The projections of health system costs to the year 2020, are alarming. Assuming a policy neutral environment, health system costs are projected to rise from $198 million in 2009 ($1,583 per person with vision loss) to $523 million by 2020 ($3,008 per person with vision loss). These estimates warrant close monitoring in the light of rapid changes in the management of eye conditions.

9.1.5 Public health

Given the functional significance of sight as a determinant of health and wellbeing, eye health and vision care become public health issues on a par with smoking and obesity. The socio-economic consequences of blindness and vision loss outlined in this report justify active monitoring and refinement of Interventions.

The majority of international vision loss is avoidable or treatable. The WHO estimated that 75% of world blindness was avoidable with cost effective intervention strategies (WHO 2005). In 2000, of 45 million people who were blind, 60% were blind due to cataract and refractive error (treatable), 15% of blindness was due to trachoma, vitamin A deficiency and onchocerciasis (preventable); another 15% of blindness was due to DR and glaucoma (partly preventable although difficult, or treatment can slow progress of disease) and the other 10% was attributable to AMD and other diseases (progress can be slowed in some cases but more research needed) (WHO 2005). The newer estimates by Access Economics (2010) drawing on more recent data from Resnikoff et al, (2004) and Resnikoff et al, (2008) suggest close to 75% of world blindness in 2010 was due to cataract and URE alone implying an even higher proportion of avoidable blindness.

This report estimates that in New Zealand, 68% of vision loss and 14% of blindness are due to cataract and uncorrected refractive error — avoidable through cost effective treatment.

Benefits should flow from eye health messages being included in general prevention and health promotion campaigns targeted at high risk populations. There appears to be a low level of public awareness regarding the simple measures people can take to conserve and enhance sight. New Zealanders are entitled to the information that enables them to take charge of their own eye health and vision care. Public awareness campaigns promoting simple measures that preserve sight such as five yearly checks for the over 50's would pay dividends. Such checks are required for early detection of refractive error and eye disease and would reduce vision loss from cataract, age related macular degeneration, diabetic retinopathy and glaucoma. Integrated primary health care and chronic disease management, along with sound information transfer between eye-care professionals is needed, particularly for those with diabetes-related eye conditions. Education of general medical practitioners, nurses and allied health-care professionals would aid detection of vision loss and speed appropriate referral. Delivering community-based eye-care in a convenient and appropriate manner should reduce costs and enhance equity of access to service.

Fairness, equity and efficiency should result from better integration of eye health and vision care across the spectrum. Patients benefit from evidence-based practice guidelines, continuous shared learning, consistent documentation, information transfer and referral.

Ongoing research into service delivery systems and the mitigation of the major causes of vision loss is essential, given the report's findings.

9.1.6 Eye health workforce

Few previous economic or prevalence studies on vision loss have been undertaken in New Zealand. Evidence from this report points to the fact that the most effective interventions possible are needed to limit avoidable blindness. Despite the heroic efforts of clinicians and technical advances in eye care, we have a long way to go to improve overall eye health and to stem the growing vision loss problem in New Zealand. There is a strong case for critical planning of workforce development, coordination and distribution of eye health and vision care professionals.

Equity of access to services and distribution of trained personnel in rural communities remain a significant challenge. Appropriateness and adequacy of professional training and access to facilities in a rapidly changing technological age deserve regular review.

This Report raises concerns about equity of access to ophthalmic, optometric, low vision and rehabilitation services with particular reference to the needs of Māori, Pacific, and other high needs populations.

With 55% of vision loss being caused by uncorrected refractive error, access to publicly funded optometric services could enhance early detection, aid monitoring of eye-related conditions and extend low vision services.

9.1.7 Joint sector-government eye health and vision care directorate

A ten year comprehensive eye health and vision care strategy is needed for New Zealand, headed by a national eye health directorate. The WHO Action Plan is now in its mid phase, 2008 to 2013, en route to the objective of eliminating avoidable blindness by the year 2020. To keep pace with comparable countries, New Zealand must give voice to its own eye health plan. Global and regional goals to limit avoidable blindness need translation into national relevance.

This report, Clear Focus - The Economic Impact of Vision Loss in New Zealand, 2009, demonstrates the benefits in terms of personal wellbeing and the national economy that would flow from investing in sight.

9.1.8 Counting down to 2020

Projections here suggest that the number of New Zealanders with vision loss will rise from 125,000 in 2009 to almost 174,000 by 2020 (assuming a policy-neutral environment). The number who are blind will rise from 12,000 in 2009 to more than 18,000 in 2020. The projected increases reflect demographic ageing, as most people with vision loss are aged 70 or over. In addition to the 125,000 people with vision loss, approximately 14,400 people had vision loss due to uncorrected presbyopia in 2009.

Most vision loss is correctable — 55% was caused by uncorrected refractive error (excluding presbyopia) and 13% by cataract. Other vision loss is preventable or treatable — age-related macular degeneration 9% of vision loss, glaucoma 4% and diabetic retinopathy 2%. AMD (48%) and glaucoma (16%) are the most common causes of blindness.

Vision loss and blindness are associated with substantial economic and social costs. In 2009, the total financial cost of vision loss (excluding loss of wellbeing) was estimated to be $400 million, or $3,206 per person with vision loss aged over 40 years. The loss of wellbeing that results from vision loss was estimated to add $2.4 billion to the financial costs, resulting in an overall cost of vision loss in 2009 of $2.8 billion, or $22,217 per person with vision loss aged over 40.

Together with other countries, New Zealand has pledged to eliminate avoidable blindness by 2020 through the global initiative, VISION 2020: the Right to Sight. Since 2002, New Zealand has been committed to VISION 2020 ideals. In 2009 New Zealand was a member of the WHO Executive Board that voted to further advance VISION 2020 in member countries. With only ten years remaining for this collaborative effort, the Government and the sector need to increase their work rate, build on existing services and work in partnership to ensure avoidable blindness is eliminated by the target date. An action plan to minimise avoidable blindness and vision loss is needed, together with strategies to remove the barriers to full participation in the community of people with little or no sight.

VISION 2020 New Zealand recommends that the public and private sectors collaborate and take strong and immediate action on the serious matters raised in this report. It is time to turn humane precept into practice.

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Appendix A: Literature search

Table A.1: Literature searches conducted for this report through MEDLINE/PubMed

Terms	Date	Potentially relevant articles
New Zealand and vision loss and prevalence	23 March 2010	20 journal citations, abstracts (1990 – 2009)
Australasia and vision loss and prevalence	23 March 2010	82 journal citations, abstracts (1990 – 2009)
Auckland and vision loss and prevalence	23 March 2010	5 journal citations, abstracts (1990 – 2009)
Christchurch and vision loss and prevalence	23 March 2010	4 journal citations, abstracts (1990 – 2009)
Waikato and vision loss and prevalence	23 March 2010	0 journal citations, abstracts (1990 – 2009)
Wellington and vision loss and prevalence	23 March 2010	4 journal citations, abstracts (1990 – 2009)
New Zealand and cataract and prevalence	23 March 2010	28 journal citations, abstracts (1990 – 2009)
New Zealand and diabetic retinopathy and prevalence	23 March 2010	17 journal citations, abstracts (1990 – 2009)
New Zealand and macular degeneration and prevalence	23 March 2010	5 journal citations, abstracts (1990 – 2009)
New Zealand and refractive error and prevalence	23 March 2010	19 journal citations, abstracts (1990 – 2009)
New Zealand and glaucoma and prevalence	23 March 2010	8 journal citations, abstracts (1990 – 2009)
New Zealand and blindness and prevalence	23 March 2010	15 journal citations, abstracts (1990 – 2009)
New Zealand and visual and prevalence	23 March 2010	80 journal citations, abstracts (1990 – 2009)
New Zealand and vis* impairment	23 March 2010	3 journal citations, abstracts (1990 – 2009)
Otago and vis* and prevalence	23 March 2010	1 journal citations, abstracts (1990 – 2009)
New Zealand and eye disease and prevalence	23 March 2010	155 journal citations, abstracts (1990 – 2009)
vis* and Māori	30 March 2010	5 journal citations, abstracts (1990 – 2009)
vision loss and Māori	30 March 2010	1 journal citation, abstract (1990 – 2009)
cataract and Māori	30 March 2010	1 journal citation, abstract (1990 – 2009)
glaucoma and Māori	30 March 2010	1 journal citation, abstract (1990 – 2009)

Terms	Date	Potentially relevant articles
blind and Māori	30 March 2010	7 journal citations, abstracts (1990 – 2009)
eye and Māori	30 March 2010	10 journal citations, abstracts (1990 – 2009)