Deloitte Access Economics

The economic impact of sight loss and blindness in the UK adult population, 2013

Royal National Institute of Blind People (RNIB)

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Deloitte.

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Glossary

A&E	accident and emergency
AMD	age-related macular degeneration
BSO	Business Services Organisation
CPI	consumer price index (a measure of inflation)
DALY	disability adjusted life year
DBIS	Department for Business, Innovation and Skills
DHSSPSNI	Department of Health, Social Services and Public Safety, Northern Ireland
DoH	Department of Health, England
DR	diabetic retinopathy
FCE	Finished Consulted Episode
FY	financial year
GDP	gross domestic product
GLA	Greater London Authority
GOS	General Ophthalmic Services
HRG	Health Resource Group
HSC	Health and Social Care Board, Northern Ireland
HSCIC	Health and Social Care Information Centre
HSE	Health and Safety Executive
ISD	Information Services Division, Scotland
MEGs	minority ethnic groups
MRC	Medical Research Council
MVIP	Melbourne Visual Impairment Project
NHS	National Health Service
NICE	National Institute Health and Care Excellence
NI(SRA)	Northern Ireland (Statistics and Research Agency)
NRS	National Records of Scotland
NWIS	NHS Wales Informatics Service
ONS	Office for National Statistics
PSS	personal social services
QALY	quality adjusted life year
R&D	research and development
RE	refractive error
RNIB	Royal National Institute of Blind people
UK	United Kingdom
US(D)	United States (dollar)

VEGF	vascular endothelial growth factor
VSL(Y)	value of a statistical life (year)
WG	Welsh Government
WHO	World Health Organization
WTP	willingness to pay
YLD	years of healthy life lost due to disability
YLL	years of life lost due to premature mortality

Executive Summary

Deloitte Access Economics (Australia) was commissioned by the Royal National Institute of Blind People (RNIB) to update the 2009 Access Economics report on the economic impact of sight loss and blindness in the UK adult population, including the direct and indirect costs of sight loss and blindness, and the burden of sight loss and blindness on health. In this update, estimates are also provided for each country in the UK. This is important since health is an issue devolved down to the Scottish Parliament and the Welsh and Northern Ireland Assemblies.

The economic costs presented in this report relate to the adult UK population (≥18 years of age). Although prevalence of sight loss and blindness has been estimated and reported for those aged 0 to 39, these data must be used with caution. Data on the prevalence of childhood sight loss and blindness in the UK is limited and variable. More research needs to be undertaken into measuring childhood sight loss and blindness and the associated economic costs within the UK.

This report comprises the following estimates:

- prevalence of sight loss and blindness in the UK by age, gender, ethnicity, severity, regions and countries, and major cause in 2013, and future projections by decade to the year 2050;
- the direct health system costs of sight loss and blindness in the UK adult population, disaggregated by cost components (hospital, non-admitted, prescribing in primary care, ophthalmic services, research and development, residential care and community care, capital and administration) for the year 2013;
- the indirect costs of sight loss and blindness in the UK adult population, disaggregated by cost components (including productivity losses, informal care costs, devices and modifications, and the tax inefficiencies associated with transfer payments and public funding of health care) for the year 2013; and
- the burden of disease, measured in terms of disability adjusted life years (DALYs), of sight loss and blindness in the UK adult population, disaggregated by years of life lost due to premature death (YLL) and healthy years of life lost due to disability (YLD), and converted into a reasonable monetary equivalent.

The results of the study indicate that sight loss and blindness in the adult population places a large economic cost on the UK, totalling £28.1 billion in 2013. Direct health care system costs amount to £2.99 billion, of which inpatient and day case costs amount to £735 million (24.6%) and outpatient costs amount to £771 million (or 25.8%). Together, inpatient and day case costs, and outpatient costs account for 50% of all direct costs, with AMD accounting for 40% of this. Indirect costs amount to £5.65 billion. In addition, the loss of healthy life and the loss of life due to premature death associated with sight loss and blindness also impose a cost on society through a reduction in the stock of health capital. This reduction was estimated at £19.47 billion in 2013. A detailed breakdown of direct and indirect costs, and the reduction in the stock of health capital associated with the burden of disease is shown in Table i. It is not surprising that England has the highest costs (84% of the total), given its population size.

Table i: Summary of prevalence and costs associated with sight loss and blindness in UK adults 2013

	England	*Wales*	*Scotland*	*Northern Ireland*	*UK*
Total Prevalence	**1,622,266**	**101,050**	**160,549**	**48,240**	**1,932,105**
Direct costs	*£ million*	*£ million*	*£ million*	*£ million*	*£ million*
Hospital recurrent expenditure	588.9	44.7	85.9	15.3	734.9
Non-admitted expenditure	673.8	33.7	47.3	16.3	771.1
Prescribing expenditure*	321.9	20.6	29.3	9.1	380.9
General ophthalmic services (GOS)	481.1	32.3	80.9	20.2	614.6
Expenditure associated with injurious falls	19.9	1.0	2.0	0.6	23.4
Research and development	14.1	0.5	2.1	0.3	17.0
Residential care and community care services	220.8	13.2	31.7	11.0	276.8
Capital and administration	145.7	5.1	12.8	7.1	170.7
Total – Direct costs	**2,466.1**	**151.1**	**292.1**	**80.1**	**2,989.3**
Indirect costs					
Lower employment	2,078.5	88.0	210.9	50.0	2,427.4
Absenteeism	65.6	3.7	6.5	1.9	77.6
Premature mortality	1.8	0.1	0.2	0.1	2.1
Informal care costs	1,951.9	134.8	194.8	76.7	2,358.2
Devices and modifications	343.8	21.5	34.1	10.2	409.6
Deadweight loss	311.8	19.8	37.0	10.3	379.0
Total – Indirect costs	**4,753.3**	**267.8**	**483.6**	**149.2**	**5,653.9**
Burden of disease costs					
Years of life lost due to morbidity	15,318.2	959.5	1,513.0	451.5	18,242.3
Years of life lost due to premature death	1,030.3	64.4	101.6	28.2	1,224.3
Total – Burden of disease costs	**16,348.5**	**1,023.8**	**1,614.6**	**479.6**	**19,466.6**
Total –Costs	**23,567.9**	**1,442.8**	**2,390.2**	**708.9**	**28,109.8**

Note: * Includes the cost Lucentis.

Source: Deloitte Access Economics calculations

Compared with the findings in the 2009 Access Economics report, the number of people with sight loss and blindness in the UK has increased by 135,115 (i.e. 7.5%), primarily due to changes in demographics and population size. Total costs (including burden of disease) have also increased by approximately 27.8% during the same period.

It is worth highlighting that the findings from Deloitte Access Economics (2013), *The economic cost and burden of eye diseases and preventable blindness in the UK*, are naturally lower than those estimated in this report due to differences in the eye conditions covered,

definitions of blindness and cost components included. The coverage in this report is much broader, as it includes the costs of sight loss as well as of blindness, and the definition of blindness in this report is based on best-corrected visual acuity of <6/60, while Deloitte Access Economics (2013) was based on best-corrected visual acuity of <3/60. Finally, in this report, more cost components such as costs associated with research and development, devices and modifications and deadweight losses were included.

1 Background

In 2008, Deloitte Access Economics was commissioned by the Royal National Institute of Blind People (RNIB) to undertake an economic impact analysis estimating the prevalence, direct and indirect costs, and burden of disease associated with sight loss and blindness in the UK adult population. This report updates the analysis to reflect the results for the year 2013 using similar methods and data sources, where appropriate.

The report is structured as follows.

- Chapter 2 estimates prevalence of sight loss and blindness in the UK adult population by age, gender, ethnicity, severity, regions and countries, and major cause in 2013, and provides future projections by decade to the year 2050.
- Chapter 3 presents the direct health care system costs of sight loss and blindness in the UK, disaggregated by cost components (hospital, non-admitted, prescribing in primary care, ophthalmic services, research and development, residential care and community care, capital and administration) for the year 2013.
- Chapter 4 calculates the indirect costs of sight loss and blindness in the UK, disaggregated by cost components (including productivity losses, informal care costs, community care costs, and the deadweight losses associated with transfer payments), for the year 2013.
- Chapter 5 estimates the burden of disease of sight loss and blindness in the UK, measured in terms of disability adjusted life years (DALYs), disaggregated by years of life lost due to premature death (YLL) and healthy years of life lost due to disability (YLD), and converted into a monetary equivalent for the year 2013.
- Chapter 6 provides a comparison of current cost estimates (i.e. 2013) with previous estimates (i.e. 2008), and with another recent report from Deloitte Access Economics (2013), *The economic cost and burden of eye diseases and preventable blindness in the UK*, which had a different focus and purpose.
- Chapter 7 provides conclusions.

All monetary values presented in this report are in Sterling and 2013 prices[1], unless otherwise stated.

1.1 Definitions of sight loss and blindness

Sight loss and blindness can be broadly defined as a limitation in one or more functions of the eye or visual system, most commonly impairment of visual acuity (sharpness or clarity of vision), visual fields (the ability to detect objects to either side or above or below the direction in which the person is looking), contrast sensitivity and colour vision.

Normal vision is recorded as 20/20 in Imperial measures (6/6 in metric), which means that a person can see at 20 feet (6 metres) what a person with normal vision can see at

[1] Where relevant , all costs in this report have been converted to 2013 prices using the consumer price index (CPI) derived from http://www.statistics.gov.uk/statbase/tsdataset.asp?vlnk=7174&More=N&All=Y (accessed 27 May 2014)

20 feet. Degrees of sight loss and blindness are measured similarly, where the first number in the measure is the furthermost distance at which the person can clearly see an object and the second number is the distance at which a person with normal vision could see the same object. For example, 20/40 vision means that the person can clearly see at 20 feet (but not more) an object that a person with normal vision could see at 40 feet (but not more).

Sight loss and blindness can differ from one eye to the other (when vision remains good in one eye). As a result, prevalence rates can be reported for either the better or the worse eye in terms of the extent of sight loss. Asymmetrical sight loss, however, has little impact on function or disability and indeed, the visual function is determined by the vision of the better eye, and often it is only when sight loss becomes bilateral that it is identified and treated.

When reporting prevalence rates, better eye measures would provide conservative estimates while worse eye measures may tend to overstate sight loss and costs. In this study, the conservative approach has been adopted to report sight loss and blindness prevalence for the better eye.

The legal definition of sight loss varies internationally, however it is generally accepted that sight loss refers to best-corrected visual acuity of <6/12 in developed countries (Dandona and Dandona, 2006; Taylor et al, 2005; Congdon et al, 2004). Common definitions for visual acuity used in the UK and in this report are as follows:

- Blindness (severe sight loss) is defined as best-corrected visual acuity of <6/60 in the better-seeing eye.
- Sight loss is defined as best-corrected visual acuity of <6/12 to 6/60 in the better-seeing eye, and is categorised as:
  - Low vision – best-corrected visual acuity of <6/12 but better than or equal to 6/18; and
  - Partial sight – best-corrected visual acuity of <6/18 but better than or equal to 6/60.

1.2 Conditions leading to sight loss and blindness

Within this study five leading causes of sight loss and blindness were investigated, including age-related macular degeneration (AMD), cataract, diabetic retinopathy (DR), glaucoma, and refractive error (RE). The prevalence of sight loss and blindness from all other causes was also calculated as the residual from total sight loss and blindness minus the five leading causes of sight loss and blindness.

1.2.1 Age-related macular degeneration (AMD)

AMD is an incurable eye disease and a leading cause of blindness in elderly people in developed economies. AMD occurs with degeneration of the macula, which is the part of the retina that enables central vision and seeing fine detail. Damage to the macula is characterised by central vision loss.

In “early AMD,” small yellow deposits called drusen form under the macula. Vision is usually lost with more advanced stages of AMD. There are two types of “late AMD”.

- Dry (geographic/atrophic): In around one third of cases of late AMD, the macula thins. Vision loss is directly related to the location and amount of retinal thinning, but the progress of dry AMD is slower than that of the "wet" type. There is no known treatment or cure for the "dry" type of AMD.
- Wet (exudative/neovascular): Two thirds of those with late AMD have this type. Abnormal blood vessels grow under the retina and macula; these vessels bleed and leak fluid, causing the macula to bulge or lift up. The abnormal creation of new blood vessels is due to the protein called vascular endothelial growth factor (VEGF). Vision loss may be rapid and severe. Anti-VEGF treatments injected into the eye may stop the progression of the disease and in some instances improve vision over time provided the condition is detected early enough. Anti-VEGF drugs include the brands Lucentis, Eylea, Avastin and Regeneron. Upon injection, a portion of an antibody is released that binds and inhibits the VEGF protein. This helps slow the overproduction of blood vessels and the resultant blood vessel leakage. Treatment generally requires one injection per month for three months, although further injections are possible.

Risks of AMD include smoking, age and a genetic component, with family history increasing the risk of AMD three to four times – in fact genetic factors now explain around 75% of AMD. In most cases there is no effective prevention of, or treatment for, AMD. Because AMD is painless, usually progressing slowly and generally in one eye first, it may be difficult to self-detect in the initial stages (Access Economics, 2006; Access Economics, 2009; Deloitte Access Economics, 2011; Deloitte Access Economics; 2013).

1.2.2 Cataract

A cataract is a clouding of the eye's natural lens. The lens is mostly made of water and protein and the protein is arranged in a precise way that keeps the lens clear and allows light to pass through it. However, some of the protein may clump together and start to scatter light and cloud a small area of the lens forming a cataract. Over time, the cataract may grow larger and cloud more of the lens, making it hard to see. The most common symptoms are blurry vision, problems with light, 'faded' colours, double or multiple vision and the need for frequent changes in glasses or contact lenses.

The four main types of cataract are age-related (most common), congenital, secondary (following intravascular inflammation systemic disease or steroid use) and traumatic (e.g., due to eye injury). Causes of age-related cataract include hereditary factors, age, smoking, diabetes and ultraviolet (UV) exposure. 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).

Cataract surgery may be recommended to improve vision, with the cloudy lens removed and replaced with a substitute lens. Surgery is safe and very effective, with almost all people having better vision and improved quality of life afterward, and only a small percentage experiencing complications such as infection, bleeding or inflammation. Cataract surgery is generally performed as same-day surgery without general anaesthetic, with a six week total recovery period. Recent advances in intraocular lenses potentially reduce the need for glasses post-surgery, by creating a lens that duplicates the function and quality of the eye's natural lens.

1.2.3 Diabetic retinopathy (DR)

DR is a complication of diabetes mellitus, usually affecting both eyes, wherein microaneurysms develop on the tiny blood vessels inside the retina. As the disease progresses, some blood vessels that nourish the retina are blocked, causing vision loss through either proliferative retinopathy or macular oedema.

DR often has no early symptoms. Sometimes the person sees specks of blood, or spots, "floating" in their vision. Diagnosis can be made via a visual acuity test (eye chart test), dilated eye examination, retinal photography and/or fluorescein angiogram. Macular oedema is treated with intravitreal steroids and newer anti-VEGF therapies are also being used. Anti-VEGF therapies work to reduce neovascularisation by halting the effects of the VEGF protein and potentially reducing vessel leakage. This can slow and possibly reverse sight loss in some instances. The treatment protocol is similar to the Anti-VEGF treatment for AMD discussed in section 1.2.1. The recent move to using anti-VEGF therapies as opposed to laser treatment or vitrectomy has seen an overall improvement in the management and treatment of DR.

Proliferative retinopathy is retarded with peripheral scatter laser surgery (pan-retinal photocoagulation) that, while it can worsen peripheral, colour and/or night vision, can save the rest of a person's sight. As with macular oedema, anti-VEGF therapies have been used with some success in slowing and reversing sight loss, although this treatment method is still evolving (Osaadon et al, 2014). If bleeding is severe and persistent, a vitrectomy may be necessary, where blood and gel are removed from the centre of the eye and replaced with a salt solution, under local or general anaesthetic.

Although both laser treatment and vitrectomy can effectively retard vision loss they do not cure DR, and the patient remains at risk for new bleeding. Multiple treatments may be necessary. People with diabetes can delay and possibly prevent the onset and progression of DR (and the need for surgery) by controlling their levels of blood sugar, blood pressure and blood cholesterol. Early diagnosis and treatment can prevent up to 98% of blindness (Access Economics, 2004; Access Economics, 2009; Centre for Eye Research Australia; 2014) and the earlier treatment is received the more likely it is to be effective.

1.2.4 Glaucoma

Glaucoma is a group of diseases that, while initially asymptomatic, can damage the eye's optic nerve and result in blindness. The optic nerve comprises nerve fibres that connect 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.

Primary 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 lead to damage of the optic nerve and cause vision loss. Although people can see objects clearly in front of them, they miss things to the side and out of the corner of their eye. Peripheral vision may deteriorate without treatment, like looking through a tunnel, until there is no vision left. Other less common types of glaucoma include the following.

- **Closed-angle glaucoma**, in which the fluid at the front of the eye is blocked from reaching the angle, resulting in a sudden increase in pressure, pain, redness and blurred vision. Immediate (medical emergency) laser surgery is required to clear the blockage and protect sight.
- **Congenital glaucoma,** occurring in children born with defects in the angle of the eye that slow fluid drainage, causing cloudy eyes, sensitivity to light and excessive tearing. Prompt surgery provides an excellent chance of saving vision.
- **Secondary glaucoma,** which develops as a complication of other medical conditions, such as surgery, advanced cataract, eye injuries, certain eye tumours, uveitis (eye inflammation), diabetes or the use of corticosteroid drugs. Treatment includes medicines and laser or conventional surgery.

Increased risk for glaucoma occurs with age, family history and race. Glaucoma is detected through an eye examination including visual acuity, visual field, tonometry and optic nerve examination. Although there is no cure for glaucoma, early diagnosis and treatment may help protect eyes against serious vision loss and blindness. Some of these include the following.

- **Medicine** (very common) – eye drops and/or pills taken several times a day can lower pressure by helping fluid drain from the eye or causing the eye to make less fluid. Rare side effects include headaches or eye irritation.
- **Laser surgery** (laser trabeculoplasty) – helps fluid drain from the eye by burning holes in the meshwork with a high-energy light beam. The effects of laser surgery wear off so that, after two years, the pressure increases again in more than half of all patients. Repeating laser surgery is often not useful.
- **Filtration surgery** – can make a new opening for the fluid to leave the eye. Such surgeries are often performed after medicine and laser surgery have failed to control pressure. Surgery is around 80 to 90% effective at lowering pressure. However, if the new drainage opening closes, a second operation may be needed. Conventional surgery works best in the absence of other previous eye surgery.

Newer treatment options for glaucoma include the potential to incorporate a probe-like device, called a Trabectome, which would act as a means of providing drainage and energy to the trabecular meshwork of the eye. Other options to lower intraocular pressure include Canaloplasty or the insertion of a mini glaucoma shunt. Canaloplasty refers to clearing the drainage canal, while the mini glaucoma shunt acts to divert aqueous humour from the anterior chamber.

Possible side effects of glaucoma surgery include cataract, inflammation or infection inside the eye, and swelling of blood vessels behind the eye – all of which are treatable. In some cases, vision may worsen after surgery.

1.2.5 Refractive error (RE)

It is important to distinguish between sight loss caused by under-corrected RE that is easily reversed with the appropriate correction (spectacles or contact lenses) and sight loss from pathologic myopia.

- Under-corrected REs (such as myopia and hyperopia) occur when optical defects result in light not focusing properly on the retina. In most cases this sight loss due to RE can be easily corrected by eye glasses or contact lenses.
- Pathologic myopia is quite different from uncorrected myopia. Pathologic myopia occurs in extreme short-sightedness that is associated with major lengthening and

elongation of the eyeball. This is associated with degenerative changes in the macula and at times with retinal detachment. Each of these changes can result in profound sight loss (including blindness) that will not be corrected with refraction. There have been recent advances in the treatment of pathologic myopia with the development of Visudyne (photodynamic therapy) as an injection. Anti-VEGFs are also used to treat choroidal neovascularisation in pathological myopia, and have been shown to have promising results in clinical trials (Zhu et al, 2013).

1.2.6 Other causes of vision loss

Less common conditions such as neuro-ophthalmic disorders (main disorders in children), retinitis pigmentosa and other retinal conditions account for the remaining prevalence of sight loss and blindness.

While these conditions are less well known, inherited retinal disorders are now the largest cause of sight loss certification in working age people in England and Wales. There is no specific cure or treatment for inherited retinal disorders, although emerging technologies include medical devices such as retinal implants, pharmacological drugs and cell therapies which regenerate photoreceptors and retinal neurons (NIHR Horizon Scanning Centre, 2014).

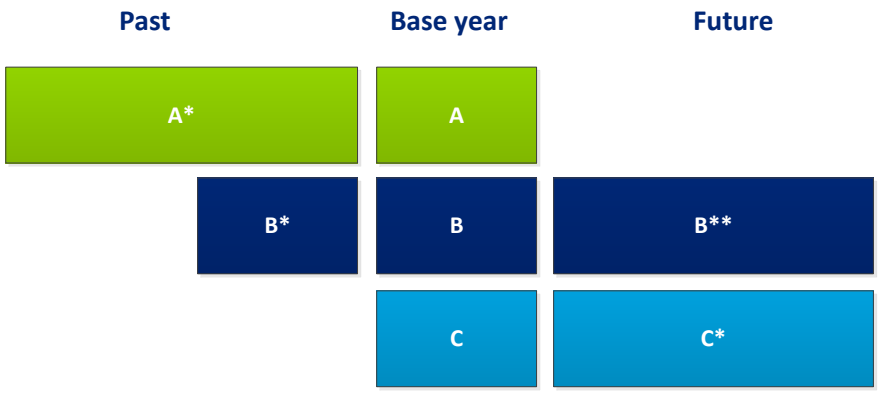
2 Prevalence of sight loss and blindness

The costing methodology used in this study is based on a prevalence approach to cost measurement, as the data sources lend themselves to utilisation of such an approach. This methodology also avoids the uncertainty surrounding estimates of future treatment costs associated with an incidence approach.

Prevalence approaches measure the number of people with a given condition (in this case sight loss and blindness) in a base period (in this case calendar year 2013) and the costs associated with treating them, as well as other financial and non-financial costs (productivity losses, carer burden, loss of quality of life) in that year, due to the condition.

Figure 2.1 depicts the difference between a prevalence approach (areas A+B+C in Figure 2.1) and an incidence approach, the latter estimating the present value of the lifetime costs of new cases of sight loss and blindness in 2013 (area C plus the present value of C* in Figure 2.1). Consider person A, who first experienced sight loss and its impacts in 1996 and continued to experience them until death in 2013. This person would be included in a prevalence approach (but not in an incidence approach), although only the costs incurred in 2013 would be included (i.e., A but not A*, where A includes the present value of premature mortality costs if the death was premature). Person B developed sight loss during the late 1990s and experiences sight loss and its impacts through to 2020 (with costs of B+B*+B**); she also would be counted (but only costs of B) using a prevalence approach, but not using an incidence approach. Person C is newly diagnosed with sight loss in 2013 and his costs in 2013 (C) would be included in a prevalence approach but not future costs (C*).

Figure 2.1: Incidence and prevalence approaches to measurement of costs



Annual prevalence costs in the base year = Σ(A + B + C);
Annual incidence costs in the base year = Σ(C + present value of C*)

In this study, prevalence of sight loss and blindness was calculated by multiplying population data by prevalence rates for the six key causes of sight loss and blindness (AMD, cataract, DR, glaucoma, RE, and other). This was stratified by age, gender,

ethnicity, severity. An overview of the methodology used to construct and project the population data is provided below, along with an overview of the prevalence rates for each major condition.

2.1 Population data

Population estimates for England regions, UK countries and the total UK population were required for 2013, split by five-year age cohorts, gender and five ethnic groups – White, Black, Asian, Mixed and Other. Population projections for the total UK population were also required for 2020, 2030, 2040 and 2050.

2.1.1 England regions

Population by age cohorts, ethnicity and gender was estimated for nine England regions in 2013. The regions comprised:

- North East;
- North West;
- Yorkshire and Humberside;
- East Midlands;
- West Midlands;
- East;
- South East;
- South West; and
- London.

Total population for each region by age cohorts and gender for 2013 were derived from 2010-based sub-national population projections for government office regions developed by the Office of National Statistics (ONS, 2012). As these projections only relate to the total population they were split by ethnicity to meet the needs of this study.

Ethnicity population by five year age cohorts and gender for each region were derived from the 2011 Census. Ethnic proportions for each region were applied to the total population projections for 2013. This method implicitly assumes that the composition of ethnicity within each region has not changed significantly between 2011 and 2013. It is not expected that any changes will have a significant impact on the final sight loss and blindness results. Table 2.1 shows the projected regional population by ethnicity for 2013.

Table 2.1: Projected regional population by ethnicity, 2013

	White	Black	Asian	Mixed	Other	Total
	'000	*'000*	*'000*	*'000*	*'000*	*'000*
North East	2,506.5	13.4	60.9	22.7	25.9	2,629.4
North West	6,410.9	98.2	391.6	111.7	93.2	7,105.6
Yorkshire	4,773.9	81.5	363.6	85.9	71.3	5,376.1
East Midlands	4,151.5	83.1	275.2	88.1	51.7	4,649.5
West Midlands	4,786.3	163.2	513.7	118.5	56.3	5,637.9
East	5,430.4	118.8	248.2	114.0	63.0	5,974.4
London	5,012.7	1,110.2	1,413.1	410.5	412.4	8,359.0
South East	7,923.6	135.6	398.0	168.3	104.0	8,729.5
South West	5,137.5	49.9	83.7	72.9	38.2	5,382.2
	%	%	%	%	%	%
North East	95.3	0.5	2.3	0.9	1.0	100.0
North West	90.2	1.4	5.5	1.6	1.3	100.0
Yorkshire	88.8	1.5	6.8	1.6	1.3	100.0
East Midlands	89.3	1.8	5.9	1.9	1.1	100.0
West Midlands	84.9	2.9	9.1	2.1	1.0	100.0
East	90.9	2.0	4.2	1.9	1.1	100.0
London	60.0	13.3	16.9	4.9	4.9	100.0
South East	90.8	1.6	4.6	1.9	1.2	100.0
South West	95.5	0.9	1.6	1.4	0.7	100.0

Source: Deloitte Access Economics calculations.

2.1.2 Devolved nations

Population for 2013 by age cohorts, ethnicity and gender were estimated for the four UK countries – England, Scotland, Northern Ireland and Wales. Total population estimates for 2013 were derived from the 2012-based national population projections developed by the ONS and needed to be split by ethnicity.

Ethnic population estimates for England, its regions, and Wales were calculated from 2011 census in the UK, published by the ONS. To determine the ethnic splits by five year age cohorts and gender for Scotland and Northern Ireland, 2011 census data were collected from the National Records for Scotland (NRS) and the Northern Ireland Statistics and Research Agency (NISRA) respectively. The ethnic group splits were applied to the total population projections for 2013.Table 2.2 shows the projected UK devolved nations populations by ethnicity for 2013. Most of the UK minority ethnic population reside in England (which is primarily concentrated in and around London) while Wales, Scotland and Northern Ireland have a relatively small proportion.

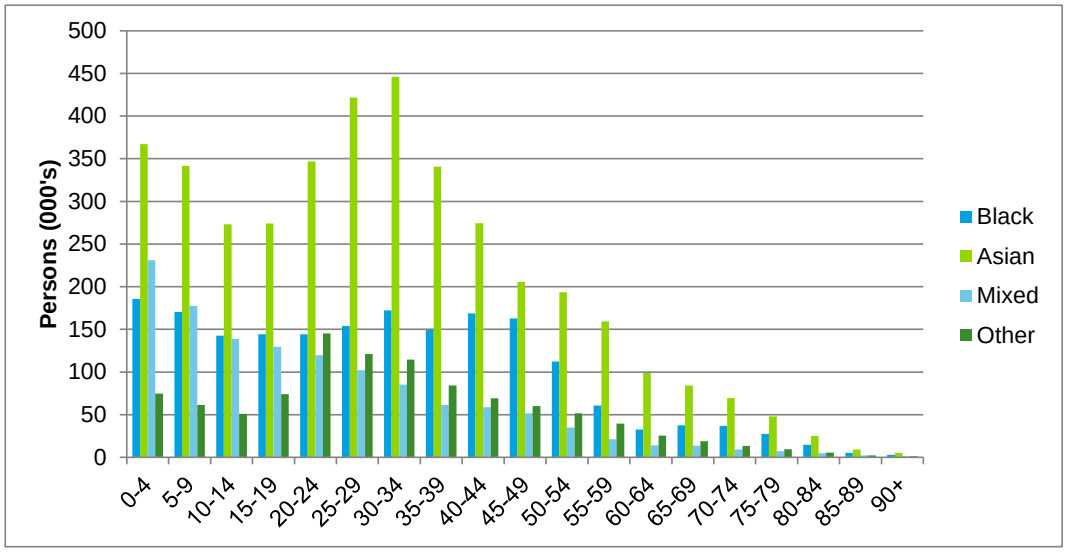
Table 2.2: Projected UK country population by ethnicity, 2013

	White	Black	Asian	Mixed	Other	Total
	'000	*'000*	*'000*	*'000*	*'000*	*'000*
England	46,133.2	1,853.8	3,748.1	1,192.6	915.9	53,843.6
Scotland	5,116.5	36.2	107.1	19.8	48.3	5,327.9
Wales	2,947.9	18.3	56.5	31.6	29.1	3,083.3
N.I.	1,801.2	3.6	12.8	6.0	8.7	1,832.3
	%	%	%	%	%	%
England	85.7	3.4	7.0	2.2	1.7	100.0
Scotland	96.0	0.7	2.0	0.4	0.9	100.0
Wales	95.6	0.6	1.8	1.0	0.9	100.0
N.I.	98.3	0.2	0.7	0.3	0.5	100.0
UK	55,998.8	1,911.9	3,924.5	1,250.0	1,002.0	64,087.1

Source: Deloitte Access Economics calculations.

Age distribution of the minority ethnic population in the UK is shown in Figure 2.2. The distribution of a relatively younger population is expected given the waves of alternative ethnicities entering into the UK since the New Commonwealth immigration started in the 1950s. For example, the Black population has a relatively larger proportion of individuals that are above 65 years of age, reflecting the wave of this ethnic group into the UK in the 1950s and early 1960s. Also, the age structure of the Mixed ethnic group is skewed towards the young, which is a reflection of increased integration between white and minority ethnic populations.

Figure 2.2: Age distribution of projected minority ethnic population in the UK, 2013



Source: Deloitte Access Economics calculations.

2.1.3 Long term UK population projections

Long term UK population projections are also required in order to estimate the future prevalence of sight loss and blindness within the UK. Population projections of the UK population for 2020, 2030, 2040 and 2050 by age and five year age cohorts were derived from the ONS (ONS, 2013a) using the 2012-based principal projections. Unfortunately these projections do not include ethnic splits.

Over the long term there is expected to be a significant change in the ethnic composition of the UK population. For example, between 1991 and 2011 the proportion of foreign born people in the UK increased from 7% to 13% of the population (ONS, 2012a). In addition, the ONS predicts that net migration between mid-2012 and mid-2037 will be around 5.8 million migrants, or around 60% of the projected population growth (ONS, 2013a). It is expected that the net migration will comprise British citizens dominating emigration and non-British citizens dominating immigration.

Methodological issues in developing ethnic population projections have been debated in the UK for many years, starting with a comprehensive feasibility study by the ONS that consulted government departments and a wide range of academic specialists (ONS, 2002).[2] Since then there have been a small number of local authorities that have estimated ethnic populations. For example, the Greater London Authority (GLA, 2012) has developed a multi-borough projection model that used hospital episode data to estimate fertility rates, Census data for inter-borough migration by ethnic group, and incorporated housing capacity constraints. GLA estimated the ethnic group population across London, between 2011 and 2041, by single year of age, sex and ethnic group. Key inputs used in the model include data tables from the ONS 2011 census (GLA, 2014).

There are two academic groups within the UK that have also developed ethnic projections for the UK. Coleman (2010) from the Oxford Centre for Population Research has undertaken ethnic population projections for England and Wales across 12 ethnic groups. Coleman predicted that minority ethnic populations would increase from 13% of the population in 2006 to 43% of the population by 2056.

Rees et al (2012) of the University of Leeds projected the total population for the UK from 2001 to 2051. The projections included segregation by 16 ethnic groups and factors such as fertility rates, survival probabilities, internal migration probabilities and international migration flows were taken into consideration. They found that the ethnic minority share of the population would increase from 13% in 2001 to between 20 and 25% by 2051. However, projections by age groups and by gender were not publicly available for use in this report.

Consequently, for the purpose of this study, the GLA projections were utilised as the projections were considered the most comprehensive among publicly available data. Since GLA only projected the population to 2041, the average growth rates for the period between 2013 and 2041 were assumed to apply for the period between 2041 and 2051. The growth rates were calculated for each ethnic group and by five-year age groups. The growth rates were then applied to the base population for each country to determine the ethnic splits by age groups. Adjustments were applied to ensure the total

[2] The ONS now publishes a methodology paper on estimating ethnic group populations. However, at present, projections by ethnic group are not yet available (ONS, 2011).

UK population summed from the components agreed with the 2020 overall population estimate for instance. This was done for each time period to 2050.[3]

Table 2.3 outlines the projected population for each country by ethnicity between the years 2013 and 2050.

Table 2.3: Projected UK country population by ethnicity, 2013-2050

	White	Black	Asian	Mixed	Other	Total
	'000	*'000*	*'000*	*'000*	*'000*	*'000*
UK						
2013	55,889.7	1,925.3	3,983.9	1,264.7	1,023.5	64,087.1
2020	57,511.4	2,151.3	4,576.7	1,628.7	1,257.9	67,125.8
2030	60,006.0	2,398.1	5,173.1	1,970.5	1,489.8	71,037.5
2040	62,352.0	2,586.5	5,648.1	2,205.2	1,657.8	74,449.5
2050	63,164.5	2,924.4	6,455.2	2,709.4	1,981.0	77,234.5
	%	%	%	%	%	%
2013	87.2	3.0	6.2	2.0	1.6	100.0
2020	85.7	3.2	6.8	2.4	1.9	100.0
2030	84.5	3.4	7.3	2.8	2.1	100.0
2040	83.8	3.5	7.6	3.0	2.2	100.0
2050	81.8	3.8	8.4	3.5	2.6	100.0
England						
2013	46,024.2	1,867.2	3,807.4	1,207.3	937.5	53,843.6
2020	47,408.8	2,086.8	4,376.9	1,554.8	1,154.7	56,582.1
2030	49,571.2	2,329.5	4,953.4	1,881.3	1,371.1	60,106.5
2040	51,696.0	2,516.1	5,416.9	2,106.6	1,529.0	63,264.6
2050	52,422.5	2,846.9	6,196.1	2,587.9	1,829.4	65,882.9
	%	%	%	%	%	%
2013	85.5	3.5	7.1	2.2	1.7	100.0
2020	83.8	3.7	7.7	2.7	2.0	100.0
2030	82.5	3.9	8.2	3.1	2.3	100.0
2040	81.7	4.0	8.6	3.3	2.4	100.0
2050	79.6	4.3	9.4	3.9	2.8	100.0
Wales						
2013	2,947.9	18.3	56.5	31.6	29.1	3,083.3
2020	3,008.6	20.3	64.1	40.8	35.2	3,168.9
2030	3,092.1	22.1	70.7	49.9	40.5	3,275.2
2040	3,144.4	23.4	74.0	56.0	43.7	3,341.6

[3] ONS population projections past 2041 are in five year brackets up to 2081. Consequently projections for 2041 were used for 2040 and projections for 2051 were used for 2050. It is not expected that there would be a significant difference between adjoining years given the uncertainty in population projections produced by ONS.

	White	Black	Asian	Mixed	Other	Total
2050	3,157.4	26.1	82.4	69.7	51.2	3,386.8
	%	%	%	%	%	%
2013	95.6	0.6	1.8	1.0	0.9	100.0
2020	94.9	0.6	2.0	1.3	1.1	100.0
2030	94.4	0.7	2.2	1.5	1.2	100.0
2040	94.1	0.7	2.2	1.7	1.3	100.0
2050	93.2	0.8	2.4	2.1	1.5	100.0
Scotland						
2013	5,116.5	36.2	107.1	19.8	48.3	5,327.9
2020	5,230.8	40.1	120.9	25.4	57.2	5,474.4
2030	5,409.5	42.3	133.4	30.5	65.4	5,681.1
2041	5,536.9	42.9	141.2	33.3	71.2	5,825.5
2051	5,595.3	46.9	158.8	40.7	83.6	5,925.3
	%	%	%	%	%	%
2013	96.0	0.7	2.0	0.4	0.9	100.0
2020	95.5	0.7	2.2	0.5	1.0	100.0
2030	95.2	0.7	2.3	0.5	1.2	100.0
2040	95.0	0.7	2.4	0.6	1.2	100.0
2050	94.4	0.8	2.7	0.7	1.4	100.0
Northern Ireland						
2013	1,801.2	3.6	12.8	6.0	8.7	1,832.3
2020	1,863.1	4.0	14.8	7.7	10.8	1,900.4
2030	1,933.2	4.1	15.6	8.8	12.8	1,974.6
2040	1,974.6	4.1	16.0	9.2	13.9	2,017.9
2050	1,989.2	4.5	18.0	11.0	16.7	2,039.4
	%	%	%	%	%	%
2013	98.3	0.2	0.7	0.3	0.5	100.0
2020	98.0	0.2	0.8	0.4	0.6	100.0
2030	97.9	0.2	0.8	0.4	0.6	100.0
2040	97.9	0.2	0.8	0.5	0.7	100.0
2050	97.5	0.2	0.9	0.5	0.8	100.0

Source: Deloitte Access Economics calculations.

2.2 Prevalence rates by age, gender, ethnicity, severity and region and country

A variety of data sources were utilised to estimate prevalence of sight loss and blindness by age, gender, ethnicity, region, severity and major cause. Ethnicity groupings were defined as per the population data, although 'mixed' and 'other' were combined into a single grouping 'other'. Regions were also defined as per the population categories – the four UK countries and, within England, the nine English regions. Severity groupings

were low vision (<6/12-6/18), partial sight (<6/18-6/60) and blindness (<6/60). Major causes were categorised into the six groups of AMD, cataract, DR, glaucoma, RE and other.

2.2.1 Sight loss and blindness in people aged 75 years and older

Similarly to Access Economics (2009), total sight loss and blindness data were derived from data from Evans et al (2002), who estimated the prevalence of sight loss and blindness in people aged 75 years and older in Britain using the MRC trial of assessment and management of older people in the community. In this trial, data were obtained from 14,600 participants aged 75 years and older. Sight loss and blindness overall was defined as VA <6/18, low vision as VA <6/18 to 3/60, and blindness as VA <3/60. The prevalence of VA <6/12 was also presented for comparison with other studies.

Evans et al (2002) showed rates of Sight loss and blindness increasing from 10.8% in those aged 75-79 years up to 53.1% in those aged 90 years and older. Their results have been reproduced in Table 2.4.

Table 2.4: Prevalence of sight loss and blindness for the UK population 75 years and older (binocular visual acuity <6/18)

Age	Number	Prevalence	95% CI
All Ages			
Total	14,600	19.9	17.8 to 22.0
Men	5,620	15.2	13.5 to 16.9
Women	8,980	22.8	20.3 to 25.3
Men and women			
75-79	6,898	10.8	9.1 to 12.6
80-84	4,602	20.0	17.6 to 22.4
85-89	2,319	35.3	31.7 to 38.8
90 plus	781	53.1	48.3 to 57.9
Men			
75-79	2,961	8.9	7.1 to 10.7
80-84	1,695	16.3	14.3 to 18.4
85-89	782	30.2	25.9 to 34.5
90-94	182	42.3	34.5 to 50.1
Women			
75-79	3,937	12.3	10.4 to 14.2
80-84	2,907	22.1	19.0 to 25.2
85-89	1,537	37.9	33.9 to 41.8
90-94	599	56.4	51.0 to 61.9

Source: Evans et al (2002).

Disaggregation by cause and severity

Evans et al (2004a) reported that, of the sub-group of 1,742 people with sight loss (<6/12) in the participating practices, 450 (26%) achieved a pinhole VA in either eye of 6/18 or better. In these people, the principal reason for visual loss was considered to be refractive error, and this is important for the modelling. The cause of visual loss was

available for 976 (76%) of the remaining 1,292 people with sight loss identified (<6/18). Apart from the 'big five' diseases, 'other' major causes of sight loss and blindness identified were vascular occlusions and myopic degeneration.

Causes of sight loss and blindness by age and gender as published in Evans et al (2004a) are shown in Table 2.5, Table 2.6, and Table 2.7. These shares were used, together with the overall prevalence of sight loss and blindness from Table 2.4, to estimate prevalence of sight loss and blindness by age, gender and major cause in those aged 75 years and older. The raw rates were adjusted downwards to account for comorbidities, because overall sight loss from the 'big five' and 'other' eye diseases cannot exceed 100% but need to be 'attributed' (eg, 90+ women in Table 2.6 for the major five causes are 20%+54%+24%+7%+1%>100%). 'Other' represented 7.4% after factoring down for comorbidities.

Table 2.5: Causes of sight loss and blindness (binocular visual acuity <6/18)

Cause	No	Binocular sight loss and blindness		Binocular sight loss and blindness, excl. refractive error		Everyone aged 75 years and older	
		%	*95% CI*	*%*	*95% CI*	*%*	*95% CI*
Refractive error	450	31.6	28.3 to 34.8	-	-	3.2	2.6 to 3.8
AMD	516	36.2	32.9 to 39.5	52.9	49.2 to 56.5	3.7	3.2 to 4.2
Cataract	350	24.5	21.8 to 27.4	35.9	31.7 to 40.1	2.5	2.0 to 3.0
Glaucoma	113	7.9	6.2 to 9.6	11.6	9.1 to 14.0	0.8	0.6 to 1.0
Diabetic eye disease	33	2.3	1.5 to 3.1	3.4	2.2 to 4.6	0.2	0.15 to 0.32
Vascular occlusions	9	0.6	0.1 to 1.1	0.9	0.2 to 1.6	0.06	0.01 to 0.11
Myopic degeneration	41	2.9	1.9 to 3.8	4.2	2.8 to 5.6	0.3	0.2 to 0.4
Other	67	4.7	3.7 to 5.7	6.9	5.5 to 8.2	0.5	0.4 to 0.6

Note: Refractive error = people with pinhole corrected vision in right or left eye 6/18 or better; no cause was established in 316 people; total is more than 100% as 16% of people had more than one cause of visual loss. AMD = age related macular degeneration.

Source: Evans et al (2004a).

Table 2.6: Causes of sight loss and blindness by age and sex (binocular visual acuity <6/18)

	No in group	% attributed to				
		Refractive error	AMD	Cataract	Glaucoma	Diabetes
Men						
75-79	113	40.7	23.0	17.7	9.7	8.0
80-84	141	32.6	33.3	19.2	12.1	5.0
85-89	120	33.3	37.5	28.3	10.8	0.8
90+	36	22.2	55.6	33.3	2.8	0
Women						
75-79	234	42.3	20.5	24.4	4.7	1.7
80-84	309	34.0	36.3	22.3	7.8	1.6
85-89	311	23.8	42.1	29.6	7.7	1.9
90+	162	19.8	53.7	24.1	7.4	0.6

Source: Evans et al (2004a).

Table 2.7: Causes of sight loss and blindness (binocular visual acuity <6/18)

	No in group	% attributed to				
		Refractive error	AMD	Cataract	Glaucoma	Diabetes
Low vision (<6/18-3/60)						
75-79	312	46.5	18.0	23.7	5.1	2.9
80-84	360	41.7	26.7	25.3	8.1	2.5
85-89	349	32.7	33.5	32.3	7.5	2.0
90+	155	25.8	44.5	30.3	4.5	0.7
Blindness (<3/60)						
75-79	35	0	51.4	8.6	17.1	11.4
80-84	90	1.1	70.0	5.6	13.3	3.3
85-89	82	0	72.0	15.9	13.4	0
90+	43	0	88.4	9.3	14.0	0

Source: Evans et al (2004a).

After allocating these shares across the population for low vision and blindness, taking into account the factoring down for comorbidities and the allocation of the very mild cases to RE, the prevalence of sight loss and blindness by age, gender, cause and severity was estimated as summarised in Table 2.8.

Splits between low vision, partial sight and blindness in Table 2.8 were based on Evans et al (2004a), using the relativities between the <6/18, 6/18-3/60 and <3/60 groups, together with a parameter estimating the proportion of blindness <6/60 relative to all sight loss and blindness (<6/12). This enabled a separation of those with VA<6/60 from those with VA<3/60 and a separation of VA<6/12-6/18. Overall, this parameter was based on two sources.

- Reidy et al (1998) presents results from the North London Eye Study (NLES), which was carried out from April 1995 to October 1996 and included 1,547 people aged 65 years and older of whom 1,459 (94.3%) were white. This study separated sight loss and blindness severity into the three groupings of interest in this report: <6/12-6/18, <6/18-6/60 and worse than 6/60. Population prevalence of bilateral sight loss and blindness (<6/12) was around 30% and 92 of these 448 cases (21%) had VA <6/60 in one or both eyes. This 21% parameter was considered as one bound (the upper[4] bound for the 75+ population of interest) on the proportion of people with VA<6/60 of those with VA<6/12.
- Evans et al (2002) showed blindness measured as <3/60 as 2.1% and sight loss and blindness (<6/12) as 19.9% across the 75+ population. The ratio of these rates was necessarily a lower bound (10.6%).

The average of the two estimates (15.8%) was used as the parameter for blindness as a share of total sight loss in the 75+ age group.

Table 2.8: Sight loss and blindness prevalence (%) by age, gender, cause & severity (75+)

Cause/gender	Age	<6/12	<6/12-6/18	<6/18-6/60	<6/60 (blind)
AMD males	75-79	1.90	0.89	0.26	0.74
	80-84	4.92	2.45	0.68	1.79
	85-89	9.47	4.90	1.45	3.12
	90 and over	19.10	11.73	2.47	4.90
AMD females	75-79	2.33	0.95	0.36	1.03
	80-84	7.28	3.93	0.92	2.42
	85-89	14.06	8.32	1.82	3.92
	90 and over	26.56	16.73	3.29	6.54
Cataract males	75-79	1.46	1.15	0.23	0.08
	80-84	2.84	2.24	0.48	0.11
	85-89	7.15	5.47	1.13	0.56
	90 and over	11.44	9.31	1.63	0.50
Cataract females	75-79	2.78	1.95	0.61	0.22
	80-84	4.47	3.21	1.04	0.23
	85-89	9.88	6.96	1.96	0.96
	90 and over	11.92	8.96	2.27	0.70
Diabetic disease males	75-79	0.66	0.20	0.20	0.26
	80-84	0.74	0.29	0.29	0.15
	85-89	0.20	0.10	0.10	0.00
	90 and over	0.03	0.02	0.02	0.00
Diabetic disease	75-79	0.19	0.04	0.04	0.11

[4] The Reidy et al (1998) data were at the higher end of the data reviewed. For example, Reidy et al (1998) found 30% partial sight and blindness from cataract, while Wormald et al (1992) found 1% in the 65-74 group and 10.4% in the 75+ group.

Cause/gender	Age	<6/12	<6/12-6/18	<6/18-6/60	<6/60 (blind)
females					
	80-84	0.32	0.12	0.12	0.09
	85-89	0.63	0.31	0.31	0.01
	90 and over	0.30	0.15	0.15	0.00
Glaucoma males	75-79	0.80	0.48	0.07	0.25
	80-84	1.79	1.20	0.22	0.37
	85-89	2.73	1.79	0.34	0.60
	90 and over	0.96	0.62	0.08	0.26
Glaucoma females	75-79	0.54	0.21	0.07	0.25
	80-84	1.56	1.05	0.20	0.32
	85-89	2.57	1.68	0.32	0.57
	90 and over	3.66	2.36	0.31	0.98
Refractive error males	75-79	3.43	2.57	0.85	0.01
	80-84	4.81	3.61	1.18	0.02
	85-89	8.41	6.31	2.05	0.05
	90 and over	7.63	5.72	1.86	0.05
Refractive error females	75-79	5.55	4.16	1.37	0.02
	80-84	6.82	5.12	1.67	0.03
	85-89	7.95	5.96	1.94	0.05
	90 and over	9.79	7.34	2.38	0.07
'Other' males	75-79	0.66	0.30	0.30	0.06
	80-84	1.21	0.54	0.54	0.13
	85-89	2.24	0.90	0.90	0.43
	90 and over	3.13	1.09	1.09	0.96
'Other' females	75-79	0.91	0.30	0.30	0.32
	80-84	1.64	0.62	0.62	0.39
	85-89	2.81	1.17	1.17	0.48
	90 and over	4.18	1.78	1.78	0.61
Total males	75-79	8.90	5.59	1.91	1.40
	80-84	16.30	10.33	3.40	2.57
	85-89	30.20	19.46	5.97	4.76
	90 and over	42.30	28.48	7.14	6.67
Total females	75-79	12.30	7.61	2.75	1.94
	80-84	22.10	14.05	4.57	3.49
	85-89	37.90	24.40	7.52	5.98
	90 and over	56.40	37.32	10.18	8.90

Source: Deloitte Access Economics calculations based on Evans et al (2002, 2004a) as well as population projections.

The following sources were also used to refine the splits by severity and type of disease, in particular to smooth prevalence relativities by age.

- AMD - Evans et al (2002)

- Cataracts – Data supplied by A. Reidy (pers. comm) from the NLES
- Glaucoma - Owen et al (2006) and Coffey et al (1993):
  - Owen et al (2006) was based on computerised data (the DIN-LINK database) from 131 general practices across the UK, in which half a million patients aged 40 years or more were registered annually, were used. On average 10,000 patients were treated for glaucoma and ocular hypertension annually.
  - Coffey et al (1993) looked at the prevalence of glaucoma in the west of Ireland.

2.2.2 Sight loss and blindness in people aged under 75 years

A large number of sources were used to estimate sight loss and blindness by age, gender, cause and severity in those aged under 75 years.

65-74 years – total sight loss and blindness

Van der Pols et al (2000) carried out VA measurements in the context of the national diet and nutrition survey (NDNS) of people aged 65 years or over (fieldwork was carried out in 1994-95). VA was measured in 1,362 NDNS participants who were not classified as mentally impaired. Sight loss was measured in 195 (14.3%) subjects with 'low vision' defined by the WHO criteria as VA <6/18 in the better eye and 'sight loss' defined according to US criteria is VA <6/12 and better than 6/60. For VA<6/18, prevalence was 1.8% in males 65-74 and 4.7% in females of this age – 2.5% for all 65-74 year old people. For VA<6/12, prevalence was 9.8% in the 65-74 age group. These data were used to estimate the overall prevalence of sight loss and blindness and of low vision in the 65-69 and 70-74 age groups, adjusting downwards for the relative difference between van der Pols et al (2000) and Evans et al (2002) in the 75+ groups – since van der Pols found much higher prevalence in that group (60% in 85+ and 26% in 75-84 for VA<6/12 compared to the Evans et al (2002) finding of 26% in 85+ and 15% in 75-84).

Under 65 – total sight loss and blindness

Total sight loss and blindness prevalence rates in the 40-65 age groups were derived from English and Scottish data from Charles et al (2007) and Charles (2011), together with relativities by age and gender from the Eye Disease Prevalence Research Group (EDPRG) international multi-site data (Congdon et al, 2004) applied to the older age groups as derived from UK sources (Section 2.3.1). For example, Congdon et al (2004) showed a relativity of 0.88/1.47 or 60% between sight loss in the 60-64 group compared to the 65-69 group. With sight loss of 5.2% and 5.9% estimated in 65-69 year old males and females respectively in the UK, this ratio implies sight loss of 3.1% and 3.5% respectively in the 60-64 year old males and females.

Charles (2007) and Charles (2011) were particularly useful for the groups aged under 40 years (where there are no EDPRG data) and for severity splits (using weighted averages of the English and Scottish rates). Charles (2007) based their estimates on the two UK national prevalence studies by Evans et al (2002) and van der Pols et al (2000), as these were identified as 'most reliable' in a literature review carried out under the supervision of Professor Astrid Fletcher. The MRC and NDNS studies were also identified as reporting the most reliable prevalence estimates by a review of the epidemiological evidence commissioned by RNIB (Tate et al, 2005). Tables 3 and 4 in Charles (2007) and

Charles (2011) summarise the counts (or estimates of them) by local authority social service and social work departments of those who are registered as sight impaired and severely sight impaired in England and Scotland.

Under 40s and severity-type splits

Total sight loss and blindness was also estimated in those aged under 40 as well as the distribution of sight loss and blindness in the under 65 group by type of eye disease with severity splits. As with the 75+ group, a number of different sources were used in this estimation process.

- Relativities from the overall rates of sight loss and blindness (derived from the Evans et al (2002)-adjusted van der Pols (2000) data as described above) were one input.
- Owen et al (2003), Owen et al (2012) and data supplied by A. Reidy (pers. comm) from the NLES were used for AMD and cataract, and Desai et al (1999) was also used for cataract.
- Owen et al (2006) and Coffey et al (1993) were used for glaucoma.
- Data from the EDPRG and from previous detailed Access Economics modelling including:
  - for AMD, Access Economics (2006) and Friedman et al (2004);
  - for cataract, Access Economics (2004) and Congdon et al (2004a);
  - for diabetic diseases, Access Economics (2008a) and Kempen et al (2004);
  - for glaucoma, Access Economics (2008b) and Friedman et al (2004a); and
  - for refractive error, Access Economics (2004) and Kempen (2004a).

A summary of the prevalence rates derived for the younger age groups is provided in Table 2.9 (55-74 years) and Table 2.10 (under 55, excluding cells where the prevalence rate is zero and also excluding 'other', noting it can be derived as a residual from the table).

Table 2.9: Sight loss and blindness prevalence (%) by age, gender, cause & severity (55-74)

Cause/gender	Age	<6/12	<6/12-6/18	<6/18-6/60	<6/60 (blind)
AMD males	55-59	0.10	0.10	-	-
	60-64	0.10	0.10	-	-
	65-69	0.38	0.31	0.06	0.02
	70-74	1.47	1.35	0.08	0.04
AMD females	55-59	0.10	0.10	-	-
	60-64	0.10	0.10	-	-
	65-69	0.84	0.65	0.15	0.04
	70-74	0.88	0.55	0.21	0.12
Cataract males	55-59	0.25	0.15	0.04	0.06
	60-64	0.41	0.25	0.07	0.10
	65-69	0.72	0.43	0.11	0.17
	70-74	0.97	0.59	0.15	0.23
Cataract females	55-59	0.36	0.20	0.07	0.08

Cause/gender	Age	<6/12	<6/12-6/18	<6/18-6/60	<6/60 (blind)
	60-64	0.60	0.34	0.13	0.14
	65-69	1.13	0.64	0.23	0.26
	70-74	1.80	0.29	1.10	0.41
Diabetic disease males	55-59	0.32	0.12	0.12	0.08
	60-64	0.32	0.12	0.12	0.08
	65-69	0.54	0.20	0.20	0.14
	70-74	0.54	0.20	0.20	0.14
Diabetic disease females	55-59	0.21	0.09	0.09	0.03
	60-64	0.21	0.09	0.09	0.03
	65-69	0.30	0.13	0.13	0.04
	70-74	0.30	0.13	0.13	0.04
Glaucoma males	55-59	0.13	0.07	0.02	0.04
	60-64	0.25	0.01	0.09	0.15
	65-69	0.47	0.03	0.23	0.21
	70-74	0.69	0.05	0.34	0.30
Glaucoma females	55-59	0.13	0.07	0.02	0.04
	60-64	0.23	0.01	0.08	0.14
	65-69	0.41	0.03	0.20	0.19
	70-74	0.50	0.03	0.25	0.22
Refractive error males	55-59	0.97	0.73	0.24	0.01
	60-64	1.72	1.29	0.42	0.01
	65-69	2.58	1.94	0.63	0.02
	70-74	3.27	2.45	0.80	0.02
Refractive error females	55-59	1.15	0.86	0.28	0.01
	60-64	1.91	1.43	0.47	0.01
	65-69	2.41	1.81	0.59	0.02
	70-74	3.59	2.69	0.87	0.02
'Other' males	55-59	0.14	0.10	0.03	0.01
	60-64	0.22	0.16	0.04	0.02
	65-69	0.38	0.26	0.08	0.04
	70-74	0.55	0.39	0.11	0.06
'Other' females	55-59	0.16	0.11	0.03	0.02
	60-64	0.24	0.17	0.05	0.02
	65-69	0.41	0.29	0.08	0.04
	70-74	0.57	0.40	0.11	0.06
Total males	55-59	1.93	1.28	0.45	0.20
	60-64	3.03	1.93	0.74	0.37
	65-69	5.07	3.18	1.30	0.59
	70-74	7.49	5.02	1.68	0.79
Total females	55-59	2.10	1.43	0.50	0.17
	60-64	3.30	2.14	0.81	0.34
	65-69	5.51	3.55	1.38	0.59
	70-74	7.64	4.09	2.68	0.87

Source: Deloitte Access Economics modelling from various sources.

Table 2.10: Sight loss and blindness prevalence (%) by age, gender, cause & severity (<55)

Cause/gender	Age	<6/12	<6/12-6/18	<6/18-6/60	<6/60 (blind)
Cataract males	40-49	0.07	0.07	-	-
	50-54	0.15	0.09	0.02	0.04
Cataract females	40-49	0.07	0.07	-	-
	50-54	0.20	0.11	0.04	0.04
Diabetic disease males	30-34	0.03	0.01	0.01	0.01
	35-39	0.07	0.03	0.03	0.02
	40-44	0.12	0.05	0.05	0.03
	45-49	0.12	0.05	0.05	0.03
	50-54	0.32	0.12	0.12	0.08
Diabetic disease females	25-29	0.01	0.004	0.004	0.001
	30-34	0.02	0.01	0.01	0.003
	35-39	0.05	0.02	0.02	0.01
	40-44	0.07	0.03	0.03	0.01
	45-49	0.07	0.03	0.03	0.01
	50-54	0.21	0.09	0.09	0.03
Glaucoma males	40-44	0.13	0.07	0.02	0.04
	45-49	0.13	0.07	0.02	0.04
	50-54	0.13	0.07	0.02	0.04
Glaucoma females	40-49	0.10	0.06	0.02	0.03
	50-54	0.13	0.07	0.02	0.04
Refractive error males	0-4	0.09	0.07	0.02	0.001
	5-9	0.15	0.11	0.04	0.001
	10-14	0.22	0.16	0.05	0.001
	15-19	0.25	0.19	0.06	0.002
	20-24	0.28	0.21	0.07	0.002
	25-29	0.29	0.22	0.07	0.002
	30-34	0.27	0.20	0.07	0.002
	35-39	0.22	0.17	0.05	0.001
	40-44	0.44	0.33	0.11	0.003
	45-49	0.67	0.50	0.16	0.004
	50-54	0.67	0.50	0.16	0.004
Refractive error females	0-4	0.08	0.06	0.02	0.001
	5-9	0.14	0.10	0.03	0.001
	10-14	0.20	0.15	0.05	0.001
	15-19	0.23	0.17	0.06	0.001
	20-24	0.25	0.19	0.06	0.002
	25-29	0.26	0.19	0.06	0.002
	30-34	0.24	0.18	0.06	0.002
	35-39	0.22	0.17	0.05	0.001
	40-44	0.59	0.44	0.14	0.004

Cause/gender	Age	<6/12	<6/12-6/18	<6/18-6/60	<6/60 (blind)
	45-49	0.83	0.62	0.20	0.01
	50-54	0.85	0.64	0.21	0.01
Total males	0-4	0.10	0.07	0.02	0.001
	5-9	0.16	0.12	0.04	0.002
	10-14	0.23	0.17	0.06	0.003
	15-19	0.27	0.20	0.07	0.004
	20-24	0.30	0.22	0.07	0.004
	25-29	0.32	0.23	0.08	0.005
	30-34	0.32	0.23	0.08	0.01
	35-39	0.32	0.21	0.09	0.02
	40-44	0.83	0.56	0.19	0.08
	45-49	1.07	0.74	0.25	0.08
	50-54	1.38	0.86	0.35	0.17
Total females	0-4	0.09	0.06	0.02	0.001
	5-9	0.15	0.11	0.04	0.002
	10-14	0.21	0.16	0.05	0.003
	15-19	0.25	0.18	0.06	0.003
	20-24	0.27	0.20	0.07	0.004
	25-29	0.29	0.21	0.07	0.005
	30-34	0.29	0.21	0.07	0.01
	35-39	0.29	0.20	0.08	0.01
	40-44	0.90	0.65	0.20	0.05
	45-49	1.16	0.84	0.27	0.05
	50-54	1.50	0.99	0.38	0.13

Source: Deloitte Access Economics modelling from various sources.

2.2.3 Ethnicity and regional splits

Ethnicity splits

Ethnicity splits were then applied to the overall prevalence rates – by age, gender and severity – based on relative risks for particular eye diseases (also by age, gender and severity), from the literature.

Johnson and Scase (2000) concluded that there was no agreed, comprehensive and reliable source of information on the prevalence of sight loss and blindness among minority ethnic groups in the UK. The majority of studies of minority ethnic groups and their health in Britain have not collected data about sight loss and blindness. The exception was a study by Bhalla and Blakemore (1981) which showed high reported rates of sight problems (61% for African-Caribbean and 53% Asian contrasted with 52% for an older white control population).

Apart from the EDPRG data, one key UK source for ethnicity data was Das et al (1994, 1990), who examined 377 people and found that Asians had a significantly higher prevalence of cataract compared to people of European descent (30% compared to 3% in people aged under 60 years and 78% compared to 54% in those aged 60 years and

over). The markedly higher prevalence of cataract in Asians under 60 suggests an earlier onset of the disease in Asian people. After adjusting for age, the prevalence did not differ significantly with gender. The higher prevalence of cataract in Asians has also been found in other population-based studies from India and in a hospital-based study in Leicester (Thompson, 1989). Thompson (1989) was based on demand incidence and does not wholly support the widespread belief that there is under-utilisation (or avoidance) among the Asian community. However if this does exist, he may be underestimating the true levels of need. Das et al (1994, 1990) obtained a higher response rate from Asian than White ('Caucasian') samples and reports substantially higher prevalence (24% compared to 0% in those aged 40 to 59, and 73% compared to 41% for ages over 60).

Research has also investigated the epidemiology of glaucoma among African-Caribbean people living in London (Wormald et al, 1994), a group with significantly higher rates of this disease. The purpose of the study was to estimate the prevalence of, and risk factors for, chronic glaucoma in a sample of African Caribbean people over 35 years of age living in the London Borough of Haringey. Of 873 eligible persons examined (out of a total of 1022), 32 definite cases of glaucoma were identified, a prevalence of 3.9% and 42% of these had been previously diagnosed. An age-standardised comparison with the findings of the Roscommon survey revealed a relative risk for glaucoma for the Haringey black population compared with Irish whites of 3.7. Despite the lack of a population base, this study provides strong evidence that the four times greater risk of glaucoma estimated for American black people compared with white people applies equally to the United Kingdom population.

Table 2.11 shows the relative risk of selected eye diseases due to ethnicity. In summary:

- The black population has a greater risk of developing AMD compared to the white population in younger age groups, whereas the white population has a greater risk of developing AMD in the latter years of life; Asians are at lower risk than white people of AMD (Friedman et al 2004; Das et al 1994).
- Asians have a greater risk of developing cataracts compared to the black population and white population (Kempen et al 2004; Das et al 1994).
- Black and Asian populations have a greater risk of developing diabetic eye disease compared to the white population (Kempen et al 2004; Das et al 1994).
- The relative risk of glaucoma is much higher for the black population compared to the white population (Friedman et al 2004a; Wormald et al 1994).
- The white population has the greater risk in developing refractive error compared to the black population (Kempen et al 2004a).

For other eye disease, no robust differences in relative risk as a result of ethnicity have been found (Munier et al 1998; Ghafour et al 1983).

Table 2.11: Relative risk of selected eye diseases due to ethnicity

	Males	Females	Persons
AMD	Black:white	Black:white	
50-54	1.235	3.400	
55-59	1.268	3.727	
60-64	1.000	2.857	
65-69	0.713	1.729	
70-74	0.470	0.967	
75-79	0.287	0.520	
80+	0.131	0.149	
	Asian:white	Asian:white	
70+	0.438	0.821	
Cataract	Black:white	Black:white	Asian:white
40-49	0.607	1.158	11.000
50-54	0.918	1.460	8.167
55-59	0.927	1.362	8.167
60-64	0.862	1.189	2.300
65-69	0.781	1.029	2.300
70-74	0.711	0.912	1.453
75-79	0.663	0.843	1.453
80+	0.648	0.795	1.453
Diabetic disease	Black:white	Black:white	
40-49	1.450	1.917	
50-64	1.222	2.124	
65-74	0.621	1.417	
75+	1.110	1.209	
			Asian:white
All ages			1.353
Glaucoma	Black:white	Black:white	
40-49	1.528	1.819	
50-54	2.803	2.517	
55-59	3.600	2.804	
60-64	4.186	2.967	
65-69	4.415	2.937	
70-74	4.238	2.727	
75-79	3.710	2.388	
80+	2.367	1.415	
Refractive error			
40-49	0.614	0.430	
50-54	0.604	0.493	
55-59	0.551	0.539	
60-64	0.468	0.572	
65-69	0.373	0.591	
70-74	0.281	0.600	

	Males	Females	Persons
75-79	0.202	0.604	
80+	0.096	0.616	

Source: Friedman et al (2004), Das et al (1994), Wormald et al (1994), and Kempen et al (2004, 2004a).

Total prevalence rates by ethnicity were calculated 'bottom up' as the sum of prevalence from the relative risks, and fitted back proportionally into the total population of people with sight loss and blindness as estimated in Section 2.3.2.

Regional splits and literature summary

After allowing for age, gender and ethnicity, there were no sources investigated in the literature that showed further differences in the prevalence or severity of sight loss and blindness attributable to regions within the UK. As such, the prevalence modelling by region was based on the demographic differences alone. A summary of prevalence sources used in the modelling is provided in Table 2.12.

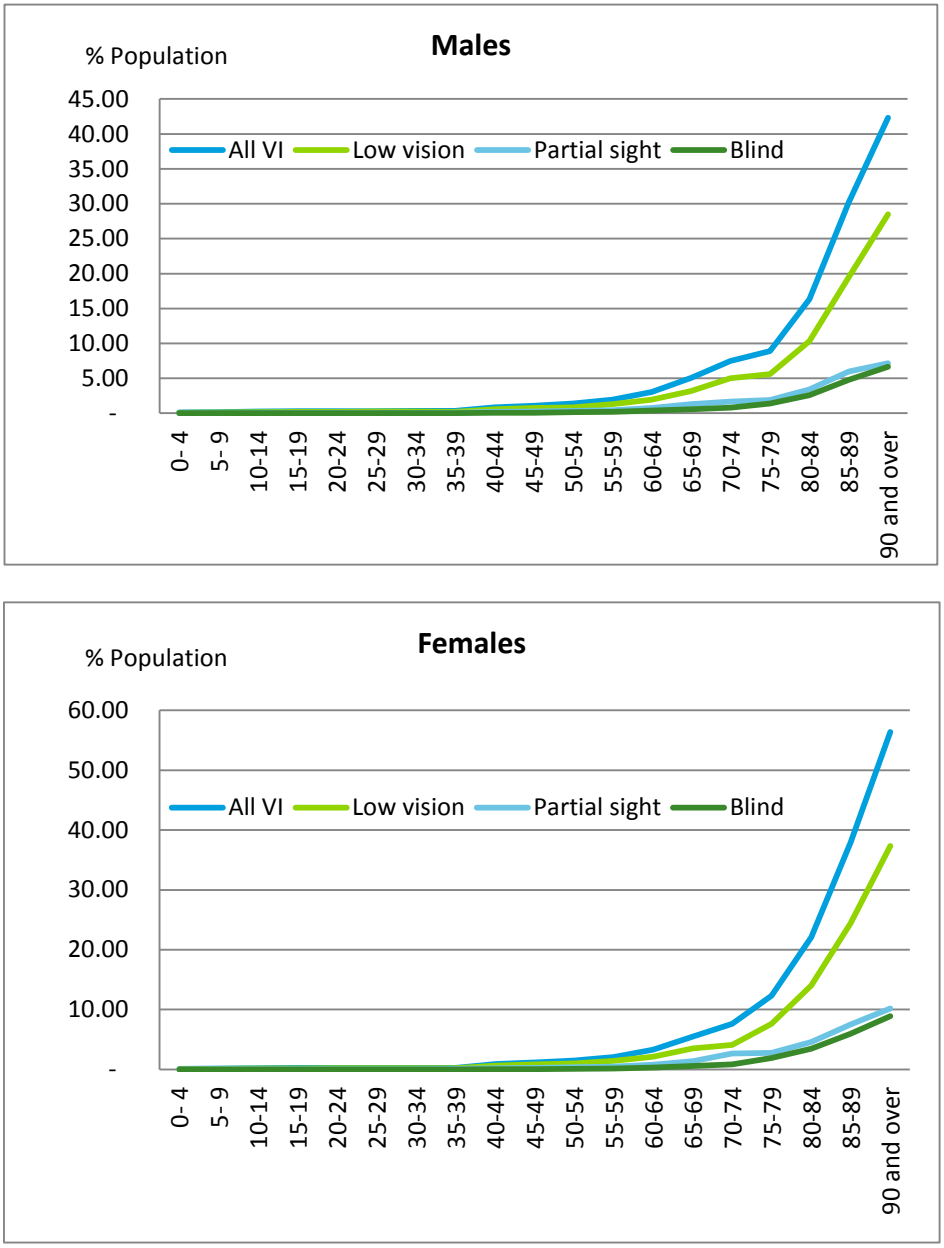
Table 2.12: Summary of prevalence sources

Age group	Total VI by age/gender	Severity splits	Splits by type of eye disease
75+	Evans et al (2002)	Evans et al (2004a) for low vision	Evans et al (2004a) for shares of 'big 5' and 'other' in total
		Blind: 15.8% parameter for VA<6/60 relative to VA<6/12 from Evans et al (2004a) lower bound and Reidy et al (1998) upper bound	AMD: Evans et al (2004b)
			Cataract: NLES data from Reidy
			Glaucoma: Owen et al (2006); Coffey et al (1993)
		Partial sight derived as a residual	
65-74	Van der Pols (2000)	Relativities from older age groups and Van der Pols (2000), Owen et al (2003, 2006, 2012); Reidy NLES data, Desai et al (1999), Coffey et al (1993), Access Economics (2004, 2006, 2008a, 2008b), Congdon et al (2004, 2004a), Friedman et al (2004, 2004a), Kempen et al (2004, 2004a).	
40-64	Congdon et al (2004) relativities		
Under 40s			
Ethnicity splits		Congdon et al (2004, 2004a), Friedman et al (2004, 2004a), Kempen et al (2004, 2004a), Das et al (1994), Wormald et al (1994).	

Other literature sources reviewed but not used directly in the prevalence modelling are provided in the following section (note some of these were reviewed by the EDPRG and

form part of their estimates). Tables of prevalence rates for males and females, by age and severity, are presented in Chart 2.1.

Chart 2.1: Prevalence (rates) by age, gender and severity, UK 2013



Source: Deloitte Access Economics calculations.

2.3 Prevalence of sight loss and blindness in the UK

Applying the prevalence rates estimated in Section 2.2 to each country's population data estimated in Section 2.1 provided estimates of the numbers of people with sight loss and blindness in England, Wales, Scotland and Northern Ireland for the base year 2013. The estimate of people with sight loss and blindness in the UK is the summation of country level estimates. Estimates of prevalence for each country in 2013 are shown in Appendix B. It is not surprising that the number of people with sight loss and blindness

was concentrated within England given its population size relative to Northern Ireland, Wales and Scotland.

Table 2.13 shows a total of 1.93 million people with sight loss and blindness in 2013 for UK as a whole (3.0% of the total population). In summary, it was estimated that approximately:

- 1.20 million (61.9%) were female and 737,000 (38.1%) were male;
- 446,000 (23.1%) had sight loss and blindness due to AMD;
- 361,000 (18.7%) had sight loss and blindness due to cataract;
- 140,000 (7.2%) had sight loss and blindness due to glaucoma;
- 91,000 (4.7%) had sight loss and blindness due to DR;
- 752,000 (38.9%) had sight loss and blindness due to RE; and
- 143,000 (7.4%) had sight loss and blindness due to other eye diseases.

Table 2.14 shows there was an estimated total of 255,000 blind people in the UK in 2013. In summary, it was estimated that approximately:

- 160,000 (62.9%) were female and 94,000 (37.1%) were male;
- 122,000 (47.7%) were blind due to AMD;
- 41,000 (16.2%) were blind due to cataract;
- 45,000 (17.5%) were blind due to glaucoma;
- 20,000 (7.9%) were blind due to DR;
- 4,000 (1.7%) were blind due to RE; and
- 23,000 (8.9%) were blind due to other eye diseases.

Table 2.13: Sight loss and blindness (<6/12) by age, gender & disease type, UK (people) 2013

	AMD	Cataract	DR	Glaucoma	RE	Other	Total
Males							
0- 39	-	-	2,164	-	36,287	3,076	41,527
40-44	-	1,527	2,744	2,880	9,847	1,360	18,357
45-49	-	1,592	2,861	3,002	15,408	1,829	24,691
50-54	-	3,254	6,943	2,895	14,331	2,194	29,616
55-59	1,852	4,719	5,989	2,498	18,059	2,649	35,767
60-64	1,734	7,173	5,605	4,368	29,827	3,897	52,604
65-69	6,489	12,169	9,126	8,010	43,819	6,369	85,982
70-74	17,660	11,653	6,460	8,224	39,294	6,663	89,954
75-79	18,078	13,912	6,288	7,624	32,698	6,288	84,888
80-84	32,035	18,471	4,810	11,640	31,362	7,865	106,184
85-89	32,581	24,588	695	9,383	28,932	7,694	103,875
90+	28,560	17,105	51	1,438	11,403	4,685	63,243
Males	**138,989**	**116,163**	**53,736**	**61,963**	**311,267**	**54,569**	**736,688**
Female							
0- 39	-	-	1,731	-	32,377	2,729	36,837
40-44	-	1,504	1,675	2,366	13,419	1,517	20,480
45-49	-	1,570	1,749	2,470	19,762	2,044	27,596
50-54	-	4,318	4,666	2,835	18,659	2,438	32,916
55-59	1,900	6,794	4,040	2,455	21,761	2,956	39,905
60-64	1,804	10,864	3,836	4,175	34,454	4,411	59,544
65-69	15,117	20,267	5,454	7,433	43,219	7,319	98,809
70-74	11,770	24,046	4,067	6,721	47,972	7,566	102,141
75-79	26,552	31,603	2,202	6,087	63,076	10,362	139,882
80-84	65,457	40,212	2,885	14,065	61,310	14,714	198,644
85-89	82,845	58,247	3,739	15,152	46,834	16,545	223,362
90+	101,376	45,497	1,133	13,970	37,379	15,948	215,302
Females	**306,820**	**244,922**	**37,176**	**77,730**	**440,220**	**88,549**	**1,195,417**
Total	**445,809**	**361,085**	**90,912**	**139,693**	**751,487**	**143,119**	**1,932,105**

Source: Deloitte Access Economics modelling.

Table 2.14: Blindness (<6/60) by age, gender & disease type, UK (people) 2013

	AMD	Cataract	DR	Glaucoma	RE	Other	Total
Males							
0- 39	-	-	553	-	231	308	1,092
40-44	-	-	701	802	63	136	1,701
45-49	-	-	731	836	98	183	1,848
50-54	-	777	1,774	806	91	219	3,668
55-59	-	1,127	1,531	695	115	265	3,733
60-64	-	1,714	1,432	2,639	190	390	6,364
65-69	275	2,908	2,332	3,591	279	637	10,022
70-74	535	2,784	1,651	3,619	250	666	9,505
75-79	7,097	796	2,500	2,361	114	525	13,392
80-84	11,645	698	998	2,384	147	879	16,752
85-89	10,736	1,910	6	2,074	170	1,492	16,388
90 and over	7,332	749	1	385	76	1,435	9,977
All Males	**37,620**	**13,462**	**14,211**	**20,190**	**1,823**	**7,136**	**94,442**
Female							
0- 39	-	-	249	-	206	273	728
40-44	-	-	241	665	85	152	1,143
45-49	-	-	252	694	126	204	1,276
50-54	-	977	672	796	119	244	2,809
55-59	-	1,538	582	690	138	296	3,243
60-64	-	2,459	553	2,523	219	441	6,195
65-69	784	4,589	786	3,332	275	732	10,498
70-74	1,607	5,443	586	2,957	305	757	11,655
75-79	11,694	2,498	1,210	2,815	219	3,632	22,068
80-84	21,785	2,060	812	2,881	288	3,513	31,339
85-89	23,086	5,677	41	3,348	275	2,811	35,238
90 and over	24,960	2,656	18	3,741	248	2,345	33,967
All Females	**83,917**	**27,896**	**6,003**	**24,441**	**2,505**	**15,399**	**160,160**
Total	**121,536**	**41,358**	**20,213**	**44,632**	**4,328**	**22,535**	**254,602**

Source: Deloitte Access Economics modelling.

The severity of sight loss and blindness is presented in Table 2.15, which shows:

- 64.5% had low vision (largely due to refractive error);
- 22.3% had partial sight; and
- 13.2% were considered blind (severe sight loss), with the proportion who are blind rising with age.

Table 2.15: Sight loss and blindness by age, gender & severity, UK (people) 2013

	Low vision	Partial Sight	Blind	Low vision	Partial Sight	Blind
		Number			%	
Males						
0- 39	30,174	10,262	1,092	72.7%	24.7%	2.6%
40-44	12,449	4,206	1,701	67.8%	22.9%	9.3%
45-49	17,123	5,720	1,848	69.3%	23.2%	7.5%
50-54	18,406	7,543	3,668	62.1%	25.5%	12.4%
55-59	23,687	8,347	3,733	66.2%	23.3%	10.4%
60-64	33,432	12,807	6,364	63.6%	24.3%	12.1%
65-69	53,893	22,067	10,022	62.7%	25.7%	11.7%
70-74	60,313	20,136	9,505	67.0%	22.4%	10.6%
75-79	53,278	18,218	13,392	62.8%	21.5%	15.8%
80-84	67,293	22,139	16,752	63.4%	20.8%	15.8%
85-89	66,943	20,544	16,388	64.4%	19.8%	15.8%
90 and over	42,586	10,680	9,977	67.3%	16.9%	15.8%
All Males	**479,577**	**162,669**	**94,442**	**65.1%**	**22.1%**	**12.8%**
Female	Low vision	Partial sight	Blind	Low vision	Partial sight	Blind
0- 39	26,933	9,175	728	73.1%	24.9%	2.0%
40-44	14,690	4,647	1,143	71.7%	22.7%	5.6%
45-49	19,974	6,345	1,276	72.4%	23.0%	4.6%
50-54	21,745	8,363	2,809	66.1%	25.4%	8.5%
55-59	27,246	9,415	3,243	68.3%	23.6%	8.1%
60-64	38,678	14,671	6,195	65.0%	24.6%	10.4%
65-69	63,526	24,785	10,498	64.3%	25.1%	10.6%
70-74	54,696	35,790	11,655	53.5%	35.0%	11.4%
75-79	86,585	31,229	22,068	61.9%	22.3%	15.8%
80-84	126,260	41,046	31,339	63.6%	20.7%	15.8%
85-89	143,826	44,298	35,238	64.4%	19.8%	15.8%
90 and over	142,460	38,876	33,967	66.2%	18.1%	15.8%
All Females	**766,619**	**268,638**	**160,160**	**64.1%**	**22.5%**	**13.4%**
Total	**1,246,196**	**431,307**	**254,602**	**64.5%**	**22.3%**	**13.2%**

Note: Low vision<6/12-6/18; partial sight <6/18-6/60; Blind <6/60.

Source: Deloitte Access Economics modelling.

Table 2.16 presents the ethnicity splits. Of the estimated 1.93 million people with sight loss and blindness in the UK, approximately:

- 1.83 million (94.9%) were white – a population prevalence of 3.3%;
- 19,000 (1.0%) were black – a population prevalence of 1.0%;
- 58,000 (3.0%) were Asian – a population prevalence of 1.5%; and
- 21,000 (1.1%) were other ethnicities – a population prevalence of 0.9%.

Table 2.16: Sight loss and blindness (<6/12) by age, gender & ethnicity, UK (people) 2013

<6/12	White	Black	Asian	Other	Total
Males					
0- 39	34,062	1,547	3,724	2,195	41,527
40-44	15,033	585	2,197	543	18,357
45-49	21,498	697	1,879	617	24,691
50-54	25,830	716	2,470	600	29,616
55-59	31,654	511	3,019	583	35,767
60-64	49,968	380	1,675	581	52,604
65-69	82,089	647	2,421	824	85,982
70-74	85,419	957	2,729	850	89,954
75-79	81,108	804	2,248	728	84,888
80-84	102,735	646	1,997	807	106,184
85-89	101,400	419	1,375	681	103,875
90 and over	61,844	198	784	417	63,243
All Males	692,640	8,106	26,516	9,426	736,688
Male % of population	**2.5%**	**0.9%**	**1.3%**	**0.8%**	**2.3%**
Female					
0- 39	30,275	1,498	3,189	1,874	36,837
40-44	17,073	633	2,166	608	20,480
45-49	24,195	731	1,969	701	27,596
50-54	28,547	873	2,848	648	32,916
55-59	34,867	758	3,634	645	39,905
60-64	56,022	622	2,220	680	59,544
65-69	93,734	1,303	2,862	909	98,809
70-74	97,006	1,346	2,924	865	102,141
75-79	134,344	1,305	3,179	1,054	139,882
80-84	193,328	1,015	3,071	1,231	198,644
85-89	219,688	580	2,049	1,045	223,362
90 and over	211,883	501	1,903	1,016	215,302
All Females	1,140,963	11,165	32,014	11,276	1,195,417
Total	**1,833,603**	**19,270**	**58,530**	**20,702**	**1,932,105**
Female % of population	**4.0%**	**1.1%**	**1.6%**	**1.0%**	**3.7%**
Total % of population	**3.3%**	**1.0%**	**1.5%**	**0.9%**	**3.0%**

Source: Deloitte Access Economics modelling.

2.4 Projections of prevalence to 2050

Applying the prevalence rates estimated in Sections 2.2 to each country's population projections from Section 2.1 provides estimates of the numbers of people with sight loss and blindness in England, Wales, Scotland and Northern Ireland for the years 2013 to 2050. As before, the estimate of people with sight loss and blindness in the UK is the summation of country level estimates. The projected prevalence for each country is shown in Appendix C.

The prevalence rates estimated in Sections 2.2 provide an indication of the projected prevalence for each country, although the projection does not account for changes such as new technologies for treating sight loss and blindness, or healthcare and policy changes regarding access to treatment. For example, Anti-VEGF treatments have been shown to be highly effective in treating sight loss. This can delay and reverse some of the prevalent cases. For now, there are few studies estimating the impact of these treatments, and it remains to be seen how this will affect future projections. This indicates that ongoing research is needed.

Given this, these projections present the case of what will happen if treatment rates, technologies, and other such assumptions remain constant over the years to 2050.

The main findings for UK as a whole are summarised in Table 2.17 showing more than a doubling (115% increase between 2013 and 2050) in the numbers of people with sight loss and blindness in the UK, to more than 4 million people by 2050. Of these:

- 1.6 million (40%) will be males and 2.5 million (60%) will be females;
- population prevalence will rise from 3.0% in 2013 (2.3% for males and 3.7% for females) to 5.4% (4.2% for males and 6.5% for females) in 2050;
- the proportion of white people with sight loss and blindness will fall (to 88.5%), while the proportion of black people will increase to 1.8%, Asians to 6.4%, and others to 3.3%.[5]

Chart 2.2 highlights the projected increase in prevalence rates and numbers, while Table 2.18 summarises the changes in shares contributed by different eye diseases. From 2013 to 2050, the share of sight loss and blindness from:

- AMD increases from 23.1% to 29.7% (more than doubling to 1.23 million people), reflecting demographic ageing;
- cataract increases from 18.7% to 21.4% (increasing 146% to 888,000 people), likewise;
- DR decreases from 4.7% to 3.1% (a 41% increase in absolute numbers though, to 129,000 people);
- glaucoma decreases slightly from 7.2% to 7.0% (but doubles in absolute terms to over 288,000 people);
- RE decreases from 38.9% to 31.3% (but also nearly doubles, to 1.3 million people); and

[5] This does not indicate that sight loss will be less of a problem for white people in the future; rather, it is an indication of the increasing burden of sight loss in black people, Asians and others.

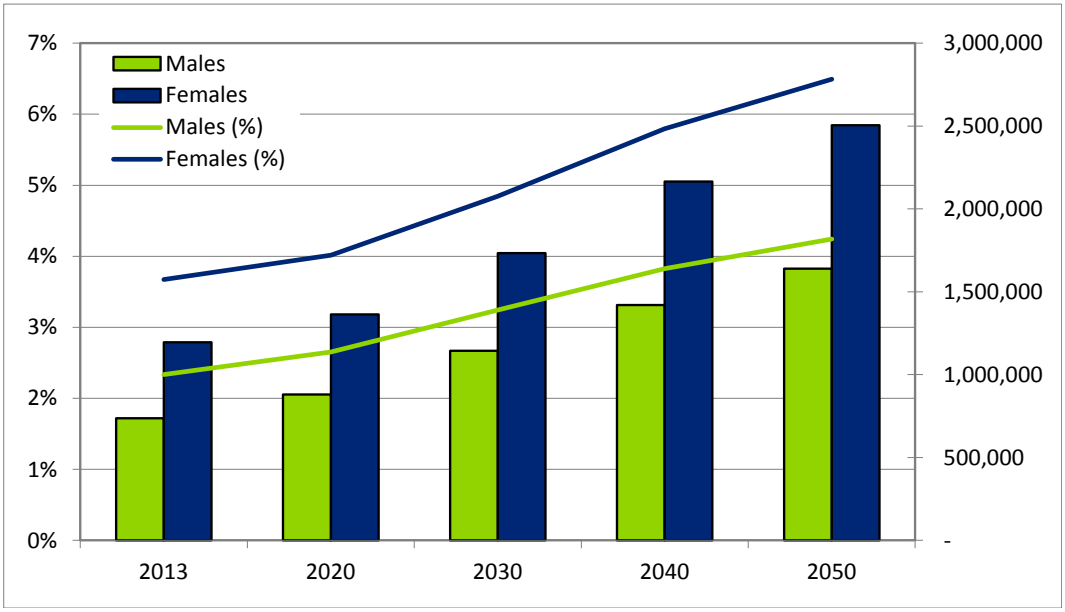
- other eye disease stays constant in its share of the total prevalence (rising in absolute terms to over 300,000 cases).

Table 2.17: Projection of sight loss and blindness (<6/12) by gender & ethnicity UK (people)

	2013	2020	2030	2040	2050	% increase 2050/2010
Males	736,688	880,812	1,143,576	1,419,304	1,640,020	123%
% pop'n	2.3%	2.7%	3.2%	3.8%	4.2%	
Females	1,195,417	1,363,266	1,732,819	2,164,618	2,505,476	110%
% pop'n	3.7%	4.0%	4.8%	5.8%	6.5%	
All ethnicities	**1,932,105**	**2,244,078**	**2,876,395**	**3,583,922**	**4,145,496**	**115%**
% pop'n	3.0%	3.3%	4.0%	4.8%	5.4%	
% share	100.0%	100.0%	100.0%	100.0%	100.0%	
Males	692,640	819,381	1,051,398	1,286,236	1,442,162	108%
% pop'n	2.2%	2.5%	3.0%	3.5%	3.7%	
Females	1,140,963	1,285,382	1,611,050	1,982,470	2,226,110	95%
% pop'n	3.5%	3.8%	4.5%	5.3%	5.8%	
White	**1,833,603**	**2,104,762**	**2,662,448**	**3,268,706**	**3,668,272**	**100%**
% pop'n	2.9%	3.1%	3.7%	4.4%	4.7%	
% share	94.9%	93.8%	92.6%	91.2%	88.5%	
Males	8,106	10,483	14,631	19,182	25,801	218%
% pop'n	0.9%	1.0%	1.3%	1.6%	1.9%	
Females	11,165	15,432	23,630	33,848	49,697	345%
% pop'n	1.1%	1.4%	1.9%	2.5%	3.2%	
Black	**19,270**	**25,915**	**38,261**	**53,030**	**75,498**	**292%**
% pop'n	1.0%	1.2%	1.6%	2.0%	2.6%	
% share	1.0%	1.2%	1.3%	1.5%	1.8%	
Males	26,516	36,832	54,480	77,722	116,072	338%
% pop'n	1.3%	1.6%	2.1%	2.7%	3.5%	
Females	32,014	45,347	68,974	99,685	149,342	366%
% pop'n	1.6%	2.0%	2.7%	3.6%	4.8%	
Asian	**58,530**	**82,179**	**123,454**	**177,406**	**265,414**	**353%**
% pop'n	1.5%	1.8%	2.4%	3.1%	4.1%	
% share	3.0%	3.7%	4.3%	5.0%	6.4%	
Males	9,426	14,116	23,067	36,164	55,986	494%
% pop'n	0.8%	1.0%	1.3%	1.8%	2.3%	
Females	11,276	17,106	29,165	48,616	80,327	612%
% pop'n	1.0%	1.2%	1.7%	2.6%	3.5%	
Other	**20,702**	**31,222**	**52,232**	**84,780**	**136,313**	**558%**
% pop'n	0.9%	1.1%	1.5%	2.2%	2.9%	
% share	1.1%	1.4%	1.8%	2.4%	3.3%	

Source: Deloitte Access Economics modelling.

Chart 2.2: Projection of sight loss and blindness (<6/12) by age & gender, UK (people), 2013 to 2050



Source: Deloitte Access Economics modelling.

Table 2.18: Projection of sight loss and blindness (<6/12) by disease type, UK (people), 2013 to 2050

	AMD	Cataract	DR	Glaucoma	RE	Other
Share of total cases						
2013	23.1%	18.7%	4.7%	7.2%	38.9%	7.4%
2020	24.0%	19.2%	4.5%	7.2%	37.7%	7.4%
2030	26.2%	20.0%	3.9%	7.2%	35.4%	7.4%
2040	28.5%	20.7%	3.4%	7.0%	33.0%	7.4%
2050	29.7%	21.4%	3.1%	7.0%	31.3%	7.4%
Cases						
2013	445,809	361,085	90,912	139,693	751,487	143,119
2050	1,232,042	888,475	129,556	288,310	1,299,311	307,801
% change	176%	146%	43%	106%	73%	115%

Source: Deloitte Access Economics modelling.

3 Health care system expenditure

There are four publicly funded health care systems in the UK, which are collectively known as the NHS. These include the NHS England, Health in Wales, NHS Scotland, and Health and Social Care in Northern Ireland. The Department of Health (DoH) has responsibility for the NHS in England, the Welsh Government has responsibility for the NHS in Wales, the Scottish Government Health Department has responsibility for the NHS in Scotland and the Northern Ireland Assembly has responsibility for public health in Northern Ireland.

The most comprehensive health care system expenditure data is Reference Costs collected by the Department of Health in England. Reference Costs publications (DoH, 2013) show inpatient and outpatient data on average unit costs and activity levels for a wide range of health care services within a given year (2012-13 is the most recent publication). Specifically, data is provided on:

- the average cost of an episode, an interquartile range of episodic costs, and a high/low range of episodic costs; and
- the number of episodes, attendances, and average bed days.

Data is collected from NHS trusts and NHS foundation trusts in England as part of the National Programme Budgeting project. Trusts provide the Department of Health with estimates of annual expenditure for 23 different programs using a systematic classification of acute care interventions into distinct clinical categories. These programs are based on International Classification of Disease (ICD v.10) chapters. Reference Cost data covers services provided in hospitals, in the community and other settings, and paramedic services provided by Ambulance NHS Trusts.

Reference Cost data is used for a variety of reasons throughout the UK. The DoH uses reference costs to support the DoH's commitment to data transparency, while NHS providers use reference costs to report to executive teams, amongst other reasons. Other organisations, such as the Health and Social Care Information Centre (HSCIC) and the ONS, use the data to inform estimates of NHS productivity for calculating gross domestic product, and providing comparative analyses. The data has been used extensively within cost effectiveness analysis studies in the UK (DoH, 2013).

In 2012-13, Reference Cost data covered £55.2 billion of NHS expenditure based on costs collected from over 244 NHS trusts and NHS foundation trusts (DoH, 2013). Health care services within the Reference Cost data are broken down into Health Resource Groups (HRGV.4+). The HRGs were revised in 2012-13. HRGs have been designed at a spell level covering a patient's whole stay from admission to discharge, although only Finished Consulted Episode (FCE) data has been published. A FCE is a continuous period of inpatient care administered by a particular consultant within a single hospital provider. If another consultant takes responsibility for the patient, or the patient is transferred to another hospital, then a new FCE will commence. Data items within FCEs are entered from the patient's notes onto the hospital's administration system by people who are trained in clinical coding. It includes primary and secondary diagnoses (coded using ICD-10), information regarding the patients demographics and clinical data relating to the patient's stay.

Reference Cost data is sub-divided into areas of particular interest, by service (elective inpatients, non-elective inpatients, day cases, and outpatients) and provider type. HRGs are designed to group episodes that are clinically identifiable and consume similar amounts of resources. This provides the opportunity to collect detailed information on the health care system expenditure relating to eye conditions that lead to sight loss and blindness.

Not all health system expenditure relating to sight loss and blindness has been captured by the Reference Cost publications. Importantly they do not provide information on costs relating to sight loss and blindness and residential aged care, allied health care, research relating to eye disease, health administration costs and other costs. For these estimates a 'bottom up' approach was constructed using additional sources of data.

There are a variety of direct and indirect costs associated with sight loss and blindness within the health care system. Costs investigated within this section relate to sight loss and blindness of the UK adult population (≥18 years), and include:

- hospital inpatient expenditure;
- non-admitted expenditure (outpatient costs and community services);
- prescribing within a primary and secondary care environment;
- general ophthalmic services (eye examinations and corrective vision aids);
- expenditure associated with injurious falls attributable to sight loss and blindness;
- research and development;
- aged care and community care sector; and
- capital and administration expenditure.

All costs relating to eye disease that cause sight loss and blindness have been estimated within this chapter.

3.1 Hospital recurrent expenditure

Reference Cost data contain 58 HRG codes that specifically related to eye disease. In order to determine hospital inpatient expenditure for each condition, each HRG code was mapped to each condition. The mapping, by HRG code, description, and the condition assigned by Deloitte Access Economics is shown in Appendix A.

Hospital inpatient expenditure for England was calculated using the Reference Cost data for 2012-13 (DoH, 2013). Since the 2012-13 Reference Cost data no longer includes information about non-NHS expenditure (DoH, 2013), the share of non-NHS expenditure relative to the total expenditure from the 2011-12 Reference Cost data was therefore used to complete the estimations for non-NHS expenditure for the year 2012-13. Reference Cost information is presented as number of FCEs, number of excess bed days and national average unit costs, with an interquartile range of unit costs. Within this study, national average costs were used.[6] Section B of Reference Costs data, which is assigned for Eyes and Periorbita, identifies around £516.3 million of expenditure (in

[6] Average HRG costs are actually a weighted cost derived by multiplying the cost for each procedure by the total number of episodes. This gives the total costs for each procedure, which are added together and divided by the total number of episodes for the costed codes within the HRG (DHSSPSNI, 2006)

2013 prices) on admitted care for patients whose primary diagnosis is eye-related or who have undertaken eye surgery.

Mapping the HRG codes to the conditions of interest within this study provided the opportunity to determine the total inpatient costs by condition and to split this between NHS providers (Primary care trusts and NHS trusts) and non-NHS providers, elective inpatient, non-elective inpatient, and day cases.[7]

However, Reference Cost data are not split by age groups across service recipients. In order to get the proportion of episodes for non-adults, the Health and Social Care Information Centre (England), Hospital Episode Statistics for 2012-13 was used. These data break down episodes by ICD10 codes and by age groups 0-14, 15-59, 60-74, and 75+. The proportion of episodes that were undertaken on those aged 0-17 was around 12.7%. However most of these episodes were concentrated within five ICD10 codes, including Convergent concomitant strabismus (H50.0), Acute inflammation of orbit (H05.0), Strabismus (H50.9), Chalazion (H00.1), and Divergent concomitant strabismus (H50.1). None of these five conditions relate to the conditions of interest within this study so it was assumed that Reference Costs for the conditions of interest did not contain those under the age of 18.

Table 3.1 shows the breakdown of hospital inpatient costs and episodes for England by condition. It is broken down into NHS providers and non-NHS providers, and elective patient, non-elective patient and day cases. Of the £516.3 million attributed to Eyes and Periorbita:

- £72.1 million was spent on AMD;
- £263.87 million was spent on Cataracts;
- £14.7 million was spent on Diabetic Retinopathy;
- £18.3 million was spent on Glaucoma;
- £14.4 million was spent on Refractive error; and
- £132.9 million was spent on Other eye conditions.

As it was problematic to allocate Reference Costs data specifically relating to sight loss and blindness for those conditions classified as 'Other eye conditions', there is a relatively large amount of expenditure within this category. Consequently this data must be taken with caution as it also includes procedures that may not result in sight loss and blindness, for example conditions relating to adnexa of the eye. While it is recognized that 'Other' eye conditions makes up a significant proportion of hospital recurrent expenditure, unfortunately it could not be broken down any further than the HRG V.4+ breakdown presented in Table A.1. Consequently, the only conclusion that can be drawn from 'Other' expenditures is that it primarily relates to expenditure on oculoplastics, orbits/lacrimal, and ocular motility, or a combination of the five conditions of interest with no way to separate out which condition it should be assigned to.

The proportion of expenditure for inpatient and day cases in England across conditions is shown in Chart 3.1. In total, around 51.1% of hospital expenditure (inpatient and day cases) was spent on Cataracts. This is due to the large number of episodes associated

[7] Elective inpatient refers to planned activity where a patient expects that they will remain in hospital for at least one night, while non-elective inpatient refers to unplanned activities such as emergency admissions and non-emergency patient transfers from other hospitals.

with cataracts although the majority of this expenditure was within day cases. AMD had the second largest single proportion of expenditure at around 14.0%, while Glaucoma had the third largest at 3.5%. Diabetic retinopathy and Refractive error each make up 2.8% respectively, while 'Other' eye conditions make up the remaining 25.7%.

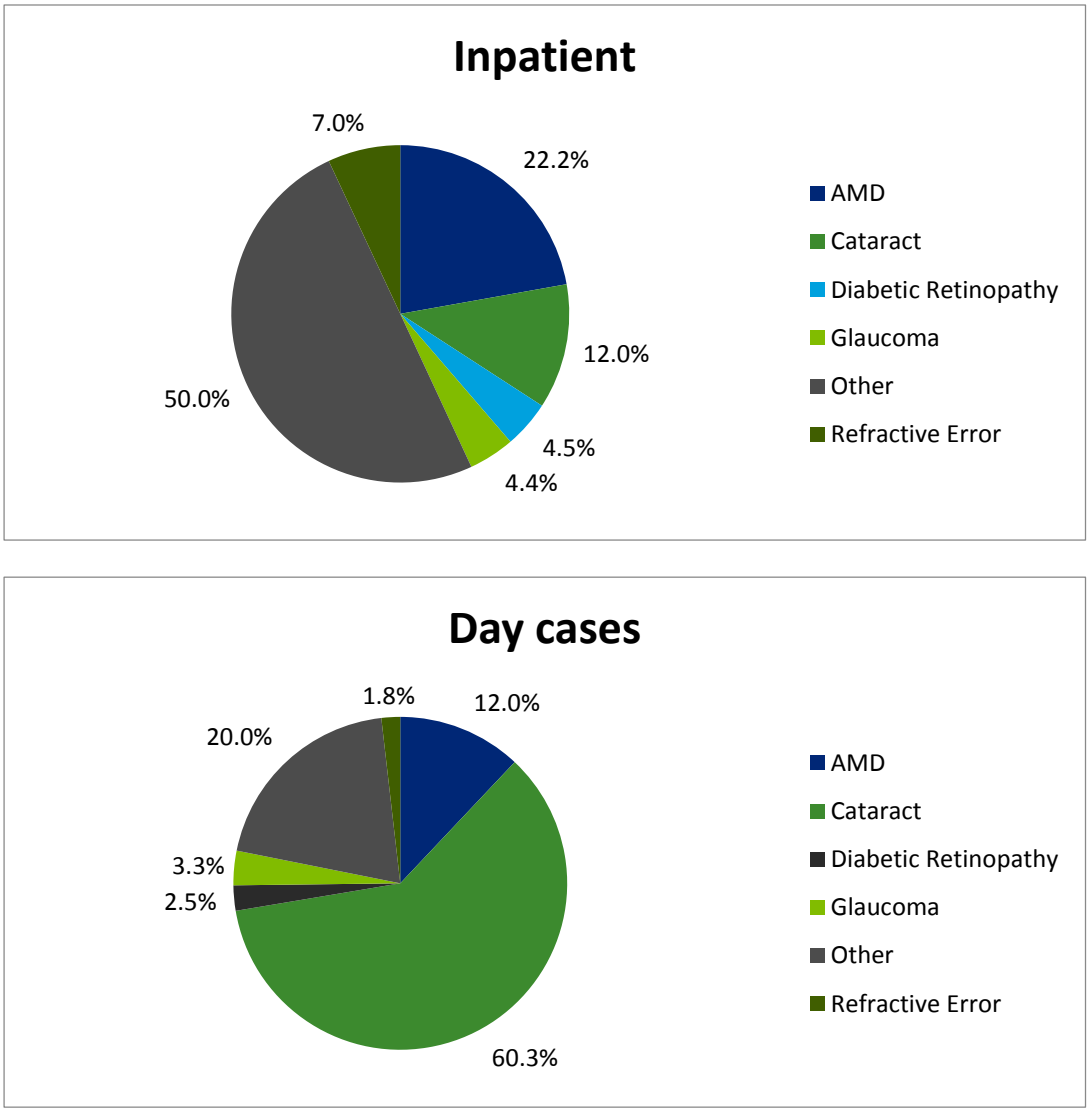
Table 3.1: Hospital recurrent expenditure associated with sight loss and blindness in England 2013

	NHS providers					Non-NHS providers				Total	
Condition	**Elective inpatient**	**Non-elective inpatient**	**Day cases**	**Other[a]**	**Total (NHS providers)**	**Elective inpatients**	**Non-elective inpatient**	**Day cases**	**Total (Non NHS providers)**	**Expenditure**	**Episodes**
	£ million	£ million	£ million	£ million	£ million	£ million	£ million	£ million	£ million	£ million	Number
AMD	12.71	9.09	48.55	0.00	70.36	0.04	-	1.67	1.71	72.07	106,563
Cataracts	10.44	1.34	251.47	0.01	263.26	0.01	-	0.61	0.62	263.87	298,255
DR	2.59	1.85	9.90	0.00	14.35	0.01	-	0.34	0.35	14.70	21,629
Glaucoma	2.51	1.80	13.97	0.01	18.30	-	-	0.00	0.00	18.30	17,448
Refractive error	3.40	3.45	7.58	0.00	14.43	-	-	-	-	14.43	8,576
Other	18.53	30.44	83.64	0.21	132.81	0.01	0.01	0.07	0.09	132.90	130,503
Total	50.17	47.97	415.11	0.24	513.50	0.06	0.01	2.74	2.81	516.30	582,975

Note: (a) 'Other' refers to regular day/night admissions.

Source: DoH (2013) and Deloitte Access Economics calculations.

Chart 3.1: Proportion of recurrent hospital expenditure in England, by condition 2013



Source: DoH (2013).

As Reference Cost data only relates to expenditure incurred within NHS England, data for inpatient expenditure within Scotland, Wales, and Northern Ireland was collected from alternate sources. Inpatient expenditure within Scotland was estimated using Health Service Costs (Costs Book) for 2012-13 (Information Services Division (ISD), 2013). These costs are based on financial and statistical data collected from Scottish Health Boards and published centrally by Information Services Division Scotland. Data is collected according to speciality and care setting, such as Ophthalmology expenditure. Although data is divided into inpatient and day cases, it is not broken down by condition. In order to break down total Ophthalmology expenditure into the conditions of interest, the proportion of total expenditure across conditions for England (as shown in Chart 3.1) was used.

Expenditure in 2012-13 for NHS Wales is detailed in 'Health Statistics Wales', an annual publication by the Welsh Government (WG, 2013). Inpatient data is classified according to

consultant's speciality and care setting. Conditions of interest have been apportioned using Reference Costs from NHS England data. The Department of Health, Social Services and Public Safety (DHSSPS, 2013) in Northern Ireland publishes episode based hospital statistics. Patient data are classified according to HRG4+ codes and FCEs, admissions, inpatient and day cases. This publication does not include cost information per episode. The latest available Reference Cost data for Northern Ireland are 'DHSSPS Reference Costs 2007/08' (DHSSPS, 2010). Therefore, the unit costs for the relevant HRG codes were inflated to the year 2012-13, and then applied to the 2012-13 patient episode numbers to get total hospital expenditure for Ireland. HRG codes for Section B Eyes and Periorbita identifies £13.5 million (in 2013 prices) of expenditure for inpatient and day cases. The same Deloitte Access Economics mapping of HRG code to condition used for NHS England has been applied to Northern Ireland data.

Table 3.2 shows the breakdown of hospital recurrent expenditure for conditions relating to sight loss and blindness in Scotland, Wales and Northern Ireland while Table 3.3 provides a total breakdown of hospital recurrent expenditure for the UK.

Table 3.2: Hospital recurrent expenditure in devolved countries 2013

Condition	Inpatient	Day cases	Total
	£ million	*£ million*	*£ million*
Scotland			
AMD	3.72	7.05	10.77
Cataracts	2.01	35.38	37.39
Diabetic retinopathy	0.76	1.44	2.20
Glaucoma	0.74	1.96	2.70
Refractive error	1.17	1.06	2.23
Other eye disease	8.38	11.75	20.13
Total Scotland	16.78	58.65	75.42
Wales			
AMD	1.32	3.99	5.31
Cataracts	0.71	20.00	20.72
Diabetic retinopathy	0.27	0.81	1.08
Glaucoma	0.26	1.11	1.37
Refractive error	0.41	0.60	1.02
Other eye disease	2.98	6.64	9.62
Total Wales	5.97	33.16	39.12
Northern Ireland			
AMD	0.93	1.26	2.19
Cataracts	0.19	6.36	6.55
Diabetic retinopathy	0.19	0.26	0.45
Glaucoma	0.08	0.23	0.31
Refractive error	0.10	0.06	0.17
Other eye disease	1.23	2.60	3.83
Total Northern Ireland	2.72	10.77	13.49

Source: NHS Reference Costs Collection 2007-08- and Deloitte Access Economics calculations.

Table 3.3: Hospital recurrent expenditure in the UK 2013

	Inpatient	Day cases	Total
	£ million	*£ million*	*£ million*
AMD	27.82	62.52	90.34
Cataracts	14.70	313.83	328.53
Diabetic retinopathy	5.67	12.75	18.42
Glaucoma	5.40	17.27	22.67
Refractive error	8.53	9.31	17.84
Other eye disease	61.78	104.71	166.48
Total	123.91	520.38	644.29

Source: Deloitte Access Economics calculations.

In addition to hospital expenditure undertaken by the NHS, there are a significant number of procedures to reduce sight loss and blindness funded by the private sector. This expenditure also needs to be included in the total cost of sight loss and blindness to the economy.

Unfortunately there is limited data on the number of procedures related to sight loss and blindness that are funded privately. Evidence suggests that a significant number of cataract procedures are undertaken in the private sector to avoid the waiting time for the procedure to be undertaken within the NHS. In a survey of 215 acute independent hospitals with operating departments in England and Wales conducted in 1997-98, Williams et al (2000) estimated that 16.5% of lens operations were privately funded while 7.5% of other eye operations were privately funded. Within this study it has been assumed that the proportion of elective treatments purchased privately has remained constant over the last decade, and that the cost of private procedures is the same as if funded by the NHS. This allowed the cost of procedures from the Reference Cost data to be used to estimate the total cost of private procedures.

The total cost of admitted care relating to sight loss and blindness (including public and private expenditure) was calculated by multiplying total cost funded by the NHS (as presented in Table 3.1 and Table 3.2) for each condition by the reciprocal of the proportion of NHS expenditure related to lens operations (cataracts) and other eye operations, both derived from Williams et al (2000).[8] The cost attributable to private funding was derived by subtracting the total cost of admitted care by the total cost funded by the NHS.

The estimated private cost for admitted care related to sight loss and blindness was estimated as £90.5 million (in 2013 prices). This is shown in Table 3.4, broken down by condition and country. As this cost only relates to admitted care, it does not include costs associated with any assessment visits that may occur before or after a procedure. These types of private costs are captured in Section 3.2.

Table 3.4: Private hospital expenditure in the UK related to sight loss and blindness 2013

	England	Scotland	Wales	Northern Ireland	Total
	£ million	*£ million*	*£ million*	*£ million*	*£ million*
AMD	5.84	0.87	0.43	0.18	7.32
Cataracts	52.14	7.39	4.09	1.29	64.92
Diabetic retinopathy	1.19	0.18	0.09	0.04	1.49
Glaucoma	1.48	0.22	0.11	0.02	1.84
Refractive error	10.78	0.18	0.08	0.01	11.05
Other eye disease	1.17	1.63	0.78	0.31	3.89
Total	72.61	10.47	5.59	1.86	90.52

Source: Deloitte Access Economics calculations.

[8] NHS expenditure was assumed to be 83.5% (100%-16.5%) of total funding for lens operations and 92.5% (100%-7.5%) of total funding for all other eye procedures.

3.2 Non-admitted expenditure

Non-admitted expenditure consists of outpatient costs and other community services, including paramedic services, consultant led outpatient attendances and non-consultant led outpatient attendances.

Outpatient costs for England were sourced from the Reference Costs data and are shown in Table 3.5. The outpatient services were provided by NHS service providers, and outpatient services not provided by NHS service providers. As these services were categorised by HRG codes, a split into eye conditions could be made using the concordance shown in Appendix A. In total, around £124.0 million (in 2013 prices) was spent in 2012-13 on these types of services.

'Other community services' for England were also sourced from the Reference Costs data and totalled £496.6 million (in 2013 prices) (as shown in Table 3.6). These are broken down into 17 different types of services. Unfortunately, Reference Cost data does not split them into HRG codes, instead it uses a more general coding such as Orthoptics, Eye problems / Injuries, Ophthalmology, and Medical Ophthalmology. It also provides expenditure data for Paediatric Ophthalmology although this was not included in the total expenditure as this study is concerned with adults.

In order to split 'Other community services' across eye conditions, the proportion of expenditure for each eye condition within 'Outpatient costs' was applied to the total expenditure for 'Other community services'. This implicitly assumes that the breakdown in expenditure across eye conditions for outpatient costs are the same, or similar, to other community services. Expenditure for 'Other community services' by condition is shown in Table 3.7.

For Scotland, Wales, and Northern Ireland, total expenditure for outpatient and other community services was collected from each countries NHS publicly available data source. For Wales, the data were collected from the 'Health statistics Wales' 2013 publication (Welsh Government (WG), 2013). Scotland data were sourced from Health service costs (costs book) for 2012-13 (ISD, 2013). The latest unit cost data available for Northern Ireland were from the 2007/08 Reference Cost publication, while the data on number of cases came from Northern Ireland's hospital statistics publication. As before, for Northern Ireland, the unit costs for outpatient attendances were inflated to 2012-13 and applied to the total cases for 2012-13. Unfortunately these data sources do not break down these types of costs into the same detail for England. Consequently expenditure between outpatient costs and other community services costs as defined by NHS England could not be directly determined for devolved nations other than England.

Table 3.5: Outpatient costs for England 2013

	Total outpatient - NHS	Total outpatient – non NHS	Total outpatient NHS and non NHS
	£ million	*£ million*	*£ million*
AMD	90.20	0.27	90.47
Cataracts	4.78	-	4.78
Diabetic retinopathy	18.39	0.06	18.45
Glaucoma	3.22	0.00	3.22
Refractive error	1.69	-	1.69
Other eye disease	5.42	0.00	5.42
Total	123.70	0.33	124.03

Source: NHS Reference Costs Collection 2012-13 and 2011-12, and Deloitte Access Economics calculations.

Table 3.6: Other outpatient services costs for England, by service type 2013

	£ million
Paramedic services	1.31
Non-consultant led: first attendance multi-professional non-admitted face to face	0.46
Non-consultant led: follow up attendance multi-professional non-admitted face to face	0.27
Non-consultant led: first attendance multi-professional non-admitted non face to face	0.00
Non-consultant led: follow up attendance multi-professional non-admitted non face to face	0.05
Non-consultant led: first attendance non-admitted face to face	17.25
Non-consultant led: follow up attendance non-admitted face to face	44.97
Non-consultant led: first attendance non-admitted non face to face	0.16
Non-consultant led: follow up attendance non-admitted non face to face	0.23
Consultant led: first attendance multi-professional non-admitted face to face	10.91
Consultant led: follow up attendance multi-professional non-admitted face to face	10.79
Consultant led: first attendance multi-professional non-admitted non face to face	0.00
Consultant led: follow up attendance multi-professional non-admitted non face to face	0.00
Consultant led: first attendance non-admitted face to face	137.37
Consultant led: follow up attendance non-admitted face to face	272.13
Consultant led: first attendance non-admitted non face to face	0.07
Consultant led: follow up attendance non-admitted non face to face	0.66
Total	496.64

Source: NHS Reference Costs Collection 2012-13 and 2011-12, and Deloitte Access Economics calculations.

Table 3.7: Other outpatient services costs for England, by condition 2013

	£ million
AMD	362.25
Cataracts	19.15
Diabetic retinopathy	73.87
Glaucoma	12.87
Refractive error	6.77
Other eye disease	21.71
Total	496.64

Source: NHS Reference Costs Collection 2012-13 and 2011-12, and Deloitte Access Economics calculations.

To allocate expenditure across eye conditions for Scotland, Wales, and Northern Ireland, the expenditure proportions across eye conditions for England were applied to the total outpatient and other community services expenditure for each country. Total non-admitted expenditure (outpatient and community services costs) by eye condition for each country was estimated to be £710.3 million (in 2013 prices) and is shown in Table 3.8.

Table 3.8: Outpatient and other community services NHS expenditure for the UK 2013

	England	Scotland	Wales	N.I.	Total
	£ million	*£ million*	*£ million*	*£ million*	*£ million*
AMD	452.72	31.78	22.62	10.98	518.10
Cataracts	23.94	1.68	1.20	0.58	27.40
Diabetic retinopathy	92.32	6.48	4.61	2.24	105.65
Glaucoma	16.09	1.13	0.80	0.39	18.41
Refractive error	8.47	0.59	0.42	0.21	9.69
Other eye disease	27.13	1.90	1.36	0.66	31.05
Total	620.67	43.57	31.02	15.05	710.30

Source: Deloitte Access Economics calculations.

There are significant outpatient services that are also paid by the private sector. These mainly relate to pre and post procedural assessment visits. However, there are limited data relating to the amount of private funds spent on outpatient care. Consequently it has been assumed that the proportion of total expenditure for outpatient services funded by the NHS is 83.5% for cataract and 92.5% for all other eye conditions, derived from Williams et al (2000). Total outpatient expenditure funded by the private sector is estimated to be £60.8 million (in 2013 prices). This is shown in Table 3.9, broken down by condition and country.

Table 3.9: Outpatient and other community services private expenditure for the UK 2013

	England	Scotland	Wales	N.I.	Total
	£ million	*£ million*	*£ million*	*£ million*	*£ million*
AMD	36.71	2.58	1.83	0.89	42.01
Cataracts	4.73	0.33	0.24	0.11	5.41
Diabetic retinopathy	7.49	0.53	0.37	0.18	8.57
Glaucoma	1.30	0.09	0.07	0.03	1.49
Refractive error	0.69	0.05	0.03	0.02	0.79
Other eye disease	2.20	0.15	0.11	0.05	2.52
Total	53.11	3.73	2.65	1.29	60.78

Source: Deloitte Access Economics calculations.

Non-admitted expenditure for ophthalmic disease also includes expenditure on GP services. GP expenditure is likely to represent a significant cost as most eye diseases are managed by GPs. In a survey of GPs in Nottingham, Sheldrick et al (1993) estimated around 1.5% of all GP consultations were related to eye problems, while in a survey of GPs in London, McDonnell (1988) estimated that 2.3% of all consultations were associated with ocular symptoms. However, most of the ophthalmic disease managed by GPs relate to bacterial conjunctivitis, allergic conjunctivitis, meibomian cyst and blepharitis, accounting for around 70% of consultations (McDonnell 1988)

The funding of GPs and their premises are not within the remit of Reference Costs. Unfortunately there were not sufficient data to allow the estimation of the expenditure on GP consultations. Although the majority of GP costs associated with ophthalmic disease are not associated with eye diseases relating to this study, there is still likely to be a significant cost. Consequently total non-admitted expenditure presented in this section should be considered a conservative estimate.

3.3 Prescribing expenditure

According to the Health and Social Care Information Centre (HSCIC), community prescribing reached £8.63 billion in 2012-13 (HSCIC, 2014). As part of this total, NHS England expenditure on prescriptions for eye therapy was around £137.9 million, or 1.6%. Although this estimate includes prescriptions written in hospitals and dispensed in the community, it is likely to be an underestimate of the actual total cost of prescribing expenditure in primary and secondary care as it does not include prescriptions dispensed in hospitals. Rather, expenditure on hospital prescriptions is estimated separately.

Prescribing expenditure for the eye was further broken down according to the British National Formulary (BNF) Classification, which is shown in Table 3.10. In England, around £90.1 million (in 2013 prices), or 65.4% of total prescribing costs for the eye, was spent towards the treatment of glaucoma, while around £29.9 million, or 21.7% of total prescribing costs for the eye went towards miscellaneous ophthalmic preparations such as ocular diagnosis, peri-op preparations and photodynamic treatment, tear deficiency, and

eye lubricant and astringent (HSCIC, 2014). Similar data was also obtained for Scotland, Wales and Northern Ireland from their respective government reports (Table 3.10).

Table 3.10: Community eye prescription expenditure for the UK 2013

	England	*Scotland*	*Wales*	*N.I.*	*Total*
Classification	£ million	£ million	£ million	£ million	£ million
11.3 Anti-infective eye preparations	6.04	0.58	0.41	0.27	7.29
11.4 Corticosteroids and other anti-inflammatory preparations	10.54	0.78	0.65	0.37	12.34
11.5 Mydriatics and cycloplegics	1.26	0.13	0.10	0.08	1.57
11.6 Treatment of glaucoma	90.14	7.24	5.64	1.92	104.95
11.7 Local anaesthetics	0.01	0.01	0.00	0.00	0.02
11.8 Miscellaneous ophthalmic preparations	29.87	3.06	2.22	1.29	36.44
Total Eye	137.86	11.80	9.01	3.93	162.60

Source: HSCIC (2014), BSO (2014), ISD (2013a) and WG (2014)

Once the expenditure of treating glaucoma was removed from the total prescribing expenditure, the remainder of the expenditure was split between all other conditions. Rather than using an equal split, the prescribing costs were split according to the proportion of total separations for each condition, as shown in Table 3.1. This was on the assumption that most other prescribing costs were associated with surgery, regardless of the type of surgery undertaken.

Lucentis (i.e. ranibizumab), a drug primarily used in the treatment of the wet type of AMD, was the third highest expenditure drug in hospital prescriptions in 2012 (HSCIC, 2013). Deloitte Access Economics (2013) estimated that the cost of Lucentis was approximately £218.3 million in 2013. In May 2013, Eylea received final draft guidance from the National Institute for Health and Care Excellence (NICE) for the treatment of Wet AMD, allowing patients an alternative to Lucentis. No information on the cost of Eylea was available at the time of this report and therefore, the cost of Eylea was excluded although the cost is expected to be substantial due to its high cost per treatment. The listing price of Eylea was £816 per 100-microlitre vial as at July 2013 (NICE, 2013).

The estimates of prescribing expenditure in both primary and secondary care are combined and shown in Table 3.11.

Table 3.11: Eye prescription expenditure for England, by condition 2013

Condition	*England*	*Scotland*	*Wales*	*N.I.*	*Total*
	£ million	£ million	£ million	£ million	£ million
AMD*	192.96	18.36	12.14	5.49	228.95
Cataracts	25.17	2.40	1.98	1.08	30.64
Diabetic retinopathy	1.83	0.17	0.11	0.06	2.17
Glaucoma	90.14	7.24	5.64	1.92	104.95
Refractive error	0.72	0.07	0.72	0.55	2.06
Other eye disease	11.03	1.05	0.03	0.02	12.13
Total Eye	321.85	29.29	20.62	9.12	380.90

* - Lucentis sales data for the UK has been split based on the estimates of prevalence for AMD, which can be found in Appendix B.

Source: HSCIC (2014) and Deloitte Access Economics calculations.

This estimate of public prescribing expenditure makes up only one component of total prescribing costs as there will also be private expenditure through co-payments. Unfortunately there was insufficient utilisation and cost unit data to estimate private co-payments for medications.

3.4 General ophthalmic services

General Ophthalmic Services (GOS) provides free preventative and corrective eye care for children aged 0 to 15 years old, students aged 16 to 18 years old, people aged 60 and over, people on low incomes and those suffering from, or pre-disposed to, eye disease. The service comprises eye tests, vouchers for spectacles (new and replacements) and eye test domiciliary visits.

In England, expenditure for GOS was sourced from the HSCIC general ophthalmic services, activity statistics report (HSCIC, 2013a). In 2012-13 the total cost was £494.9 million. For the same period, expenditure in Scotland was £97.3 million (ISD, 2013b), expenditure in Wales was £31.5 million (WG, 2013a), and for Northern Ireland expenditure totalled £20.8 million (BSO, 2013). These expenditures relate to sight tests, vouchers for a pair of glasses, services provided by ophthalmic medical practitioners, domiciliary visits, and repairs to glasses.

As total GOS expenditure includes costs associated with children, expenditure related to children was removed to ensure GOS expenditure related to adults only. A report on general ophthalmic services activity in England for 2012-13 provides a breakdown of service expenditure by broad age groups, which includes children aged 0 to 15 and students aged 16 to 18 (HSCIC, 2013). Data on activity is provided by Primary Care Trusts in England. It shows that the share of total expenditure on eye tests and vouchers for spectacles (new and replacement ones) for people aged between 0 and 18 years of age was 23.4% and 33.4% respectively. The publication 'Eye Care Statistics for Wales, 2012-13' shows that the share of total eye test and voucher expenditure on people aged between 0 and 18 years of age was 22.0% and 27.5% respectively (WG, 2013a). Total GOS expenditure for England,

Scotland and Northern Ireland was adjusted using the England proportions, while Wales' total GOS expenditure was adjusted using its own proportion.

Total public GOS expenditure for eye tests and optical vouchers was estimated as £464.8 million as shown in Table 3.12. As expenditure on vouchers relates to spectacles (new and replacements), it was assumed that this total cost is due to Refractive Error. Expenditure for eye tests was broken down into specific eye conditions using data published by the Information Services Division (ISD) Scotland for the year ending March 2013 (ISD, 2013b). This source identifies the number of eye tests carried out by NHS Scotland according to patient type and eye condition. Table 3.13 shows the data from ISD Scotland with eye tests for each condition also shown as a proportion of total tests.

The proportion of eye tests by condition (as shown in Table 3.13 for Scotland) was used to split eye test expenditure into conditions for each country. The category 'Visually impaired' and the category 'None of the above' was apportioned to RE. Total public GOS expenditure by condition for each country is shown in Table 3.14.

Table 3.12: Public GOS expenditure on persons ≥18 years of age 2013

	Vouchers	Eye tests	Total
	£ million	*£ million*	*£ million*
England	157.25	197.54	354.79
Scotland	20.77	50.67	71.44
Wales	11.21	12.53	23.73
Northern Ireland	7.52	7.28	14.80
Total	196.75	268.02	464.77

Source: HSCIC (2013a), ISD (2013b), WG (2013a), BSO (2013) and Deloitte Access Economics calculations.

Table 3.13: Number of eye tests in Scotland, by condition, 2012-13

	Number	Proportion (%)
Visually impaired	14	0.0
Cataracts	341,848	15.7
Diabetic retinopathy	165,993	7.6
Glaucoma	136,402	6.3
External eye disease	118,180	5.4
AMD	105,397	4.9
None of the above	1,303,537	60.0
Total	2,171,371	100.0

Note: The number of eye tests was based on the number by patient type as published by ISD (2013b).

Source: ISD (2013b).

Table 3.14: Public GOS expenditure on people ≥18 years of age, by condition 2013

	England	Scotland	Wales	N.I.	Total
	£ million	*£ million*	*£ million*	*£ million*	*£ million*
AMD	9.59	2.46	0.61	0.35	13.01
Cataracts	31.10	7.98	1.97	1.15	42.20
Diabetic retinopathy	15.10	3.87	0.96	0.56	20.49
Glaucoma	12.41	3.18	0.79	0.46	16.84
Refractive error	275.84	51.19	18.73	11.89	357.65
Other eye disease	10.75	2.76	0.68	0.40	14.59
Total	354.79	71.44	23.73	14.80	464.77

Source: Deloitte Access Economics calculations.

Not only are GOS paid for through public funds, a significant proportion of costs are borne by individuals through out-of-pocket expenses. The Sight Tests Volume and Workforce Survey estimated that that around 31.4% of sight tests in the UK were paid for privately in 2005-06 (ONS, 2006). As public funds can be used for sight tests for those people aged 60 and over and those suffering from, or pre-disposed to, eye disease, it was assumed that eye tests paid out-of-pocket are mostly for RE. It is also likely that the proportion of people who pay for spectacles is similar to the proportion of people who pay for eye tests. This is because the same conditions must be met for public funding.

The total public cost for RE for those aged 18 years and over was estimated to be £357.7 million (see Table 3.14), which includes expenditure on eye tests and vouchers for spectacles. Assuming this expenditure represents 68.6% of total expenditure for Refractive Error, it is estimated that private expenditure on eye tests and spectacles within the UK was around £149.8 million. The breakdown of this expenditure by expenditure type and country is shown in Table 3.15. There has been no private expenditure for eye tests assigned to Scotland as the Scottish population receives free eye tests.[9]

Table 3.15: Private GOS expenditure by persons ≥18 years of age 2013

	Spectacles	Eye tests	Total
England	71.98	54.28	126.26
Scotland	9.51	0.00	9.51
Wales	5.13	3.44	8.57
Northern Ireland	3.44	2.00	5.44
Total	90.06	59.73	149.78

Source: Deloitte Access Economics calculations.

[9] http://www.scotland.gov.uk/Topics/Health/Services/Eyecare/Eye-Examination, accessed 23 April 2014

3.5 Expenditure associated with injurious falls

Sight loss has a profound impact on wellbeing. It can shorten life, increase the risk of other conditions, restrict social participation and independence and impair physical and mental health. Moreover, the cost of sight loss is not limited just to the treatment cost of the various conditions that underlie it. Brody et al (2001) showed that:

- 78% of subjects reported having at least one comorbid condition in addition to the sight loss for which he or she was receiving medical care;
- the mean number of comorbid conditions reported was 1.33, suggesting an attributable fraction for sight loss relative to all conditions of 42.9%;
- the most frequently reported comorbid conditions were hypertension (32%), heart disease (14%), thyroid disorder with medication (10%) and cancer (8%); and
- the depressed group had a higher mean number of comorbidities at 1.67 compared to 1.17 in the non-depressed group.

The only conditions that were statistically significant and likely to be causally related to sight loss and blindness were falls and depression. These mechanisms can also increase mortality for people with sight loss and blindness.

Older people are more at risk of falls that often cause injuries and additional health expenditures. Many studies have examined the factors underlying increased propensity to fall in the elderly and several have found a significant link between falls and sight loss. For example, Coleman et al (2004) reported that women with declining visual acuity had 1.85 to 2.08 odds of experiencing a fall. In a review of 31 studies on the risks and types of injuries associated with sight loss, Legood et al (2002) suggest that those with sight loss are 1.7 times more likely to have a fall and 1.9 times more likely to have multiple falls. They also suggest that the odds of a hip fracture are between 1.3 and 1.9 times greater for those with sight loss.

A summary of some key studies regarding vision loss and falls or fractures is presented in Table 3.16. Generally, these studies distinguish between the occurrence of accidental falls and the expensive and morbid complications of a hip fracture resulting from some falls. On average across all the studies, the odds ratio (OR) of accidental falls is 1.68 while, for those with low vision or partial sight, the OR of hip fracture is 1.83 and for the blind it is 3.95.

Sight loss can also cause depression. Most studies find prevalence rates of depression in elderly populations with sight loss between 25% and 45% (Burmedi et al, 2002). Within the general elderly population, less than 20% have mild dysphoria with less than 5% suffering from severe depression. It is again necessary to control for other comorbidities. Table 3.17 provides a review of findings regarding the prevalence of depression within those who experience sight loss. Comparing estimated risk of depression from these studies, the relative risk of depression is estimated to be around 3.5 times higher. However, as there was not enough adequate Reference Cost data on health care system expenditure relating to depression this cost has not been estimated.

Table 3.16: Odds ratio of falls and hip fractures due to sight loss

	Visual acuity	Odds ratios	Source
1	Loss ≥ 2 lines compared to <2 lines	OR of multiple falls = 1.43	Coleman, 2004
2	<6/12	OR of multiple falls = 1.75	Koski, 1998
3	poor distance vision	OR of multiple falls = 2.3	Koski, 1998
4	<6/9 in either eye	OR of hip fractures = 1.73	Felson et al, 1989
5	≤ 6/30 in both eyes	OR of hip fractures = 2.17	Felson et al, 1989
6	≤ 6/15 compared to >6/9	OR of hip fracture = 2	Dargent-Molina, 1996
7	No association found between VA and fractures		Cumming et al, 1995
8	≤ 6/18	OR of hip fracture = 8.4	Ivers et al, 1998
9	≤ 6/12	OR of hip fracture = 1.75	Klein et al, 1998
10	≤ 60/60 (face recognition)	OR of hip fracture = 3.1	de Boer et al, 2004
11	≤ 60/60 (face recognition)	OR of hip fracture = 4.8	Grisso et al, 1991
12	≤ 6/18	OR of hip fracture = 1.5	Ivers et al, 2000
13	<6/12 better eye	OR of fall at home = 0.98 OR hip fracture = 1.50	Vu et al, 2005
	<6/12 worse eye	OR fall at home = 2.86 OR hip fracture = 1.80	
14	VA worse than 20/40 vs 20/40 or better	OR of multiple falls = 1.06	Coleman et al, 2007
15	Visual deficit	OR of falls = 2.5	Rubenstein and Josephson, 2006
16	BCVA <6/12 vs ≥ 6/12	OR of multiple falls = 2.47	Kuang et al, 2008
17	Vision loss (present vs absent)	OR of femur fracture = 1.67 OR of falls or accidents = 1.59	Bramley et al, 2008
18	Central vision impairment (moderate to severe vs not)	OR of falls = 2.36 OR of fall with injury =2.76	Patino et al, 2010
	Peripheral visual impairment (moderate to severe vs not)	OR of falls = 1.42 OR of fall with injury = 1.40	
19	Severe visual impairment in worse eye	OR of fall = 1.6	Lamoreux et al, 2008
	Severe VI in worse eye and mild or moderate VI in other	OR of fall = 2.1	

Table 3.17: Prevalence of depression in those with sight loss

Source	Finding
Brody et al, 2003	33% depressed
Karisson, 1998	Less than 10% depressed
Kleinschmidt, 1995	22% mildly; 4% moderately to severely depressed
Rovner et al, 1997	39%-70% depression depending on measurement scale used
Wahl, 1994	43% of blind, 29% of visually impaired depressed
Robbins et al, 1988	Mean score of 10.3, 10+ indicates depression
Vu et al, 2005	OR 6.28 for health and emotional problems; OR 4.7 for 'not full of life'
Horowitz et al, 2005	7% with current major depression, 26.9% with sub-threshold depression.
Rovner et al, 2002	33% were depressed at baseline
Evans et al, 2007	13.5% were depressed (GDS-15 score of 6 or more) compared with 4.6% of people with good vision.
Lamoureux et al, 2009	10.5% had mild symptoms of depression, 5.5% had moderate symptoms of depression
Freeman et al, 2009	26% showed signs of depression

Source: Burmedi et al (2002), Horowitz et al (2005), Royner et al (2002), Evans et al (2007), Lamoureux et al (2009), Freeman et al (2009).

Health care system expenditure due to injury relating to sight loss and blindness was estimated using the methodology presented in Scuffham et al (2002), a study developed to find costs and incidence of falls associated with sight loss and blindness in the UK. Within their study the cost of falls attributable to sight loss are estimated by assuming that people with sight loss would have the same rate of falls as people with no sight loss if their sight was corrected. The same assumption was made within this study.

Hospital Episodes Statistics (HES) is an online data source which collects details for all hospital episodes in England (HSCIC, 2013b). Admissions according to age and the total number of emergency admissions are recorded by 'external cause' meaning that the original cause of injury is recorded whenever it is possible to do so. Similarly, the Patient Episode Database for Wales (PEDW) also records admissions by 'external cause'.

To record 'external cause', ICD-10 codes are used. There are 19 diagnostic codes assigned to alternative types of falls for example, slipping, tripping or tumbling, or falling from a bed

or chair. However not all of the diagnosis codes are attributable to sight loss and blindness, so those that are likely not to be the result of sight loss and blindness were omitted.[10]

To calculate the total cost associated with falls (for all people not just those with sight loss), the number of FCEs, day cases and A&E attendances were multiplied by the weighted average costs for these services. A weighted average cost for FCEs was derived from non-elective inpatient HRG Reference Cost data for the three HRG codes attributed to falls (WA23A, WA23B, and WA23C), estimated as £1,007.9. A weighted average cost for day cases was derived from the same HRG codes for Reference Cost data regarding Day Cases, and equated to £1223.8. As A&E Reference Cost data is not broken down into HRG codes for falls, an average cost for attendance was derived from Reference Cost data relating to minor injury service leading to admitted. This equated to £69.1 per attendance.

As patients can arrive to A&E either by their own transport or using a paramedic service, the proportion of those arriving by ambulance was estimated as 40.2%.[11] This proportion was applied to the total A&E episodes related to falls to derive an estimate of the total number of ambulance episodes related to falls. A weighted average FCE cost associated with ambulance services was derived from 2010-11 Reference Costs relating to paramedic services associated with falls.[12] The weighted average cost was calculated across services provided by urban ambulance NHS Trusts for categories A, B, and C. This equated to £234.6 in 2013 prices.

Table 3.18 shows the number of episodes relating to admissions, A&E attendances, day cases and ambulance services. Due to a lack of available data with similar coding, falls within the HES relating to England were scaled up by a factor of 1.13 to represent falls associated with the UK population excluding Wales (i.e. England, Scotland and Northern Ireland).[13] The falls related expenditure for Wales was calculated in the same way as England, using the PEDW case data. This was added to the England HES data (with scaling applied) to get the total UK falls related estimates.

[10] Categories omitted include: W00 Fall on same level involving ice and snow, W02 Fall involving ice-skates skis roller-skates or skateboards, W03 Other fall same level due collision/pushing by another person, W04 Fall while being carried or supported by other persons, W05 Fall involving wheelchair W06 Fall involving bed W07 Fall involving chair W08 Fall involving other furniture W09 Fall involving playground equipment, W11 Fall on and from ladder, W12 Fall on and from scaffolding, W13 Fall from out of or through building or structure, W14 Fall from tree, W15 Fall from cliff, W16 Diving/jumping into water causing injury other than drowning or submersion

[11] Calculated by dividing the total number of paramedic services (excluding transfers) by the total number of A&E attendances, both sourced from the Reference Cost data for 2012-13.

[12] The 2012-13 Reference Costs data no longer provide the appropriate breakdown and hence the 2010-11 Reference Costs data were used.

[13] Scaling was calculated by dividing the total UK population excluding Wales by the England population, which were both derived from the population model used in Section 2 of this report.

Table 3.18: Number of episodes related to falls for total UK population, 2012-13

Fall type	0-17	18-59	60-74	≥75	Total ≥18
England, Scotland and Northern Ireland					
Admitted	26,625	73,663	63,469	215,698	352,831
A&E	24,802	68,554	59,052	200,771	328,377
Day cases	547	1,464	1,259	4,096	6,819
Ambulance	9,967	27,551	23,732	80,686	131,969
Wales					
Admitted	1,535	3,895	3,261	9,667	16,823
A&E	1,407	3,563	2,977	8,774	15,313
Day cases	-	-	-	-	-
Ambulance	565	1,432	1,196	3,526	6,154
Total	65,448	180,121	154,947	523,218	858,286

Source: HSCIC (2013b) and Deloitte Access Economics calculations.

Scuffham et al's (2002) methodology was used to determine the number of episodes attributable to sight loss and blindness. They estimated the number of falls attributable to sight loss and blindness as the difference between the estimated number of falls in the population with sight loss and blindness and the expected number of falls in this population if they did not have sight loss. Within this study, rather than using falls, the different types of episodes were used (admitted, day cases, A&E, and ambulance). Following Scuffman et al (2002) this can be represented by:

$$Episodes_{k,VI} = (I_{VI} - I_{non-VI})P_{VI}$$

where $Episodes_{k,VI}$ is the number of episodes directly attributable to sight loss and blindness across the k types of episodes, P_{VI} is the prevalence of sight loss and blindness, and $I_{k,VI}$ and $I_{k,non-VI}$ are the attributable fractions given by the following equations:

$$I_{k,VI} = RR * \left[\frac{Episodes_{k,Total}}{RR * P_{VI} + P_{non-VI}} \right]$$

$$I_{k,non-VI} = \left[\frac{Episodes_{k,Total}}{RR * P_{VI} + P_{non-VI}} \right]$$

where P_{non-VI} is the population of people without sight loss and blindness, RR is the relative risk of falls associated with sight loss and blindness, which was 1.9 (Scuffham et al, 2002) and $Episodes_{k,Total}$ is the known number of episodes related to falls within the population.

Table 3.19 shows the number of episodes relating to falls due to sight loss and blindness in the UK and Table 3.20 shows the associated direct health care system costs. Excluding the costs of those aged between 0 and 17 to focus on adults, the total cost of falls related to sight loss and blindness for adults was estimated as £23.5 million.

Table 3.19: Estimated episodes related to falls due to sight loss and blindness in the UK 2013

Fall type	18-59	60-74	≥75	Total
England, Scotland and Northern Ireland				
Admitted	3,956	3,409	11,585	18,950
A&E	3,682	3,172	10,783	17,636
Day cases	78	67	219	365
Ambulance	1,480	1,275	4,333	7,088
Wales				
Admitted	208	174	515	897
A&E	190	159	468	816
Day cases	-	-	-	-
Ambulance	76	64	188	328
Total	9,670	8,319	28,092	46,080

Source: Deloitte Access Economics calculations.

Table 3.20: Public cost of episodes related to falls due to sight loss and blindness in the UK 2013

Fall type	18-59	60-74	≥75	Total
	£ million	*£ million*	*£ million*	*£ million*
England, Scotland and Northern Ireland				
Admitted	3.99	3.44	11.68	19.10
A&E	0.25	0.22	0.74	1.22
Day cases	0.10		0.27	0.45
Ambulance	0.35	0.30	1.02	1.66
Wales				
Admitted	0.19	0.18	0.52	0.89
A&E	0.01	0.01	0.03	0.06
Day cases	-	-	-	-
Ambulance	0.02	0.01	0.04	0.08
Total	4.91	4.24	14.30	23.45

Source: Deloitte Access Economics calculations.

To split the expenditure by country, the proportion of prevalence for each country was applied to the total expenditure on admitted, A&E, day cases and ambulance (see the total prevalence for each country in Appendix B). The prevalence estimate for the UK (excluding Wales) is 1,831,055 (100.0%). The prevalence estimates for England, Scotland and Northern Ireland are 1,622,266 (88.6%), 160,549 (8.8%) and 48,240 (2.6%) respectively. The estimated breakdown of public expenditure on falls in the UK related to sight loss and blindness is shown in Table 3.21.

Table 3.21: Public cost of episodes related to falls due to sight loss and blindness in the UK by country 2013

	England	Wales	Scotland	N.I.	Total
Admitted	16.92	0.89	1.67	0.50	19.99
A&E	1.08	0.06	0.11	0.03	1.27
Day cases	0.40	-	0.04	0.01	0.45
Ambulance	1.47	0.08	0.15	0.04	1.74
Total	19.87	1.02	1.97	0.59	23.45

Source: Deloitte Access Economics calculations.

While these estimates show there is a significant cost associated with falls due to sight loss and blindness, there are some limitations in utilising this information as they are based on broad assumptions regarding the relative risk of falling for a person with sight loss or blindness compared to a person with normal vision. Some of the literature in Table 3.16 shows that the odds ratio of falling with injury is higher for a person with sight loss or blindness than for a person with normal vision, however the model treats the outcome of the fall as a constant. Additionally, the estimates are also highly sensitive to the relative risk of falling, which can easily be affected by factors such as the environment. As Scuffham et al (2002) observes, the UK contains many apartment buildings with stairs, which would likely increase the relative risk of falling for people with sight loss or blindness. The expenditure associated with falls estimated here fails to account for both of these reasons, and should be used with caution.

In addition, the above costs will underestimate the total cost associated with injurious falls related to sight loss and blindness as they do not include any private costs that are also expected to occur, such as wound dressings, antiseptics, and private rehabilitation services. Unfortunately data on utilisation was not available to adequately estimate these costs.

3.6 Research and development

Funding for medical R&D is channelled through three main sources in the UK, including private industry, non profit organisations, and public funds through the government (McGuire and Raikou, 2006). When any of these sources invest in R&D, they divert money from other uses, which imposes a cost.

The private sector contributes a significant proportion, accounting for 69% of total medical R&D in the UK in 2004-05 (Hargreaves, 2008). This is primarily through pharmaceutical and biotechnology companies where research is undertaken in commercial facilities. Non profit organisations (such as The Wellcome Trust, Cancer Research UK, and British Heart Foundation) contribute a large proportion, accounting for around 9% of funding in 2004-05. Finally, public funding from the UK government, which includes the Medical Research Council (MRC), Higher Education Funding Councils, other government departments such as Defence, and the NHS, accounts for 23%. Most of these funds are channelled through the Department of Health in England (which is managed by the National Institute for Health Research) and the research councils (Hargreaves, 2008).

Similar findings were concluded by Rottingen et al (2013). According to their analysis, total global investments in health R&D (both public and private sector) in 2009 amounted to USD240 billion with the UK contributing around £12 billion. Of the total expenditure, around 60% came from the business sector, 30% from the public sector and about 10% from other sources (including non-profit organisations).

As private expenditure on R&D mostly relates to pharmaceutical and biotech products, it is not expected that a large amount of funding would come from the private sector for eye and adnexa conditions. Consequently it has been assumed that all R&D funding for these types of conditions comes from non-commercial sources.

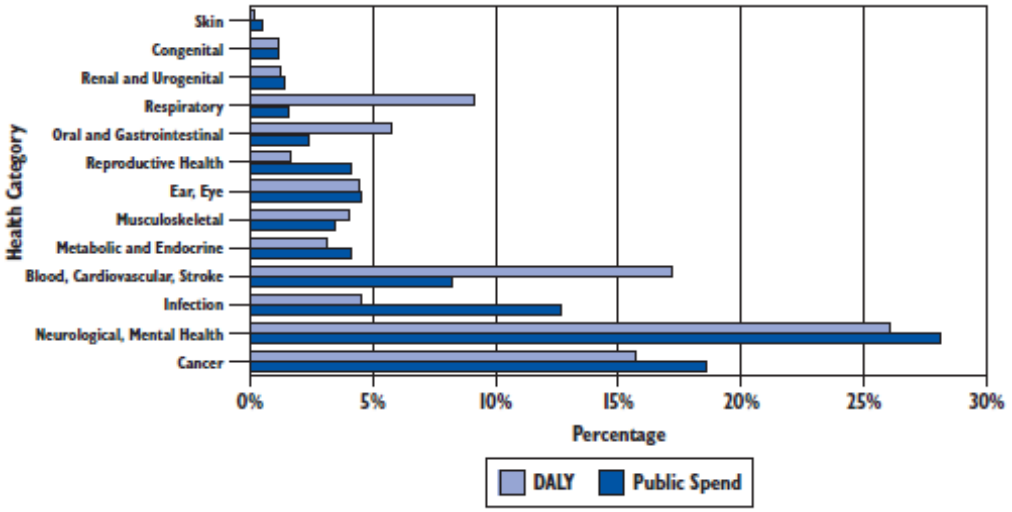
According to the Department for Business, Innovation and Skills (DBIS), the total government funding for R&D was approximately £9,060 million in 2012 (DBIS, 2013). Of this, around 21.3% (i.e. £1,930 million) was spent on health-related R&D, which translated to around £1,977 million in 2013 prices. Assuming that this represented 30% of the total R&D expenditure in accordance with Rottingen et al (2013), then the health R&D from other sources was estimated to be approximately £659 million in 2013. As a result, the total health R&D expenditure from public sector and other sources was estimated to be around £2,589 million in 2013. However, this expenditure is not specific to eye conditions; rather, it includes all health conditions.

According to the Medical Research Council (MRC), out of the total research program expenditure of £767 million, 2.2% was spent on the health category 'Ear and eye'. Applying this proportion to the total health-related R&D expenditure in the UK, it was estimated that approximately £57.0 million was spent on eye and ear conditions.

As total expenditure relates to both eye and ear conditions, it was split to estimate the cost of medical R&D for sight loss and blindness. As noted by Cooksey (2006), the overall funding pattern of health categories is generally in line with the burden of disability, which is measured by the UK DALYs for each health category. For example, ear and eye category accounts for around 4.5% of total non-commercial funding and similarly accounts for around 4.5% of the total burden of disease in Figure 3.1.

To breakdown the ear and eye category into its component parts, DALYs by cause, sex, and age in high income countries were sourced from the WHO Global Burden of Disease project (WHO, 2006). The breakdown for sense organ disorders are shown in Table 3.22.

Figure 3.1: Breakdown of non-commercial UK health research funding, 2003-04



Source: Cooksey (2006).

Table 3.22: DALYs for sense organ diseases, by cause and gender, 2001

	Males	Females	Total	Proportion of total
	000s	*000s*	*000s*	*%*
Glaucoma	107	161	268	3.5
Cataracts	201	292	493	6.4
Vision disorders, age related	611	915	1,525	19.9
Hearing loss, adult onset	2,669	2,718	5,387	70.2
Other sense disorders	1	1	3	0.04
Total	3,589	4,087	7,676	100.0

Source: WHO (2006).

Based on the breakdown in DALYs, it is estimated that expenditure on medical R&D for eye conditions is around 29.8% of the total medical R&D for ear and eye conditions. Consequently, total expenditure for eye conditions is estimated to have been around £16.98 million in 2013.[14]

As the Global Burden of Disease project does not specifically itemise DALYs associated with diabetic retinopathy and refractive error, it is problematic to break down the total R&D expenditure using DALYs extracted from WHO (2006) into the eye conditions under investigation within this report. Instead it was assumed that the relative burden of disease

[14] Due to current debates surrounding the disability weights used to estimate the DALYs for vision loss in the 2010 Global Burden of Disease report (Taylor et al, 2012), we have retained use of the DALY distribution as per Access Economics (2009). However, if the 2010 DALYs distribution was applied, then the R&D expenditure for partial sight and blindness would be estimated as £29.6 million for the year 2013.

between eye conditions is similar in Australia and the UK. This allowed us to use a detailed Australian report on the burden of disease (Begg et al, 2007), which is based on the WHO methodology used to calculate burden of disease, to further breakdown the proportion of DALYs across eye conditions. The final breakdown of medical R&D across conditions for the UK is shown in Table 3.23.

Table 3.23: Breakdown of non-commercial UK health research funding 2013

	% of DALY[a]	Medical R&D expenditure
	£ million	*£ million*
AMD	25.17	4.13
Cataracts	5.08	0.83
Diabetic retinopathy and other eye disease	24.76	4.06
Glaucoma	7.98	1.31
Refractive error	40.61	6.66
Total	103.60	16.98

Note: (a) Proportion of total DALYs associated with eye conditions were derived from Begg et al (2007) and relate to the Australian population. It is assumed that the proportion of the burden of disease across eye conditions in Australia is similar to the UK.

Source: Begg et al (2007) and Deloitte Access Economics calculations.

The ONS (2014) contained information on the gross domestic expenditure relating to research and development for the year 2012 by country and region. To split the non-commercial UK health research funding (Table 3.23) into England, Northern Ireland, Wales and Scotland, the proportions based on ONS (2014) were applied. Table 3.24 presents the estimates by country.

Table 3.24: Breakdown of non-commercial UK health research funding by country 2013

	Eye related R&D
	£ million
England	14.11
Scotland	2.08
Wales	0.51
Northern Ireland	0.28
Total	16.98

Source: ONS (2014) and Deloitte Access Economics calculations.

3.7 Residential care and community care sectors

Publicly funded social services in the UK are provided at a local level by Councils with Social Services Responsibilities. Some social services are provided by the NHS but the majority of services are provided by councils.

It is common for the costs of social care to be shared by the local council and person receiving care. Contributions are paid to councils and recorded as revenue. The size of the contribution made by each person receiving services is determined by financial means test which is based on income, capital and assets.

In order for a person to qualify for social care an assessment of needs is carried out by a health visitor. Councils are obliged to carry out one or continual assessments in a timely manner whenever a person, relative or healthcare professional requests it. Assessments are based on a person's ability to live independently, their physical safety, level of physical and mental health, involvement in education/work/learning and the availability of social/familial support.

Community services are categorised as either community or residential based. Community-based services include day care, meals, home care, overnight respite, short term residential, direct payments, professional support, equipment and other (which primarily includes transport costs). Residential care covers independent sector residential care, local authority residential care and nursing care.

Community care in England is provided through Personal Social Services (PSS). Expenditure for PSS is broken down into client groups for children and families, people aged 65 and over and adults aged 18 to 64 with mental, learning or physical disabilities (which includes sight loss and blindness). The latter two client groups were relevant to this study.

A report by the HSCIC estimated that PSS expenditure in England totalled approximately £17.16 billion in 2012-13 (HSCIC, 2013c). Table 3.25 shows the breakdown of expenditure for the relevant client groups. Expenditure on people aged 65 years and over totalled around £8.85 billion and expenditure for physically disabled adults totalled around £1.56 billion.

Table 3.25: Expenditure on social services for adults with physical disability and older people in England, 2012-13

	Disabled adults 18-64	Older people (≥65)	Other	Total
	£ million	*£ million*	*£ million*	*£ million*
Community-based	990	3,150	3,600	7,740
Residential care	350	4,710	2,440	7,500
Assessment and care management	220	990	700	1,910
Total	1,560	8,850	6,740	17,150

Source: HSCIC (2013c).

To estimate expenditure on services, activity data for physically disabled adults and older people aged 65 and over experiencing sight loss and blindness and dual sensory loss for community-based and residential services in England was used. This data was sourced from a report by the HSCIC (2013c), which showed around 1.33 million people received some form of PSS care in 2012-13 and of these, around 27,000 people suffered from a sight loss

and blindness while 4,800 experienced dual sensory loss. That is, around 2.4% of PSS services were related to sight loss and blindness.

Estimated expenditure on community services for those with sight loss and blindness in England are shown in Table 3.26. These were calculated by multiplying the proportion of people with sight loss or dual sensory loss clients by the total expenditure for people aged 65 years and over and total expenditure for adults aged 18 to 64 with mental, learning or physical disabilities.[15]

Data for PSS expenditure and activity in Wales (WG, 2013b) was also available, although Scotland and Northern Ireland had limited information on expenditure. For Wales, Scotland and Northern Ireland, total community services expenditure was multiplied by the same proportions derived from England social services activity data. Doing so, the total UK expenditure was estimated to be £276.8 million in 2013. Community services expenditure for sight loss and blindness across devolved nations is shown in Table 3.27.

Table 3.26: Estimated expenditure on community services for those with sight loss in England 2013

	Disabled adults 18-64	Older people (≥65)	Total
	£ million	*£ million*	*£ million*
Sight loss and blindness			
Community-based[a]	14.16	80.35	94.51
Residential care[a]	1.75	89.88	91.63
Dual sensory loss			
Community-based	1.95	14.83	16.78
Residential care	0.59	17.23	17.83
Total	18.46	202.29	220.75

Note: (a) A client may have received more than one service thus there may be double counting across categories.

Source: HSCIC (2013c) and Deloitte Access Economics calculations.

[15] Although this calculation includes individuals with dual sensory loss it was assumed that partial sight and blindness was the main contributor to community-based and residential care. Consequently no adjustments were made for the contribution of any other sensory loss to care.

Table 3.27: Estimated expenditure on community services for those with sight loss, Devolved Nations 2013

	Sight loss and blindness		Dual sensory loss		Total
	18-64	≥65	18-64	≥65	
	£ million	*£ million*	*£ million*	*£ million*	*£ million*
Scotland					
Community-based	1.67	11.74	0.23	2.17	15.81
Residential care	0.21	13.13	0.07	2.52	15.93
Total - Scotland	1.87	24.88	0.30	4.69	31.73
Wales					
Community-based	0.91	4.78	0.13	0.88	6.70
Residential care	0.11	5.35	0.04	1.03	6.53
Total - Wales	1.02	10.13	0.16	1.91	13.23
Northern Ireland					
Community-based	0.65	4.05	0.09	0.75	5.54
Residential care	0.08	4.53	0.03	0.87	5.51
Total – Northern Ireland	0.73	8.58	0.12	1.62	11.05

Source: HSC (2013), Scottish Government (2014), WG (2013b) and Deloitte Access Economics calculations.

3.8 Capital and administration

Across all country health departments, there is a significant proportion of expenditure undertaken on administrative functions and capital purchasing. This cost is across all program budgeting areas and the data is not broken down into specific areas.

In the annual report and accounts for 2013, the DoH, England, (2013) reported an administration expense of £3,502 million and a capital expense of £3,783 million. In Northern Ireland, the DHSPSS (2013a) reported a net administration expense of £34.7 million and a capital expense of £320 million in their resource accounts for 2013. The Scottish Government (2014) report total administration expenditure of £214 million, of which £21 million (i.e. 9.8%) was attributed to health. The capital expenditure on health was £620 million. The Welsh Government (2013) published a report for 2012-13 which showed capital expenditure on health to be £227 million. They also reported that the total administration expenditure was around£272 million, however, not all was related to health. Assuming that a similar proportion of administration is health related as per Scotland's financial report, approximately £26.7 million of the total administration expense in Wales was estimated to be related to health.[16]

[16] The Scottish proportion was applied to the Wales data as the information presented in the annual reports is similar.

The proportion of these costs attributable to eye conditions leading to sight loss and blindness was then estimated by assuming the level of administrative and capital expenditure attributable to eye conditions is in proportion to the level of gross operating costs across program budgeting areas. The gross operating cost for the Department of Health was approximately £107 billion in 2010-11 (DoH, 2012). Of this, around £2.14 billion (or 2.0%) was spent on 'Problems with vision'. Multiplying this proportion by total administrative and capital costs, it is estimated that administrative costs and capital costs, attributable to eye conditions leading to sight loss and blindness, is around £71.7 million and £99.0 million respectively in 2013. Total vision related administration and capital expenditure by country is shown in Table 3.28.

Table 3.28: Breakdown of eye related administration and capital expenditure by country, 2013

	Total expenditure		Vision related expenditure		
	Administration	Capital	Administration	Capital	Total
	£ million	*£ million*	*£ million*	*£ million*	*£ million*
England	3,502	3,783	70.04	75.66	145.70
Scotland	21	620	0.42	12.40	12.82
Wales	27	227	0.53	4.55	5.08
Northern Ireland	35	320	0.69	6.40	7.09
Total	3,584	4,950	71.69	99.01	170.69

Source: Deloitte Access Economics calculations.

3.9 Summary of health care system expenditure

The estimated health care system expenditure for inpatient and day case costs and outpatient costs was calculated as £1,505.9 million for 2013. AMD accounted for 40% of total inpatient and day case costs and outpatient costs, and DR accounted for a further 15% of the total. This represents the rapid growth in costs associated with the anti-VEGF drugs Lucentis and Eylea. Inpatient and day case costs and outpatient costs account for 50% of the total health care system expenditure.

Table 3.29: Summary of inpatient and day case costs and outpatient costs, by condition 2013

	Inpatient and day case	Outpatient	Total
	£ million	*£ million*	*£ million*
AMD	44.4	560.1	604.5
CAT	389.3	32.8	422.1
DR	110.3	114.2	224.5
GLC	24.5	19.9	44.4
RE	25.8	10.5	36.3
OTH	140.5	33.6	174.1
Total	**734.8**	**771.1**	**1505.9**

The estimated total health care system expenditure was calculated as £2,989.3 million for 2013. A summary of health care system expenditure by expenditure type and country is shown in Table 3.30. A summary of health care system expenditure by condition is shown in Table 3.31. As not all health care system expenditure could be split by country or condition these have been left as 'n.a.' within the tables.

Table 3.30: Summary of health care system expenditure, by country 2013

	England	Scotland	Wales	N.I.	Total
	£ million	*£ million*	*£ million*	*£ million*	*£ million*
Hospital recurrent expenditure	588.9	85.9	44.7	15.3	734.9
Non-admitted expenditure	673.8	47.3	33.7	16.3	771.1
Prescribing expenditure	137.9	11.8	9.0	3.9	162.6
Lucentis*	184.0	17.5	11.6	5.2	218.3
General ophthalmic services (GOS)	481.1	80.9	32.3	20.2	614.6
Expenditure associated with injurious falls	19.9	2.0	1.0	0.6	23.4
Research and development	14.1	2.1	0.5	0.3	17.0
Residential care and community care services	220.8	31.7	13.2	11.0	276.8
Capital and administration	145.7	12.8	5.1	7.1	170.7
Total	2,466.1	292.1	151.1	80.1	2,989.3

Note: Cells that could not be split due to lack of information are labelled n.a. * - Lucentis sales data for the UK has been split based on the estimates of prevalence for AMD, which can be found in Appendix B.

Table 3.31: Summary of health care system expenditure, by condition 2013

	AMD	Cataract	DR	GLCMA	RE	Other	Total
	£ million	*£ million*	*£ million*	*£ million*	*£ million*	*£ million*	*£ million*
Hospital recurrent expenditure	44.4	389.3	110.3	24.5	25.8	140.5	734.8
Non-admitted expenditure	560.1	32.8	114.2	19.9	10.5	33.6	771.1
Prescribing expenditure	229.0*	30.6	2.2	104.9	2.1	12.1	380.9
General ophthalmic services (GOS)	17.2	55.8	27.1	22.3	472.9	19.3	614.6
Expenditure associated with injurious falls	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	23.4
Research and development	4.1	0.8	4.1	1.3	6.7	0.0	17.0
Residential care and community care services	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	276.8
Capital and administration	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	170.7
Total							2,989.3

Note: Cells that could not be split due to lack of information are labelled n.a. * Prescribing expenditure includes the cost of Lucentis, a drug used primarily in the treatment of AMD conditions.

4 Indirect costs

This chapter investigates indirect costs that are related to sight loss and blindness. As they do not relate to the direct health care system costs, these costs are indirectly associated with sight loss rather than costs associated with treatment. Unfortunately there was not enough data to adequately split indirect costs by condition so this chapter presents totals for sight loss and blindness. Indirect costs examined within this chapter include:

- productivity losses from reduced labour market participation through lower employment, greater absenteeism, and premature mortality associated with sight loss and blindness;
- costs to informal carers from providing care to someone with sight loss and blindness;
- sight loss and blindness devices and modifications, such as the cost of low vision aids and rehabilitation services, mobility and communication devices, visual aids, and modifications to homes; and
- deadweight loss associated with raising additional tax revenue to publicly fund health care services and direct payments to people with sight loss and blindness.

In evaluating indirect costs, it is important to make the economic distinction between real costs and transfer payments. A real cost is incurred when economic resources are used in the production of goods and services, such as land, labour and capital. Using resources in one area of the economy reduces the opportunity to produce goods and services in other areas of the economy. Transfer payments are defined as payments from one economic agent to another that are made without receiving any good or service in return. Rather than payments made for the use of any good or service, they are a transfer of claims over real resources. Some examples of transfer payments in include taxes, subsidies, and pensions. As transfer payments do not represent a real economic cost they have not been presented as an economic cost within this report. However, they have been estimated to calculate the associated deadweight loss to the economy.

4.1 Productivity losses

Sight loss can have an impact on economic productivity through three primary channels. These comprise:

- reduced productivity per worker due to the impacts of sight loss on the ability to undertake work;
- temporary reduction in the size of the labour force (total number of hours worked) due to absenteeism associated with sight loss and blindness; and

- permanent reduction in the size of the labour force due to premature retirement and premature mortality within working age due to sight loss and blindness. [17]

As total labour productivity is typically lower for people with sight loss and blindness, the loss in productivity represents a real cost to the UK economy. However, a loss in productivity of an individual due to sight loss will only equate to a loss in productivity to the economy under fairly strict conditions. These are:

- the economy is at full employment so any reduction in hours worked due to sight loss, or any permanent reduction in labour force participation through early retirement or death, cannot be replaced by employing or increasing hours of other workers; and
- the income of an individual is proportional to the total value added to production.

The first condition will fluctuate over time as the economy moves into, and out of, full employment. A reduction in labour when labour is scarce will have a greater impact on productivity compared to an economy with an abundant labour supply. Although the UK economy is currently close to full employment it is problematic to determine the scarcity of labour into the future. Given demographic ageing and current immigration and workforce policy, it is reasonable to assume that the long term goal of government is to keep the economy at full employment. This means a temporary or permanent reduction in working hours due to sight loss and blindness cannot be replaced by another worker. Consequently a loss in productivity due to sight loss is expected to represent a real cost to the UK economy.

The second condition (income of an individual is proportional to the total value added to production) will occur if there is a perfect labour market such that the marginal benefit from an additional hour of work (the value added) is equal to the marginal cost (the wage). In reality, the labour market is far from perfect for a number of reasons, for example asymmetric information within the market and labour market restrictions imposed by government regulation and natural labour market barriers. In addition, synergy created between labour, capital and land means a reduction in working hours may also impact the productivity of other factors of production. Consequently the value of productivity from labour will be larger than the wage provided to an individual so using lost income from sight loss and blindness as a proxy for lost productivity will tend to underestimate the true cost.

It is likely that in the absence of sight loss, people with sight loss would participate in the labor force and obtain employment at the same rate as other people in the UK and earn the same average weekly earnings. The implicit assumption is that the numbers of such people would not be of sufficient magnitude to substantially influence the overall clearing of the UK labor market so that the average wage would remain the same.

[17] Within this study it was assumed that working age is between 18 and 64 (inclusive) for males and 18 to 62 for females (inclusive)

4.1.1 Lower employment

The cost of unemployment due to sight loss and blindness can be calculated using either a frictional approach or a human capital approach. The frictional approach only includes the search and hiring cost (a bring forward) and productivity loss till the worker is replaced. However the human capital approach includes the search and hiring cost (a bring forward) and productivity loss of the worker's contribution relative to what it would have been in the absence of the condition (ie, this could amount to total earnings for the rest of life expectancy if the worker dies or is permanently disabled and unable to return to work). A human capital approach is appropriate for industrialised countries in which there is near-full employment. This is because the removal of labour constrains growth in the long run production possibilities frontier, *ceteris paribus*. A frictional approach is appropriate for developing countries where typically there is a large unemployment pool and/or underemployment.

A number of studies have estimated the cost of unemployment due to sight loss in the UK using the human capital approach. For example, a study by Ethical Strategies (2003) estimated the cost of loss productivity across five hypothetical individuals with sight loss. The study concluded that productivity losses are primary cost drivers in the total cost of sight loss. For example, productivity loss accounts for around 61% of lifetime costs associated with congenital sight loss in adolescence.

Lafuma et al (2006) estimated the loss of income for people with sight loss in the UK at around €3.4 billion in 2004. They concluded that sight loss has a significant impact on productivity, equating to around 22.5% of the total non-medical costs associated with sight loss in the UK.

RNIB has also estimated the cost of productivity loss due to sight loss (RNIB, 2004). Using the 2001 Labour Force Survey, the study noted that around 136,000 people of working age in the UK reported they were disabled due to 'difficult seeing'. Comparing employment rates of those not disabled to the employment rates of those with 'difficult seeing', the study estimated that there was approximately 52,650 less people in employment due to sight loss in 2001. Multiplying this 'employment gap' by average annual earnings for 2001, this equated to a loss in productivity of around £1.08 billion (RNIB, 2004).

Productivity loss due to sight loss will depend on the age of the person when sight loss first occurs. Generally the younger the person, the greater the impact sight loss will have on productivity. Those with sight loss have a lower participation rate in paid workforce activities (Ethical Strategies 2003; RNIB 2004; Lafuma et al 2006). This is the traditional measure of a loss in productivity from sight loss.

To estimate the loss in productivity, this study used the disability equality indicators published by the Office for Disability Issues at the Department for Work and Pensions (DWP, 2012). One of the disability equality indicators published by the Department is the employment rate of disabled people, by main impairment type, of which one category is 'difficulty in seeing'. This is to be distinguished from other health problems or disabilities and picks up the difference between those with sight loss and those without. This estimate is lower than the previously used estimate of the Institute for Employment Studies in 2008.

Table 4.1 presents different employment rates between those with sight loss and those without, based on information from IES (2008), DWP (2012), DFPNI (2014) and Employability in Scotland (2014). Employment rates for all people and for those not disabled and without seeing difficulty differ across the UK.

For the UK, those with no disability or seeing difficulty of the working age population had an employment rate of 79.5%, whilst those with a 'seeing difficulty' had an employment rate of 55.5%, revealing a gap of 24.0%. The employment rate gap extends even further for those who are long-term disabled with a seeing difficulty, with the gap growing to 31.8%.[18]

Other studies have provided lower employment rates for those with seeing difficulties. A previous RNIB report used slightly lower employment rates from 2001, with those disabled with a seeing difficulty having an employment rate of only 44.3% (RNIB, 2004). A separate study for RNIB reported even lower employment rates for those blind or with sight loss (visual acuity of less than 6/18) of 27%, while those with better visual acuity from 6/18 to 6/12 had an employment rate of 39% (Bruce and Baker, 2003). Similar figures were produced for Great Britain in a Network 1000 (2006) report, which estimated employment rates to be 34% for those registered blind or with sight loss. This lower estimate of employment rates may be explained by the fact that the study focused on those with more significant sight loss who are less likely to work.

Table 4.1: Employment rates, by level of seeing difficulty 2012-13

Employment rate (%)					
Working Age Population	**UK**	**England***	**Wales**	**Scotland**	**N.I.**
All	72.1	72.1	70.7	72.6	67.1
Not disabled and without seeing difficulty	79.5	79.5	74.9	80.0	75.0
Seeing difficulty^			55.5		
Long-term disabled with seeing difficulty^			47.7		
Not disabled with seeing difficulty^			82.8		

Note: * England rates were based on the overall UK rates as per DWP (2012).^ Due to a lack of data across individual country, the overall UK employment rates for these groups of individuals are assumed to apply to each country when estimating the impact of lower employment.

Source: IES (2008), DWP (2012), DFPNI (2014), and Employability in Scotland (2014).

To calculate the loss in productivity, employment rates by age group derived from ONS (2013c) were multiplied by the prevalence of those within working age that had sight loss. This provided an estimate of the number of people with sight loss that would have been employed if their sight loss could be corrected. The number of people with sight loss that were employed was estimated by multiplying the number of people with sight loss and

[18] The employment rates for those that are long term disabled with a seeing difficulty were based on the Institute of Employment Studies (IES, 2008) data. The IES (2008) data represents an average rate of employment and is not disaggregated by age or gender. Therefore this estimate does not take account that females have lower wage levels than males, differing prevalence rates and employment rates. In addition, the LFS survey looked at the working age population only (16 – 64 years old), so the lost productivity from the retirement age group could not be taken into account.

blindness by the rate of employment adjusted by the employment gap derived from DWP (2012).[19] The difference between these two calculations represented the number of people that are not employed due to their sight loss. This was multiplied by the median gross weekly earnings derived from ONS (2013c) to estimate the total cost of productivity loss due to lower employment amongst those with sight loss. The employment gap and the average weekly earnings are shown in Table 4.2. The employment gap and the productivity loss associated with this gap is shown in Table 4.3, which shows the loss in productivity for the UK is estimated to be around £2.43 billion in 2013. Of this, England contributed more than 85%, followed by Scotland with 8.7%.

Table 4.2: Employment gap and median gross income for those with sight loss 2013

Age	Employment gap (%)			Median gross income (£/week)[a]		
England[b]	Male	Female	All	Male	Female	All
18-24	19.7	19.0	19.4	563.40	460.50	520.70
25-34	28.8	24.3	26.6	563.40	460.50	520.70
35-49	29.3	25.5	27.4	563.40	460.50	520.70
50-64	24.7	20.8	22.7	563.40	460.50	520.70
Wales	Male	Female	All	Male	Female	All
18-24	6.3	5.6	6.0	513.50	421.90	476.90
25-34	17.5	17.2	17.3	513.50	421.90	476.90
35-49	23.2	19.8	21.5	513.50	421.90	476.90
50-64	23.5	22.1	22.8	513.50	421.90	476.90
Scotland	Male	Female	All	Male	Female	All
18-24	21.7	20.6	21.1	544.30	454.00	508.30
25-34	28.7	25.4	27.1	544.30	454.00	508.30
35-49	28.7	27.0	27.8	544.30	454.00	508.30
50-64	24.5	21.4	22.9	544.30	454.00	508.30
N.I.[b]	Male	Female	All	Male	Female	All
18-24	14.1	14.6	14.4	306.30	291.25	299.55
25-49	24.6	21.5	23.0	457.93	407.20	420.35
50-64	19.6	16.0	17.8	526.45	441.95	500.40

Note: (a) Where median gross weekly income was not available by age group, the median weekly age for all groups was applied for that country. (b) The employment and earnings data for Northern Ireland was only supplied for age groups of 18-24, 25-49, 50-64 and 65+.

Source: Deloitte Access Economics calculations.

[19] There is evidence that the gap between employment rates becomes more pronounced as the level of visual acuity becomes worse. As employment rates across the definitions of partial sight and blindness used within this study are not available this study has used the average gap across all levels of visual acuity.

Table 4.3: Productivity loss due to sight loss and blindness 2013

Age	Productivity loss (£ million)		
UK	Male	Female	All
18-24	68.57	48.16	116.71
25-34	144.64	90.01	234.65
35-49	432.48	335.61	768.08
50-64 (M), 50-61(F)	834.99	472.94	1307.93
Total – UK	1480.69	946.70	2427.39
England	Male	Female	All
18-24	59.26	41.37	100.63
25-34	123.76	75.59	199.35
35-49	376.31	286.43	662.74
50-64 (M), 50-61(F)	715.04	400.70	1,115.74
Total – England	1,274.37	804.09	2,078.46
Wales			
18-24	2.61	1.84	4.44
25-34	4.93	3.03	7.96
35-49	14.76	12.47	27.23
50-64 (M), 50-61(F)	31.04	17.32	48.36
Total – Wales	53.34	34.65	87.99
Scotland			
18-24	5.89	4.23	10.12
25-34	11.14	7.47	18.61
35-49	34.19	30.83	65.02
50-64 (M), 50-61(F)	71.93	45.24	117.16
Total – Scotland	123.16	87.76	210.92
N.I.[(a)]			
18-24	0.81	0.72	1.52
25-34	4.81	3.92	8.73
35-49	7.22	5.88	13.09
50-64 (M), 50-61(F)	16.98	9.68	26.67
Total – N.I.	29.82	20.19	50.02

Note: (a) The employment and earnings data for Northern Ireland was only supplied for age groups of 18-24, 25-49, 50-64 and 65+. A weighted average was used to apportion the productivity cost to the age groups presented in the table.

Source: Deloitte Access Economics calculations.

4.1.2 Absenteeism

In addition to workforce separation, people with sight loss or blindness may be absent from work more often as a result of their sight loss. For example, the higher level of risk associated with falls, accidents, and depression means there is a greater probability that a person with sight loss will take time off work.

There are no UK studies that have formally evaluated the number of additional days a person with sight loss is absent from work compared to a person without sight loss. Using data from the United States and simple linear regression to control for the impact gender, age, and income on the average number of days off work per year, Access Economics (2006) estimated that those with sight loss are likely to have an additional 4.1 days off work per year on average. As the data was not rich enough to specifically account for co-morbidities the number of days off may be an over estimate, although some of the impact from co-morbidities would have been picked up in the income variable.

For all those with sight loss and employed (using the employment data by age and gender from Section 4.1.1), the absenteeism loss was estimated as the total number of employed with sight loss and blindness multiplied by the average additional days off work for someone who has sight loss. Multiplying this by the median daily wage rate for each age bracket and gender[20] provided a total loss of productivity estimate of £77.6 million due to absenteeism in 2013. Out of the total of productivity due to absenteeism, $65.6 million was attributable to England, $3.7 million to Wales, $6.5 million to Scotland and $1.9 million to Northern Ireland.

A breakdown of this total by age and gender is shown in Table 4.4.

[20] The median daily wage rate for males and females within each age bracket was calculated by dividing the median gross weekly earnings from Table 4.2 by the number of work days in a week.

Table 4.4: Productivity loss due to absent days resulting from sight loss and blindness 2013

Age	Productivity loss (£ million)		
UK	Male	Female	All
18-24	2.19	1.54	3.73
25-34	4.64	2.88	7.52
35-49	13.82	10.70	24.53
50-64 (M), 50-61(F)	26.74	15.12	41.87
Total – UK	47.40	30.25	77.65
England	Male	Female	All
18-24	1.87	1.30	3.17
25-34	3.91	2.38	6.28
35-49	11.88	9.01	20.89
50-64 (M), 50-61(F)	22.58	12.63	35.21
Total – England	40.23	25.32	65.56
Wales	Male	Female	All
18-24	0.11	0.08	0.18
25-34	0.21	0.13	0.33
35-49	0.61	0.52	1.13
50-64 (M), 50-61(F)	1.29	0.72	2.01
Total – Wales	2.22	1.44	3.66
Scotland	Male	Female	All
18-24	0.18	0.13	0.31
25-34	0.34	0.23	0.57
35-49	1.06	0.95	2.01
50-64 (M), 50-61(F)	2.22	1.40	3.62
Total – Scotland	3.80	2.71	6.51
N.I.[(a)]	Male	Female	All
18-24	0.03	0.03	0.06
25-34	0.18	0.15	0.34
35-49	0.28	0.23	0.50
50-64 (M), 50-61(F)	0.65	0.37	1.02
Total – N.I.	1.14	0.78	1.92

Note: (a) The employment and earnings data for Northern Ireland was only supplied for age groups of 18-24, 25-49, 50-64 and 65+. A weighted average was used to apportion the productivity cost to the age groups presented in the table.

Source: Deloitte Access Economics calculations.

4.1.3 Premature mortality

Productivity losses associated with sight loss and blindness also arise from premature mortality through accidents, depression and other sources (for example, motor vehicle accidents).

In estimating increased risk of mortality, it is important to control for the age and gender of a person with sight loss (Globe et al, 2005; Anstey et al, 2001). For example, Klein et al (1995) reported that people with specific vision conditions had decreased survival chances (increased mortality risk) of 1.57 for the presence of sight loss and of 1.28 for any cataract. However, once cardiovascular disease was taken into account none of the conditions causing sight loss showed a statistically significant odds ratio for decreased survival.

An improved level of statistical control was achieved in the Melbourne Visual Impairment Project (MVIP) where sight loss and blindness was found to be significantly associated with increased risk of mortality of around 2.34 times (McCarty et al, 2001). The result took into account the confounding presence of age and age-related comorbidities, such as basic cardiac risk factors.

Wang et al (2001) report a 70% increased chance of mortality with the presence of any sight loss. Their analysis took into account comorbidities such as a history of significant events (cancer, stroke, gout and diabetes), some of which result from basic cardiovascular risk factors such as hyperlipidemia and hypertension.

The mortality rate of people with sight loss in the UK has been estimated using Mortality Statistics produced by the ONS for 2012 (ONS, 2013d). This report presents deaths occurring in England and Wales, classified by sex and age and by other selected information collected at the time of registration, such as method of certification and place of death. Death rates per million population by underlying causes are classified by ICD-10 and specifically lists diseases of the eye and adnexa by 10 year age cohorts and gender. Death rates are based on details collected when deaths are certified and registered, which are mostly undertaken by a medical practitioner using the Medical Certificate of Cause of Death (MCCD).

However, it is questionable whether death rates attributable to sight loss would be adequately captured within the MCCD. For example, a person that dies from a fractured skull due to an accident related to sight loss would have their cause of death recorded as a head injury rather than sight loss.

To estimate the mortality rate of adults with sight loss in the UK, the country specific mortality rate of the population for that country (sourced from ONS, 2013d, GROS, 2012 and NISRA, 2012) was multiplied by an odds ratio of 2.34, which was derived from the MVIP (McCarty et al, 2001). Deaths due to sight loss were calculated by multiplying the estimated number of deaths of people with sight loss by an attributable (etiological) fraction of 0.83%. This fraction was derived from Access Economics (2004) and is based on the MVIP data.

The productivity loss from those who die prematurely was estimated based on the assumption that if they had lived, the person would have earned an average annual income up until their retirement.[21] Average incomes were calculated as £29,297 for males and £23,946 for females in England, £26,702 for males and £21,938.80 for females in Wales,

[21] Data suggests there are no significant income differences between people with partial sight and blindness and people without (IES, 2008)

£28,303.60 for males and £23,608 for females in Scotland, £24,824.80 for males and £22,958 for females in Northern Ireland (derived from Table 4.2). Retirement age was represented by the State Pension age, which is 65 for males and 62 for females.[22] The number of people who were in employment at the time of their death was calculated by multiplying the number of deaths due to sight loss by the employment rate of those with sight loss, which was 55.5% (DWP, 2012). The present value of lost earnings was calculated using a discount rate of 3.5% over the number of years until retirement. Table 4.5 shows that the estimated total present value loss of productivity associated with premature mortality is around £2.14 million in 2013.

Table 4.5: Cost of premature mortality from sight loss and blindness 2013

	No, of people with sight loss of working age	Deaths per 1,000 people due to sight loss	Deaths of people due to sight loss	No. employed	Years to retirement	Present value of lost earnings per person £	Total £ million
UK							
Male							
18-39	27,811	0.7	0.47	0.26	35	304,191	0.08
40-49	43,048	2.1	1.82	1.01	20	291,246	0.29
50-54	29,616	3.6	2.12	1.18	13.5	245,759	0.29
55-59	35,767	5.9	4.15	2.30	8.5	183,730	0.42
60-64	52,604	9.5	9.77	5.42	3.5	89,854	0.49
Female							
18-39	25,035	0.4	0.20	0.11	32	253,305	0.03
40-49	48,076	1.3	1.31	0.73	17	225,407	0.16
50-54	32,916	2.5	1.64	0.91	10.5	174,067	0.16
55-59	39,905	4.0	3.37	1.87	5.5	108,271	0.20
60-61	23,818	6.2	2.92	1.62	0.5	11,689	0.02
Total - UK	*358,595*	*n.a.*	*27.77*	*15.41*	*n.a.*	*n.a.*	*2.14*
England							
Male							
18-39	23,540	0.7	0.34	0.19	35	307,593	0.06
40-49	36,405	2.1	1.47	0.81	20	294,471	0.24
50-54	24,826	3.6	1.77	0.98	13.5	248,576	0.24
55-59	29,834	5.9	3.44	1.91	8.5	185,886	0.36
60-64	43,883	9.5	8.17	4.53	3.5	90,907	0.41
Female							
18-39	21,138	0.4	0.16	0.09	32	254,854	0.02
40-49	40,303	1.3	1.03	0.57	17	226,828	0.13

[22] http://www.ageuk.org.uk/money-matters/pensions/changes-to-state-pension-age/, accessed 28 May 2015

	No, of people with sight loss of working age	Deaths per 1,000 people due to sight loss	Deaths of people due to sight loss	No. employed	Years to retirement	Present value of lost earnings per person £	Total £ million
50-54	27,380	2.5	1.35	0.75	10.5	175,206	0.13
55-59	33,060	4.0	2.63	1.46	5.5	108,999	0.16
60-61	19,789	6.2	2.43	1.35	0.5	11,769	0.02
Total - England	*300,157*	*n.a.*	*22.77*	*12.64*	*n.a.*	*n.a.*	*1.77*
Wales							
Male							
18-39	1,255	0.7	0.02	0.01	35	280,349	0.00
40-49	1,949	2.1	0.08	0.04	20	268,390	0.01
50-54	1,408	3.6	0.10	0.06	13.5	226,560	0.01
55-59	1,769	5.9	0.20	0.11	8.5	169,422	0.02
60-64	2,790	9.5	0.52	0.29	3.5	82,855	0.02
Female							
18-39	1,110	0.4	0.01	0.00	32	233,492	0.00
40-49	2,215	1.3	0.06	0.03	17	207,814	0.01
50-54	1,590	2.5	0.08	0.04	10.5	160,520	0.01
55-59	2,012	4.0	0.16	0.09	5.5	99,863	0.01
60-61	1,263	6.2	0.15	0.09	0.5	10,782	0.00
Total - Wales	*17,360*	*n.a.*	*1.38*	*0.76*	*n.a.*	*n.a.*	*0.09*
Scotland							
Male							
18-39	2,223	2.2	0.10	0.05	35	297,165	0.02
40-49	3,518	3.1	0.21	0.12	20	284,488	0.03
50-54	2,572	4.0	0.20	0.11	13.5	240,149	0.03
55-59	3,180	6.9	0.43	0.24	8.5	179,584	0.04
60-64	4,576	9.7	0.87	0.48	3.5	87,825	0.04
Female							
18-39	2,057	0.6	0.03	0.01	32	251,257	0.00
40-49	4,198	1.9	0.16	0.09	17	223,626	0.02
50-54	3,024	2.6	0.15	0.09	10.5	172,733	0.01
55-59	3,735	6.4	0.47	0.26	5.5	107,461	0.03
60-61	2,152	6.4	0.27	0.15	0.5	11,603	0.00
Total - Scotland	*31,235*	*n.a.*	*2.89*	*1.61*	*n.a.*	*n.a.*	*0.23*
Northern Ireland							
Male							
18-39	793	1.2	0.02	0.01	35	260,640	0.00
40-49	1,177	2.5	0.06	0.03	20	249,522	0.01
50-54	810	3.3	0.05	0.03	13.5	210,632	0.01

	No, of people with sight loss of working age	Deaths per 1,000 people due to sight loss	Deaths of people due to sight loss	No. employed	Years to retirement	Present value of lost earnings per person £	Total £ million
55-59	984	3.9	0.08	0.04	8.5	157,511	0.01
60-64	1,354	7.9	0.21	0.12	3.5	77,030	0.01
Female							
18-39	730	0.5	0.01	0.00	32	244,339	0.00
40-49	1,360	2.5	0.07	0.04	17	217,469	0.01
50-54	922	3.3	0.06	0.03	10.5	167,977	0.01
55-59	1,097	5.5	0.12	0.07	5.5	104,502	0.01
60-61	614	5.5	0.07	0.04	0.5	11,283	0.00
Total – N.I.	*9,843*	*n.a.*	*0.73*	*0.41*	*n.a.*	*n.a.*	*0.05*

Source: Deloitte Access Economics calculations.

4.2 Informal care costs

Informal care is the provision of home care to another person without receiving pay (although some informal carers in the UK may receive a government allowance based on an evaluation). Most commonly informal care is the provision of care by a family member, friend, neighbour or community member.

The level of informal care associated with sight loss depends on whether the person is able to live independently while maintaining an appropriate quality of life. Using UK data, Stevenson et al (2004) showed that the ability for a person with sight loss to care for themselves is adversely influenced by sight loss. In a study of individuals with AMD recruited through a hospital eye clinic in Northern Ireland, Ke et al (2007) found that the level of formal and informal care services utilised by an individual depends on the level of visual acuity in the better eye, the age of the individual, and the level of access to informal care, for example, whether the person lives alone or not. International studies have also found a positive relationship between the level of informal care and the prevalence of sight loss and blindness (Wang et al 1999, Schmier et al 2006).

RNIB (2013) estimated that the cost of informal care for the blind and those with sight loss was around £2.5 billion using reported NHS expenditure on problems of vision in the UK. This was based on the assumption that each person with sight loss over the age of 60 received one hour of care per day associated with their sight loss.

In order to estimate the total cost of informal care, the time spent providing care to people with sight loss is required along with a monetary figure representing the value of informal care. It is difficult to separate the level of informal care provided due to sight loss and blindness when the person receiving care has comorbidities that also require informal care. For example, a person may receive informal care for dementia and sight loss at the same time.

However, there are further significant costs in addition to the value of lost time in providing informal care. For example, in an evaluation of informal care in the UK, Carmichael and Charles (2003) noted that informal carers also forgo significant earnings because they have less opportunity to undertake higher paid employment and therefore earn less than equally qualified non-carers. This is because informal carers require more flexible working arrangements, which make them less likely to be promoted.

In terms of estimating a monetary value of informal care provided to people with sight loss and blindness, two methodologies can be used – the replacement cost method and the opportunity cost method.[23]

The replacement cost method measures the cost of substituting informal care for formal care services. That is, it values the output of production (van den Berg et al 2006). Thus, the number of hours providing informal care to people with sight loss is multiplied by the cost of providing care from the formal care sector (which is deemed a close substitute).

The cost of providing care in the formal sector will depend on the level of sight loss and any co-morbidities the person may have as greater demands are placed on carers as a person's level of disability increases. However, the replacement cost method may overestimate the value of informal care as it assumes the person receiving care, or society, is willing to pay for the services typically provided by a family or friend. Due to budget constraints faced by individuals and community service funders this may not be the case. Furthermore, the replacement cost method does not take into consideration any differences in the quality of care and will therefore overestimate the value of informal care if formal care is of a higher quality. Also, the time spent on providing formal care may be different to the time foregone by an informal carer if a formal carer is more efficient. If this is the case it would also lead to an overestimation of the value of informal care. Finally, if the informal carer receives utility from providing care, then the replacement cost method could actually underestimate the value of informal care.

The opportunity cost method measures the value in alternative use of time spent caring, which is typically valued by productivity losses (or value of leisure time) associated with caring. This is based on the assumption that time spent providing informal care could be alternatively used within the paid workforce or in leisure activities. The value of informal care using the opportunity cost method can be represented by:

Value of informal care = $t_i w_i$

where t_i is the time provided by individual i on providing care and w_i is the net market wage rate of individual i (van den Berg et al 2006). For those who provide informal care but are not in paid work (for example, children or those who have retired) the value of providing informal care is the value of the lost opportunity of undertaking leisure time. This can be approximated by the willingness to pay to undertake leisure, or to avoid work. However, the value of leisure time is often proxied by an average age and sex specific wage rate (Brouwer and Koopmanschap 2000; Heitmueller 2007). If the value of non-work is more

[23] There is a third methodology known as the self-valuation method but this is seldom used due to the inherent bias associated with the value people place on the services they provide.

(less) than the average wage rate, the opportunity cost method will under (over) estimate the value of informal care.

The replacement cost method and the opportunity cost method differ conceptually. The former values outputs while the latter values inputs. From a theoretical perspective, the opportunity cost method is the benchmark (van den Berg et al 2006).

Within this study, a tops-down approach using the 2011 Census was used to determine the number of informal care hours provided to people with sight loss, and an opportunity cost methodology (in line with Access Economics 2008a, 2008b, 2006) was used to value these hours.

The decennial UK Census 2011 (ONS, 2013) collected data on the number of informal carers in England and Wales. Similar data for Scotland (NRS, 2013) and Northern Ireland (NISRA, 2013) was also collected for the same period. Data was recorded according to informal carer age, sex and the number of hours care provided each week.

Approximately 6.5 million people were recorded as providing some level of informal care to another person in the UK as at April 2011. Table 4.6 shows an estimate of the number of people providing informal care in the UK and each country in 2013. These were calculated by multiplying the proportion of informal carers in 2011 derived from the Census by the population for 2013 (from Section 2.2). Although this accounts for the population growth in the UK it does not adjust for any change in the proportion of informal carers since 2011. Consequently Table 4.6 may underestimate the total number of the carers considering there has been a rise in the number of carers since the last UK Census (Carers UK, 2011).

Table 4.6: Number of informal carers in the UK and countries by age, sex and hours spent providing care, 2012-13

Age[24]	Male			Female		
	1-19 hrs	20-49 hrs	≥50 hrs	1-19 hrs	20-49 hrs	≥50 hrs
UK						
0-24	177,522	34,141	23,420	209,532	41,421	37,651
25-64	1,291,078	256,169	346,540	1,784,344	372,513	595,556
65+	345,176	92,238	281,032	366,074	96,866	301,383
Total - UK	1,813,775	382,549	650,993	2,359,949	510,800	934,591
England						
0-24	141,979	26,854	17,514	161,295	31,966	26,976
25-64	1,061,586	204,471	267,154	1,497,804	306,266	486,624
65+	304,777	79,105	237,531	321,580	82,961	254,010
Total - England	1,508,342	310,430	522,199	1,980,678	421,192	767,610
Wales						
0-24	9,786	2,077	1,414	11,101	2,267	2,041
25-64	63,776	14,631	22,264	90,357	21,928	37,295
65+	18,545	6,636	20,630	18,572	6,806	21,920
Total - Wales	92,107	23,344	44,308	120,029	31,001	61,256
Scotland						
0-24	18,777	3,535	3,493	28,592	5,259	7,250
25-64	127,700	26,014	42,492	139,801	28,315	46,914
65+	15,622	4,076	15,332	18,845	4,440	17,456
Total - Scotland	162,098	33,625	61,318	187,239	38,014	71,621
Northern Ireland						
0-24	6,980	1,675	999	8,544	1,930	1,385
25-64	38,016	11,054	14,630	56,382	16,003	24,722
65+	6,231	2,422	7,539	7,077	2,661	7,997
Total – N.I.	51,227	15,150	23,168	72,003	20,594	34,105

Source: ONS (2013), NRS (2013), NISRA (2013) and Deloitte Access Economics calculations.

To calculate the total number of hours of informal care, the same methodology used by the University of Leeds in valuing informal carers for Carers UK was used (Carers UK, 2007). Within their methodology it was assumed that the average amount of care for those providing ≥50 hours of care per week was 50 hours. For those providing between 20 to 49 hours of care the average amount of care was assumed to be 35 hours of care. For those providing between 1 to 19 hours of care per week it was assumed that 31% provided 15 hours of care, 31% provided 7 hours of care, and 38% provided 2 hours of care.

[24] DAE (2008) summarised the number of informal carers in the UK in age brackets of 5-15, 16-64 and ≥65. The results in Table 4.6 are based on the 2011 Census, which uses a different breakdown and shows the number of informal carers in the UK in age brackets of 0-24, 25-64 and ≥65.

The total number of hours of informal care represents a total across all people receiving informal care for all conditions (for example, it includes care provided to those with dementia). To determine the hours of informal care provided, the reason for each instance of care would need to be recorded. However, this is not feasible with the data available. Rather, to calculate an estimate of total informal care associated with sight loss and blindness, the proportion of activity for physically disabled adults and older people aged 65 and over experiencing sight loss and dual sensory loss for community-based and residential services in England was used (this was shown to be 2.4% in Section 3.7). Although this proportion relates to formal care services it was assumed that the level of informal care used for sight loss and blindness is in proportion to the level of formal care used for sight loss and blindness. This may be the case if the level of formal and informal care is in proportion to the burden of disease. Total number of hours of informal care for each country is shown in Table 4.7.

Table 4.7: Number of informal care hours in the UK providing care to those with sight loss and blindness, 2013

	Males					Females				
	2hrs	7hrs	15hrs	35hrs	50hrs	2hrs	7hrs	15hrs	35hrs	50hrs
UK										
0-24	3.2	9.2	19.8	28.7	28.1	3.8	10.9	23.4	34.8	45.2
25-64	23.5	67.2	144.1	215.2	415.8	32.5	92.9	199.1	312.9	714.7
≥65	6.3	18.0	38.5	77.5	337.2	6.7	19.1	40.9	81.4	361.7
Total – UK	33.1	94.5	202.4	321.3	781.2	43.0	122.9	263.4	429.1	1,121.5
England										
0-24	2.6	7.4	15.8	22.6	21.0	2.9	8.4	18.0	26.9	32.4
25-64	19.4	55.3	118.5	171.8	320.6	27.3	78.0	167.2	257.3	583.9
≥65	5.6	15.9	34.0	66.4	285.0	5.9	16.7	35.9	69.7	304.8
Total – England	27.5	78.6	168.3	260.8	626.6	36.1	103.2	221.0	353.8	921.1
Wales										
0-24	0.2	0.5	1.1	1.7	1.7	0.2	0.6	1.2	1.9	2.4
25-64	1.2	3.3	7.1	12.3	26.7	1.6	4.7	10.1	18.4	44.8
≥65	0.3	1.0	2.1	5.6	24.8	0.3	1.0	2.1	5.7	26.3
Total – Wales	1.7	4.8	10.3	19.6	53.2	2.2	6.3	13.4	26.0	73.5
Scotland										
0-24	0.3	1.0	2.1	3.0	4.2	0.5	1.5	3.2	4.4	8.7
25-64	2.3	6.7	14.3	21.9	51.0	2.5	7.3	15.6	23.8	56.3
≥65	0.3	0.8	1.7	3.4	18.4	0.3	1.0	2.1	3.7	20.9
Total – Scotland	3.0	8.4	18.1	28.2	73.6	3.4	9.8	20.9	31.9	85.9
Northern Ireland										
0-24	0.1	0.4	0.8	1.4	1.2	0.2	0.4	1.0	1.6	1.7
25-64	0.7	2.0	4.2	9.3	17.6	1.0	2.9	6.3	13.4	29.7
≥65	0.1	0.3	0.7	2.0	9.0	0.1	0.4	0.8	2.2	9.6
Total – N.I.	0.9	2.7	5.7	12.7	27.8	1.3	3.7	8.0	17.3	40.9

Source: ONS (2013) and Access Economics calculations.

To estimate the cost of informal care related to sight loss and blindness, the estimated total number of informal care hours was multiplied by the average per hour wage rate for males and females, which was £15.02 and £12.28 for England, £13.69 and £11.25 for Wales, £14.51 and £12.11 for Scotland and£2.73 and £11.77 for Northern Ireland.[25]

This provided an estimate of £2,358.2 million for the cost of informal care relating to sight loss and blindness for the UK in 2013. The cost per country is represented in Table 4.8.

[25] This was derived from the median weekly wage shown in Table 4.2 and 37.5 hours of work per week.

Table 4.8: Cost of providing informal care to those with sight loss and blindness by country, 2013

Country	£ million
England	1,951.9
Wales	134.8
Scotland	194.8
Northern Ireland	76.7

4.3 Devices and modifications

Adults who have sight loss require a variety of devices, special equipment and home modifications to function adequately and to enhance their quality of life. Some of these include:

- alternative format materials, for example large print or Braille publications, labels and tags, locator dots;
- mobility devices, for example canes, guide dogs, torches;
- glasses, sunglasses (glare reducing);
- low vision devices, for example magnifiers, telescopes and closed circuit TVs (CCTVs);
- computer devices, for example computer speech technology, large print or Braille display;
- daily living devices such as clocks and watches, coin sorters, bathroom and kitchen accessories (for example, liquid level indicators, needle-threaders), sport and recreation items (for example, embossed dice or playing cards, ringing balls);
- recording and playback devices;
- talking appliances such as calculators, scales, thermometers;
- educational devices for visual, audio or tactile learning; and
- enhanced lighting, grab rails, ramps.

The most common types of technical aids for adults included mobility and communication devices (such as guide dogs, white sticks, wheelchairs, and tape recorders), optical aids and home modifications (Lafuma et al, 2006).

The majority of studies that have sought to estimate the cost of devices and modifications have focused on adults.[26] In a cross-sectional study across 4 countries, it has been estimated that 2% to 10% of blind people declared guide dogs as a necessity (Lafuma et al, 2006). In the UK, the cost to the person with sight loss is minimal, with Guide Dogs (formally known as the Guide Dogs for the Blind Association (GDBA)) charging a nominal 50p. However a substantial amount is expended by the GDBA, with a total of around £71.2 million spent in

[26] As indicated in Access Economics (2009), the cost of devices and modifications is greater for children. This is because children often need low vision devices at home and school, and devices tend to change as the child grows older (for example, the more mobile a child becomes the more portable each device needs to be). Furthermore, children are more likely to damage low vision aids and devices.

2012 (GDBA, 2014). This included costs of generating voluntary income (£24.4 million), governance costs (£1.3 million) and charitable expenditure (£45.5 million). The greatest component of this expenditure was on the provision of guide dogs, which totalled around £41.0 million and enabled 853 people to be trained and qualified with a guide dog.

Expenditure for the GDBA is funded through income received from community fundraising, donor based funding, raffles and draws, corporate and trust income, legacies, donated services and facilities, and gifts in kind. Assuming a ten year life span, dogs cost around £8,347 a year to fund a guide dog partnership over the life of the partnership. This was calculated by dividing the total expenditure of GDBA in 2012 by the number of people and dogs trained. At the end of 2012 there were 4,752 guide dog owners in the UK, giving a total cost of around £40.0 million for 2012.

Lafuma et al has estimated the cost of communication devices, including a tape recorder (unit cost of £36, and resource use of 4.3% above those without sight loss), a computer interface (unit cost of £2839, and resource use of 6.1%) and software adapted for blindness (unit cost of £1,727, and resource use of 5.9%).

Low vision aids, particularly simple devices such as a magnifying glass, are an effective means of improving reading ability in people with sight loss, with almost nine out of 10 consumers having an improved ability to read (Margrain 2000). The most recent study estimated total optical assistance to have a unit cost of £4,357, and with a resource use of 18.3% (Lafuma et al 2006). In terms of utilisation, Margrain (2000) estimated that the most common type of magnifier was an illuminated stand magnifier (30%), followed by an illuminated hand magnifier (20%), hand magnifier (20%), a high power reading addition (13%) and a stand magnifier (6%).

Cruess et al (2008) assessed the costs of different types of magnifying glasses, and estimated the cost of a magnifying glass (£47), stand magnifier (£37), electronic magnifier (£1,950), filter (£40), telescope (£210), and a closed-circuit television system (£2,200) using 2005 values. In estimating the cost of low vision aids, Bonastre et al (2002) used a simple measure of low vision aids, an estimate that magnifying glasses cost €50 over a one year period, and that low vision aids were used by 90% of people with sight loss. However the estimate for the closed-circuit television system was between £362 and £604 per year, much smaller than Cruess et al (2008).

Landers et al (1999) formed estimates of low vision aids costs based on the hospital eye service prescription forms from a district general hospital with a Low Vision Aid Service. Two audits were conducted, the first being a retrospective analysis of the forms to outside optometrists/opticians between 1990 and 1992, whilst the second audited the costs of using the 'in-house' NHS low vision aid service. It found that the average low visual aids cost per patient was £136.33 from the first audit, and £56.41 for the second (inflated to 2000 figures). The most common low vision aids prescribed were a magnifying glass, telescopes, typoscopes and ultraviolet shields. Meads and Hyde (2003) comment that only 32% of low vision aids are obtained through the 'in house' service, and therefore, the higher cost estimate should be preferred.

Modifications to the home may include enhanced lighting, installing grab rails, ramps for those who require wheelchairs. Lafuma et al (2008) estimated modifications to the home

to be around £79.31 (2004 values). Building adaptations were carried out less frequently for people with sight loss living at home than for those institutions. Home adaptations included adaptations made to toilets, the kitchen, bathroom, tables, seats, beds, ramps, door-opening devices and stair-lift.

In developing a health technology appraisal for the NICE, Meads and Hyde (2003) estimated the costs averted by the UK government in preventing people becoming blind. Using a literature review, they estimated that the cost of blind registration was £59.70, the cost of low vision aids was £136.33, and the cost of low vision rehabilitation was £205.30 (in 2002 prices).

Smith et al (2004) has also estimated the cost of blindness from a government perspective suggesting a one-off cost of £159 (in 2000 prices), ranging between £50 and £300. These estimates included blindness registration, low vision aids and rehabilitation services. Cruess et al (2008) concentrated on the costs of bilateral neovascular AMD and estimated that the total annual vision related equipment costs per patient amounted to £270.69. Their definition of vision related equipment included glasses and spectacles in addition to the devices of magnifiers, filters, telescopes and closed circuit television.

Using two cross sectional handicap, incapacity, and dependency (HID) surveys of sight loss and blindness in France, Lafuma et al (2006) estimated that the average annual cost for all devices was £394.73 per year in the general community for those with self reported low vision and blindness (in 2004 prices). This estimate included the cost of sticks, white sticks, walking aids, wheelchairs, guide dogs, optical assistance, computer interface, software adapted for blindness and tape recorders. In addition, Lafuma et al (2006) estimated that the cost of home modifications was £79.31 per year on average (in 2004 prices). These estimates were based on cost information and data on assistance requirements, home adaptations and allowances within France. The study assumed that demand and supply of these items would be similar (and therefore the prices) across France and the UK.

4.3.1 Cost of devices and modifications

The preferred methodology in estimating the total costs of devices and modifications is to multiply annual unit costs by the annual utilisation rates of devices. Although annual unit costs are available (as presented in Section 4.3), utilisation data was not available.

Instead the total annual cost of devices and modifications has been calculated by multiplying the average cost of devices and modifications presented in Lafuma et al (2006) by the prevalence of sight loss and blindness in the UK for the adult population.[27] As Lafuma et al presented estimates in 2004 prices these were adjusted to 2013 prices using an average UK inflation rate over that period of 2.71% (Statistics UK, 2014a).[28] This gave an average total per person cost for devices and modifications of £602.88 per year. The total

[27] It is unlikely that those with low vision and blindness would utilise most items included within the average cost presented by Lafuma et al (2006). Consequently these people were left out to ensure a conservative estimate was made.

[28] As Lafuma et al (2006) presents average prices in Eurodollars, they were first converted back into Sterling by using the exchange rate used within their study (£1 = €1.5).

cost of devices and modifications was estimated as £409.6 million in the UK overall for 2013. The cost per region is represented in Table 4.9.

Table 4.9: Cost of devices and modifications per country, 2013

Country	£ million
England	343.8
Wales	21.5
Scotland	34.1
Northern Ireland	10.2

Source: Lafuma et al (2006), Statistics UK (2014a)

4.4 Deadweight loss

Public funding of direct health care system costs and community services related to sight loss and blindness means that the UK government must increase tax revenue to achieve a budget neutral position.[29] Consequently tax rates such as income tax rates and Value Added Tax (VAT) must be higher that they would have otherwise been.

As noted previously, tax and subsidy revenue is not an economic cost but a transfer of payments from one individual to another. It has therefore not been included in this study. However, increasing tax revenue is not frictionless as tax reduces the efficiency with which the economy's resources are used. For example, an increase in income tax rates will increase the relative price of work compared to leisure and therefore create a disincentive to work. Alternatively an increase in VAT increases the price of goods and services results in a loss in sales. Consequently there is an associated reduction in consumer and producer surplus, which is known as the deadweight loss, or excess burden, of tax.

While the costs associated with deadweight loss will depend on the method used to raise additional taxes,[30] the social cost will not be zero and should therefore be included as a cost of sight loss and blindness. The usual assumption in program evaluation is to assume that additional taxes are raised through income tax rate changes, and this is what has been assumed in this study.

Seminal studies that have evaluated the marginal welfare cost of raising additional tax revenue (known as the marginal cost of public funds (MCF)) mostly relate to the United States (Browning 1976, Stuart 1984, Ballard 1985, Browning 1987). Estimates have ranged from zero marginal cost to well over 100%. This wide range has been due to alternative models used (partial versus general equilibrium), alternative parameter estimates, and assumptions on the adjustment of employment relative to changes in tax rates (labour supply elasticities).

[29] This implicitly assumes funds have not been directed from some other area of the health care system.

[30] In general it is more efficient to place taxes on markets that are relatively inelastic.

There are limited studies that have specifically focused on the UK labour market. However, Kleven and Kreiner (2006) provide estimates of the MCF for five European countries using micro data on taxes, benefits paid, and labour supply elasticities across different income levels. Within this study, nine estimates of the MCF were provided for the UK, ranging from 0.93 to 1.36 (where 1 represents zero MCF) and based on alternative scenarios regarding alternative income elasticity scenarios. For the purposes of this study we have used the simple average of the MCF across the nine scenarios, calculated as 1.12. Consequently for every additional £1 raised by the UK government to fund costs associated with sight loss and blindness it has been assumed there is £0.12 in lost welfare due to deadweight loss.

In order to calculate the deadweight loss associated with sight loss and blindness, the additional revenue raised by the UK government to fund public health care system costs, residential and community care, aids and equipment, and direct payments to those with sight loss and blindness and their carers must be estimated. The cost associated with public funding of the health care system, residential and community care was derived from Chapter 3. The costs associated with aids and equipment was derived from Section 4.3.

To determine the costs associated with direct payments, a review of the current payments available to people with sight loss and carers was undertaken using data from the Department for Work and Pensions (DWP, 2013). This is a comprehensive dataset on the number of people receiving direct payments and the average weekly rate of benefit within Great Britain, by condition including eye and adnexa. As the data does not include Northern Ireland this was supplemented with payment volume data collected from the Department of Social Development (DSD, 2013).[31]

The main sources of direct payments from the government to those with sight loss include the Disability Living Allowance for those under the age of 65 and the Attendance Allowance for those aged 65 and older.[32] These payments are provided to people who need help with personal and home services and supervision for part of the day or frequently throughout day and night. Additional payments are made through the Employment and Support Allowance (ESA), which was introduced on 28 October 2008 and replaced the Incapacity Benefit, Severe Disablement Allowance (SDA)[33] and Income Support on grounds of incapacity for work. Also, people with sight loss may receive payments through Pension credits, which are available to those over 60 who have low income.

[31] As this data was not presented in the same format as the data from DWP (2013), proportional splits across rates from the DWP (2013) were applied to the total direct payments from the DSD (2013).

[32] People with partial sight and blindness may also be eligible to receive the Severe Disability Premium and Enhanced Disability Premium. However due to lack of data these were not included in the analysis. Although this may underestimate the total direct payments it is expected that it will not be significant. For example, to receive the Severe Disability Premium the person must be on the middle or higher rate of the DLA care component. Although data from DWP suggests around 6.7% receive the higher rate and 36.8% receive the middle rate (DWP, 2008), alternative criteria must also be met such as the person may have no non-dependent living with him/her or have anyone claiming Carer's Allowance for looking after him/her (AFBP, 2012).

[33] The Severe Disablement Allowance was abolished to new applicants in 2001 however those who were entitled to SDA before that date are still eligible to receive the allowance.

The government also provides direct payments to informal carers through a means tested Carers Allowance (CA) to those providing informal care for at least 35 hours a week to someone who is receiving the Disability Living Allowance or the Attendance Allowance.

Table 4.10 shows the estimated total direct payments made to people with sight loss and their carers in the UK as at November 2013. In total there was £341.02 million spent in direct payments from the government to people with sight loss. This was made up of £122.75 million for the DLA, £135.84 million for the AA, £23.27 million for the ESA, £18.33 million for the SDA, and £40.83 million for the CA.

Multiplying the sum of the total direct health care system costs and the direct payments made by the public sector[34] by the marginal cost of raising additional funds (12%) provided a total estimate of £378.9 million in deadweight loss in 2013 that is a direct result of sight loss and blindness.

Costs were apportioned to regions based on caseload data by region available from the Department for Work and Pensions (DWP).

Table 4.10: Total direct payments to people with sight loss and informal carers, by direct payment type 2013

	Recipients	Rate	Total
	No.	*£ (per year)*	*£ million*
UK			
Disability Living Allowance (DLA)			
Higher rate	4,336	4,127.11[a]	17.90
Middle rate	23,611	2,753.57[b]	65.25
Lower Rate	36,167	1,095.00[c]	39.60
Total - DLA	64,115	n.a.	122.75
Attendance Allowance (AA)			
Low and medium care (low rate)	23,864	4,127.11[d]	98.49
High care (high rate)	13,516	2,763.57[e]	37.35
Total - AAA	37,381	n.a.	135.84
Employment and Support Allowance (ESA)			
Assessment phase	2,804	5,131.78[f]	14.39
Work related Activity Component	2,814	1,483.46[g]	4.18
Support Component	2,591	1,814.57[h]	4.70
Total - ESA	*8,210*	*n.a.*	*23.27*
Severe Disablement Allowance (SDA)	4,387	4,178.86[i]	18.33
Carers Allowance (CA)	13,104[k]	3,115.54[j]	40.83

[34] Costs incurred by the private sector have been removed from this calculation as it does not represent additional tax revenue that must be generated by the government.

Total – UK	127,197	n.a.	341.02
England			
Disability Living Allowance (DLA)			
Higher rate	3,530	4,127.11[a]	14.57
Middle rate	19,219	2,753.57[b]	53.11
Lower Rate	29,439	1,095.00[c]	32.24
Total - DLA	52,188	n.a.	99.92
Attendance Allowance (AA)			
Low and medium care (low rate)	19,434	4,127.11[d]	80.21
High care (high rate)	11,007	2,763.57[e]	30.42
Total - AAA	30,442	n.a.	110.63
Employment and Support Allowance (ESA)			
Assessment phase	2,155	5,131.78[f]	11.06
Work related Activity Component	2,163	1,483.46[g]	3.21
Support Component	1,992	1,814.57[h]	3.61
Total - ESA	6,310	n.a.	17.88
Severe Disablement Allowance (SDA)	3,576	4,178.86[i]	14.95
Carers Allowance (CA)	10,475	3,115.54[j]	32.63
Total – England	102,991	n.a.	276.01
Wales			
Disability Living Allowance (DLA)			
Higher rate	318	4,127.11[a]	1.31
Middle rate	1,734	2,753.57[b]	4.79
Lower Rate	2,655	1,095.00[c]	2.91
Total - DLA	4,707	n.a.	9.01
Attendance Allowance (AA)			
Low and medium care (low rate)	1,566	4,127.11[d]	6.46
High care (high rate)	887	2,763.57[e]	2.45
Total - AAA	2,454	n.a.	8.92
Employment and Support Allowance (ESA)			
Assessment phase	166	5,131.78[f]	0.85
Work related Activity Component	167	1,483.46[g]	0.25
Support Component	153	1,814.57[h]	0.28
Total - ESA	486	n.a.	1.38
Severe Disablement Allowance (SDA)	259	4,178.86[i]	1.08
Carers Allowance (CA)	760	3,115.54[j]	2.37
Total – Wales	8,666	n.a.	22.76
Scotland			
Disability Living Allowance (DLA)			
Higher rate	455	4,127.11[a]	1.88
Middle rate	2,478	2,753.57[b]	6.85
Lower Rate	3,796	1,095.00[c]	4.16

Total - DLA	6,729	n.a.	12.88
Attendance Allowance (AA)			
Low and medium care (low rate)	2,143	4,127.11[d]	8.84
High care (high rate)	1,214	2,763.57[e]	3.35
Total - AAA	3,356	n.a.	12.20
Employment and Support Allowance (ESA)			
Assessment phase	300	5,131.78[f]	1.54
Work related Activity Component	301	1,483.46[g]	0.45
Support Component	277	1,814.57[h]	0.50
Total - ESA	878	n.a.	2.49
Severe Disablement Allowance (SDA)	367	4,178.86[i]	1.53
Carers Allowance (CA)	1,075	3,115.54[j]	3.35
Total – Scotland	12,404	n.a.	32.45
N.I.			
Disability Living Allowance (DLA)			
Higher rate	33	4,127.11[a]	0.14
Middle rate	181	2,753.57[b]	0.50
Lower Rate	277	1,095.00[c]	0.30
Total - DLA	492	n.a.	0.94
Attendance Allowance (AA)			
Low and medium care (low rate)	721	4,127.11[d]	2.98
High care (high rate)	408	2,763.57[e]	1.13
Total - AAA	1,130	n.a.	4.10
Employment and Support Allowance (ESA)			
Assessment phase	183	5,131.78[f]	0.94
Work related Activity Component	184	1,483.46[g]	0.27
Support Component	169	1,814.57[h]	0.31
Total - ESA	536	n.a.	1.52
Severe Disablement Allowance (SDA)	185	4,178.86[i]	0.77
Carers Allowance (CA)	795	3,115.54[j]	2.48
Total – N.I.	3,137	n.a.	9.81

Note: (a) Based off £79.37 per week (b) Based off £53.15 per week (c) Based off £21.06 per week (d) Based off £79.37 per week (e) Based off £53.15 per week (f) Based off £98.69 (g) based off £28.53 per week (h) Based off £34.90 per week (i) Based off £80.36 per week (j) Based off £59.91 per week (k) Calculated by multiplying the proportion of people receiving DLA and AA for blindness (1.99%) by the total number of claimants for the Carers Allowance Source: DWP (2013), DSD (2013) and Access Economics calculations.

4.5 Summary of indirect costs

The total of indirect costs attributable to sight loss and blindness in the UK amounted to £5,654 million in 2013. A breakdown of these costs is shown in Table 4.11.

Table 4.11: Summary of indirect costs 2013

	£ million				
	UK	**England**	**Wales**	**Scotland**	**N.I.**
Lower employment	2,427.4	2,078.5	88.0	210.9	50.0
Absenteeism	77.6	65.6	3.7	6.5	1.9
Premature mortality	2.14	1.77	0.09	0.23	0.05
Informal care costs	2,358.2	1,951.9	134.8	194.8	76.7
Devices and modifications	409.6	343.8	21.5	34.1	10.2
Deadweight loss	378.9	311.8	19.8	37.0	10.3
Total	5,653.9	4,753.3	267.8	483.6	149.2

Source: Deloitte Access Economics calculations.

5 Burden of disease

Adults experiencing sight loss will experience an associated loss in the quality and length of life. Consequently, the total stock of health capital will be reduced, which will be commensurate with the prevalence and severity of sight loss within the UK. As individuals place a value on their health (for example, people are willing to purchase an increase their health through treatment or to reduce the risk of experiencing poor health), the value of the reduced stock of health capital due to sight loss and blindness can be estimated.

This chapter estimates the value of a reduction in the stock of health capital in the UK adult population from reduced health and premature death related to sight loss and blindness in 2008. The method to quantify the reduction in the stock of health capital is the global burden of disease methodology developed by the World Health Organisation (Murray and Lopez, 1996). The method to value a reduction in the stock of health capital has been based off Mason et al (2008) using estimates of the value of a statistical life derived from the UK Department of Transport.

5.1 Methods used for measuring and valuing the burden of disease

Traditionally, measurement of health outcomes that combine duration and quality of life has been undertaken using the quality adjusted life year (QALY). The QALY was developed based off a multi-attribute utility theory framework under strict conditions (Sassi 2006), and has since been used as a standard in cost effectiveness analysis (Drummond et al 2005).

In the early 1990s, the multi-attribute utility framework used for the development of QALYs provided a basis for the development of the disability adjusted life year (DALY) by the World Health Organisation. DALYs were developed as the measurement unit to quantify the non-fatal health outcomes, labelled the burden of disease and injury, on populations around the world for the Global Burden of Disease Study (Murray and Lopez, 1996). Methods and data sources regarding the development of DALYs are detailed further in Murray and Acharya (1997) and Murray et al (2001).

Rather than measuring the healthy part of life associated with a condition (as in a QALY), the DALY was developed to measure the disability imposed on an individual. Thus a DALY is a negative concept, measuring the loss in a healthy life year.

DALY weights were measured on a scale of zero to one, where a zero represented a year of perfect health and one represented death. Other health states associated with specific conditions were attributed values between zero and one by a reference group convened at the WHO on the basis of a person trade-off method for measuring health state preferences (Murray and Acharya 1997). For example, a disability weight of 0.02 for low vision can be interpreted as losing 2% of a person's quality of life relative to perfect health. This represented a departure from the derivation of QALY weights, which rely on preference-

based health related quality of life measures derived from population samples or patients, and thus represent individual preferences rather than social preferences.

Access Economics has adopted a DALY approach in this report for consistency with our other international reports on the economic burden of sight loss (in the US, Australia, Canada and Japan), and also with international literature in the US, Canada and Japan (Wittenborn and Rein, 2014; Cruess et al, 2011; Roberts et al, 2010). Because DALY weights are objective and consistent across countries, they are preferred by Access Economics, as well as more broadly, for example, by the WHO. For the purposes of application in the UK, DALYs can be considered broadly comparable with QALYs (a DALY is essentially a QALY with a pre-agreed weight).

The use of the DALY approach was also endorsed in the Association for Research in Vision and Ophthalmology Workshop (the "Vancouver Group") to establish guidelines to measure the economic burden of vision loss. The DALY approach was suggested as more appropriate than the QALY approach for studies estimating the cost of vision loss, for a number of reasons (Frick et al, 2010).

Under the DALY framework, the total burden of disease for an individual with a condition is the sum of the mortality and morbidity components associated with that condition over time, including the years of healthy life lost due to disability (YLDs), and the years of healthy life lost due to premature death (YLLs). Incorporating time preference for health (and thus discounting), this can be represented by:

$$DALY_i = \sum_{t=a}^{a+L} \frac{Dw_{i,t}}{(1+r)^{t-a}}$$

where *Dw* is the DALY weight of the condition experienced by individual *i*, *L* is the residual life expectancy of the individual at age *a,* and *t* represents individual years within that life expectancy.

The total burden of disease from a condition on society can therefore be represented by aggregating DALYs of all individuals with the condition, which can be represented by:

$$DALY_t = \sum_{i=0}^{N_t} DALY_{i,t}$$

where *N* is the prevalence of the condition at time *t*.

As total DALYs are not financial they are not directly comparable with monetary costs and benefits associated with a specific condition. In an economic evaluation of public programs, a monetary conversion of the loss in healthy life is typically used to ascertain the cost of a condition so the net benefit or cost of a health intervention can be determined. This also allows benefit cost ratios to be calculated so comparisons can be made across all types of programs, not just those associated with changes to health.

In general there are two ways to estimate the value of a change in the stock of health capital using survey techniques. The first is to directly measure the willingness to pay for a

change in the health status under investigation using a choice based approach, such as contingent valuation or discrete choice methods (for example, conjoint analysis and choice modelling) (Gyrd-Hansen 2005).

The alternative is to model the WTP for a year of healthy life from existing value of a statistical life (VSL) currently used in the public arena. The VSL is generally derived from the WTP of individuals to avoid small changes in the risk of various health states, including (often) death. As this is arguably a similar context to deriving WTP for changes to morbidity, VSL estimates can be applied to summary measures of health such as QALYs and DALYs (Mason et al 2008).

This study used a modelling approach derived from Mason et al (2008) to estimate the value of a year of perfect health. Their study uses a VSL derived from the UK Department for Transport (which is also recommended for use by the Health and Safety Executive) (Mason et al 2008). The VSL was estimated to be £1.43 million in 2005 prices, derived by asking the public about their WTP for reduction in death from road safety improvements using a contingent valuation/standard gamble approach (Department for Transport, 2007).

After adjusting for quality of life, discounting using a rate of 1.5% (the recommended rate of pure time preferences by Her Majesty's Treasury), and adjusting for the value of consumption forgone due to death in the Department for Transport VSL estimates, the value of a year of perfect health was estimated to be £70,896 (in 2005 prices) (Mason et al 2008). This estimate has been used as a proxy for the value of a DALY in this study, but has been adjusted to 2013 prices using UK CPI to give £88,825.

5.2 Burden of disease from sight loss and blindness

The global burden of disease methodology developed by the WHO (Murray and Lopez, 1996) was used to quantify the loss of wellbeing and quality of life associated with sight loss.

While the 2010 global burden of disease study provided updated disability weights (Salomon et al, 2012), there has been debate over the weights assigned to sight loss and blindness. Taylor et al (2012) argue that the disability weights assigned are too low, and that "investigation and explanation" is required before they can be adopted.

The disability weights for low vision, partial sight and blindness from the global burden of disease study are (WHO 2004):

- 0.02 for low vision;
- 0.17 for partial sight; and
- 0.43 for blindness (severe sight loss).

The 2010 global burden of disease study disability weights reported in Salomon et al (2012) are:

- 0.004 for low vision;

- 0.033 for partial sight; and
- 0.191 for blindness (severe sight loss).

Due to concern over the disability weights in the 2010 global burden of disease study, we have retained use of the disability weights as per the global burden of disease study from 2004 (WHO, 2004), although estimates of the burden of disease are also provided for the new disability weights.

The total burden of disease of sight loss in the UK was calculated using the methodology presented in Section 5.1. Prevalence estimates of sight loss in the UK were derived from Chapter 2. The total burden of disease includes two components, the Years of healthy life Lost due to Disability (YLDs) and Years of Life Lost due to premature death (YLLs). Both of these are presented in more detail below.

5.2.1 Years of healthy life lost due to disability

YLDs from sight loss and blindness in the UK were calculated by multiplying the number of people with sight loss by the disability weights associated with the severity of the sight loss. It is assumed that all people with sight loss or blindness in 2013 experienced their condition for the entire year. Table 5.1 summarises the burden of disease (years of healthy life lost) from sight loss and blindness in the UK for 2013.

As shown in Table 5.1, around 205,373 DALYs was lost due to disability associated with sight loss and blindness in the UK in 2013. Of this, 62.7% was experienced by females. Chart 5.1 breaks down the share of the burden of disease across conditions. It shows that AMD has the largest burden, accounting for around 33%, followed by RE, which accounts for around 21% of the total burden of disease. This is despite the fact that there are significantly more people with RE in the UK compared to those with AMD (751,487 people compared to 445,809), suggesting AMD imposes a much greater burden per person. Diabetic retinopathy had the lowest share of the burden of disease, accounting for around 8%.

Chart 5.2 breaks down the burden of disease by severity of sight loss for each condition. It shows that although AMD and Refractive Error contribute similar proportions to the total burden of disease, their burdens are derived from different sources. For AMD, most of the burden of disease is due to the relatively large proportion of people who are blind due to AMD. In fact, blindness contributes to around 77.4% of the total burden of disease. In contrast, only 4.2% of the total burden of disease for RE comes from blindness and of this, around 70.1% is derived from those with partial sight.

In order to derive the total cost associated with the years of healthy life lost due to disability, total DALYs were multiplied by £88,825 (the value of a year of perfect health discussed in Section 5.1). This provided an estimate of £18.24 billion for the total cost associated with the years of healthy life lost due to disability in 2013.

Table 5.1: DALYs associated with disability from sight loss and blindness in the UK 2013

	AMD	Cataract	DR	Glaucoma	RE	Other	Total
UK							
Males							
18- 39	0	0	215	0	1,181	152	1,548
40-44	0	30	495	463	584	123	1,696
45-49	0	32	517	483	912	167	2,109
50-54	0	460	1,254	465	848	198	3,228
55-59	37	668	1,081	402	1,069	241	3,498
60-64	35	1,016	1,012	1,401	1,764	355	5,583
65-69	384	1,723	1,647	2,212	2,593	580	9,138
70-74	713	1,649	1,166	2,255	2,324	606	8,716
75-79	3,645	934	1,435	1,226	1,910	773	9,922
80-84	6,081	1,129	791	1,428	1,842	1,042	12,313
85-89	5,803	1,857	69	1,212	1,708	1,231	11,878
≥ 90	4,131	1,015	4	205	675	926	6,957
Total (M)	20,828	10,510	9,689	11,756	17,406	6,395	76,585
Females	0	0	0	0	0	0	0
18- 39	0	0	137	0	1,054	140	1,330
40-44	0	30	240	374	794	138	1,575
45-49	0	31	250	390	1,169	187	2,027
50-54	0	623	668	448	1,104	222	3,064
55-59	38	980	578	388	1,287	269	3,541
60-64	36	1,566	549	1,340	2,038	400	5,931
65-69	1,026	2,915	781	2,053	2,558	666	9,997
70-74	1,317	4,921	583	1,845	2,837	690	12,191
75-79	5,940	2,689	615	1,403	3,684	2,201	16,530
80-84	11,488	3,044	546	1,726	3,600	2,575	22,979
85-89	12,734	5,222	369	1,957	2,765	2,514	25,560
≥ 90	14,146	3,296	113	1,993	2,214	2,300	24,063
Total (F)	46,723	25,318	5,432	13,913	25,102	12,299	128,788
Total	67,551	35,829	15,121	25,670	42,508	18,696	205,373
England							
Males							
18- 39	-	-	183	-	998	128	1,308
40-44	-	26	418	392	496	105	1,437
45-49	-	27	433	406	770	140	1,777
50-54	-	387	1,045	389	714	167	2,702
55-59	31	558	897	334	895	201	2,916
60-64	29	849	840	1,164	1,476	296	4,653
65-69	321	1,450	1,377	1,852	2,186	487	7,673

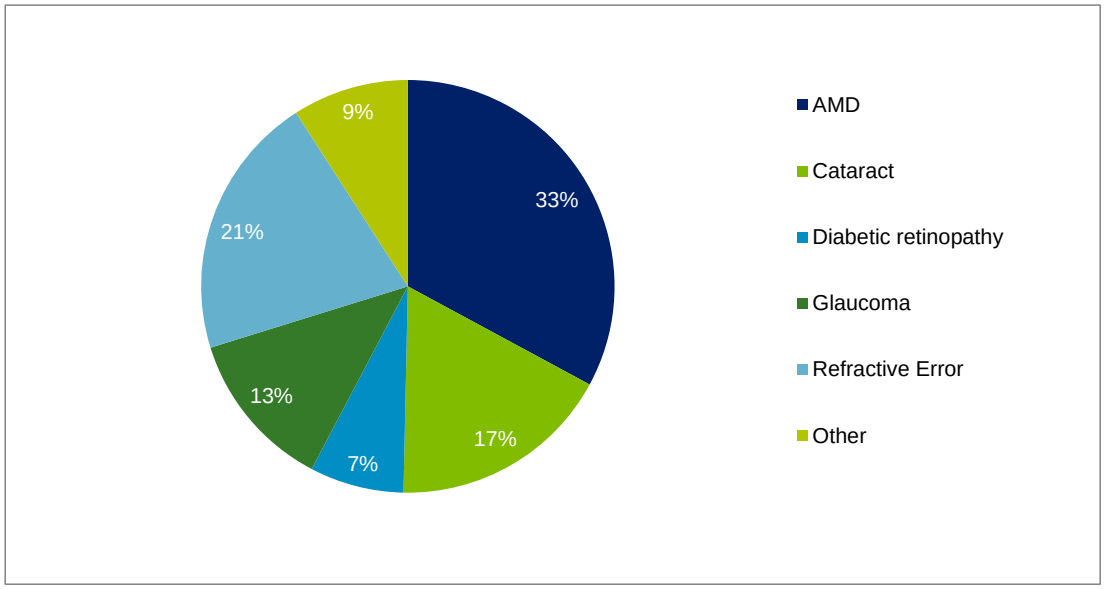
	AMD	Cataract	DR	Glaucoma	RE	Other	Total
70-74	593	1,380	969	1,877	1,932	504	7,257
75-79	3,050	782	1,201	1,026	1,598	647	8,304
80-84	5,131	953	667	1,205	1,554	880	10,389
85-89	4,939	1,581	58	1,031	1,453	1,047	10,109
≥ 90	3,549	872	4	177	580	795	5,978
Total (M)	17,642	8,864	8,094	9,853	14,652	5,398	64,504
Females							
18- 39	-	-	116	-	889	119	1,123
40-44	-	25	202	315	668	116	1,325
45-49	-	26	209	327	978	156	1,695
50-54	-	520	555	372	918	185	2,550
55-59	31	814	479	321	1,067	223	2,936
60-64	30	1,306	456	1,113	1,694	333	4,932
65-69	857	2,443	652	1,716	2,138	557	8,363
70-74	1,089	4,082	482	1,527	2,347	570	10,097
75-79	4,930	2,234	510	1,164	3,058	1,826	13,721
80-84	9,595	2,545	456	1,441	3,007	2,151	19,194
85-89	10,715	4,397	310	1,646	2,326	2,114	21,509
≥ 90	12,054	2,809	97	1,701	1,886	1,958	20,505
Total (F)	39,300	21,201	4,524	11,642	20,976	10,306	107,950
Total	56,942	30,066	12,618	21,496	35,628	15,705	172,454
Wales							
Males							
18- 39	-	-	9	-	55	7	71
40-44	-	1	22	21	26	5	76
45-49	-	1	24	22	42	8	97
50-54	-	22	60	22	40	9	154
55-59	2	33	54	20	52	12	173
60-64	2	54	54	75	93	19	297
65-69	21	92	89	120	138	31	491
70-74	40	91	65	126	130	34	486
75-79	198	51	78	67	104	42	539
80-84	321	60	42	75	97	55	651
85-89	305	98	4	64	90	65	624
≥ 90	208	51	0	10	34	47	350
Total (M)	1,097	553	502	623	899	334	4,008
Females							
18- 39	0	0	6	0	48	6	60
40-44	0	1	11	17	36	6	71
45-49	0	1	12	18	54	9	95
50-54	0	30	33	22	53	11	148

	AMD	Cataract	DR	Glaucoma	RE	Other	Total
55-59	2	50	29	20	64	14	179
60-64	2	83	29	72	107	21	315
65-69	55	156	42	110	135	35	533
70-74	72	268	32	101	155	38	665
75-79	317	144	33	75	196	117	881
80-84	601	159	28	90	188	135	1,202
85-89	676	277	20	104	147	134	1,357
≥ 90	757	176	6	106	119	124	1,288
Total (F)	2,482	1,346	281	734	1,302	649	6,794
Total	3,579	1,899	783	1,357	2,201	983	10,802
Scotland							
Males							
18- 39	-	-	17	-	93	12	123
40-44	-	2	41	37	46	10	136
45-49	-	3	45	41	75	14	177
50-54	-	39	113	41	72	17	283
55-59	3	59	99	37	93	21	312
60-64	3	87	91	125	151	31	488
65-69	32	140	140	186	209	48	755
70-74	61	136	101	193	201	52	745
75-79	307	78	121	103	161	65	835
80-84	488	90	64	115	148	83	988
85-89	430	137	5	90	127	92	881
≥ 90	289	71	0	14	47	65	486
Total (M)	1,614	842	837	983	1,422	510	6,208
Females							
18- 39	0	0	11	0	85	11	107
40-44	0	3	20	31	68	12	134
45-49	0	3	22	34	104	17	180
50-54	0	56	61	41	102	20	280
55-59	4	89	54	36	121	25	329
60-64	3	137	50	120	185	36	531
65-69	88	244	67	175	222	57	853
70-74	120	440	53	167	258	63	1,102
75-79	540	242	56	128	335	201	1,503
80-84	1,000	263	48	151	313	224	1,999
85-89	1,031	421	30	159	224	204	2,068
≥ 90	1,023	238	8	143	160	167	1,740
Total (F)	3,809	2,137	482	1,184	2,177	1,037	10,826
Total	5,423	2,979	1,319	2,167	3,599	1,547	17,034
Northern Ireland							

	AMD	Cataract	DR	Glaucoma	RE	Other	Total
Males							
18- 39	-	-	6	-	35	5	46
40-44	-	1	14	13	16	3	47
45-49	-	1	15	14	25	5	58
50-54	-	12	36	13	22	5	89
55-59	1	18	31	11	29	7	97
60-64	1	26	27	37	44	9	145
65-69	10	41	41	54	60	14	219
70-74	19	42	31	59	61	16	228
75-79	90	23	35	30	47	19	244
80-84	141	26	18	33	43	24	285
85-89	129	41	2	27	38	27	264
≥ 90	85	21	0	4	14	19	143
Total (M)	475	251	256	297	433	153	1,865
Females							
18- 39	0	0	4	0	32	4	40
40-44	0	1	7	11	22	4	45
45-49	0	1	7	11	33	5	57
50-54	0	17	19	13	31	6	86
55-59	1	27	16	11	35	7	97
60-64	1	40	14	35	52	10	153
65-69	26	72	20	52	63	17	248
70-74	36	131	16	50	77	19	327
75-79	153	69	16	36	95	57	425
80-84	292	77	14	44	92	65	584
85-89	312	127	9	48	68	62	626
≥ 90	312	73	2	43	49	51	530
Total (F)	1,132	634	145	353	647	307	3,218
Total	1,607	885	401	650	1,080	461	5,083

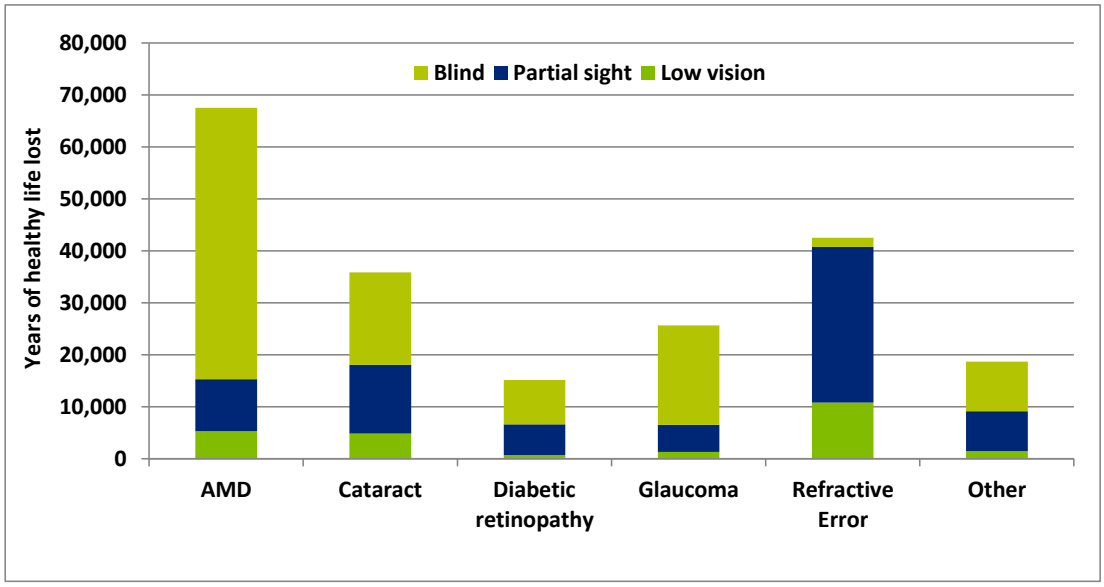
Source: Deloitte Access Economics calculations.

Chart 5.1: Share of the burden of disease across conditions in the UK, 2013



Source: Deloitte Access Economics calculations.

Chart 5.2: Burden of disease across conditions, by severity of sight loss, in the UK, 2013



Source: Deloitte Access Economics calculations.

5.2.2 Years of life lost due to premature death

The total number of deaths associated with sight loss and blindness was calculated using the same methodology outlined in Section 4.1.3. The estimated total number of deaths due to sight loss and blindness is shown in Table 5.2.

Assuming the average life expectancy for males and females in the UK is 79 and 83 years respectively[35] (OECD, 2012), the value of a year of perfect health is £88,825 (as discussed in Section 5.1), and a discount rate of 1.5%, the present value of the years of life lost due to premature death associated with sight loss and blindness was calculated as £1.2 billion in 2013.

Table 5.2: Estimated number and value of deaths due to sight loss 2013

	People with sight loss	Deaths per 1000	Deaths per 1000 attributable to sight loss	Total deaths due to sight loss	Discounted value of life lost
UK					
Male					£ million
18-19	2,185	0.465	0.01	0.02	0.07
20-39	26,719	0.725	0.01	0.45	1.39
40-49	43,049	2.05	0.04	1.82	4.27
50-54	29,616	3.62	0.07	2.12	4.16
55-59	35,767	5.87	0.12	4.15	6.87
60-64	52,603	9.47	0.19	9.77	19.15
65-74	175,936	19.745	0.39	69.49	54.28
75-84	191,072	57.23	1.12	216.81	100.94
85+	167,117	182.91	3.60	597.30	253.75
Total (M)	724,063	n.a.	n.a.	901.94	444.89
Female					
18-19	2,342	0.17	0.00	0.01	0.02
20-39	24,448	0.38	0.01	0.20	0.63
40-49	46,947	1.305	0.03	1.27	3.27
50-54	32,170	2.5	0.05	1.60	3.51
55-59	38,993	4.04	0.08	3.16	5.99
60-64	59,177	6.24	0.12	7.26	15.87
65-74	200,949	12.98	0.26	52.53	56.63
75-84	338,526	41.015	0.81	278.13	129.49
85+	438,664	154.015	3.03	1,327.66	564.01
Total (F)	1,182,216	n.a.	n.a.	1,671.77	779.42
Total	1,906,280	n.a.	n.a.	2,573.72	1,224.31
England					
Male					
18-19	1,831	0.465	0.01	0.02	0.06
20-39	22,624	0.725	0.01	0.32	1.00

[35] For the age brackets 75-84 and 85+ for both males and females, life expectancy was assumed to be 85 years and 90 years respectively.

	People with sight loss	Deaths per 1000	Deaths per 1000 attributable to sight loss	Total deaths due to sight loss	Discounted value of life lost
40-49	36,405	2.05	0.04	1.47	3.45
50-54	24,826	3.62	0.07	1.77	3.46
55-59	29,834	5.87	0.12	3.44	5.69
60-64	43,883	9.47	0.19	8.17	16.01
65-74	147,026	19.745	0.39	57.06	44.57
75-84	160,639	57.23	1.12	180.70	84.13
85+	142,743	182.91	3.60	513.20	218.02
Total (M)	609,811	n.a.	n.a.	766.15	376.39
Female					
18-19	1,963	0.17	0.00	0.01	0.02
20-39	20,353	0.38	0.01	0.15	0.49
40-49	40,303	1.305	0.03	1.03	2.65
50-54	27,380	2.5	0.05	1.35	2.95
55-59	33,060	4.04	0.08	2.63	4.99
60-64	49,473	6.24	0.12	6.07	13.28
65-74	167,077	12.98	0.26	42.63	45.96
75-84	282,014	41.015	0.81	227.36	105.85
85+	371,407	154.015	3.03	1124.37	477.65
Total (F)	993,029	n.a.	n.a.	1405.58	653.85
Total	1,602,841	n.a.	n.a.	2,171.73	1,030.25
Wales					
Male					
18-19	109	0.465	0.01	0.00	0.00
20-39	1,201	0.725	0.01	0.02	0.05
40-49	1,949	2.05	0.04	0.08	0.18
50-54	1,408	3.62	0.07	0.10	0.20
55-59	1,769	5.87	0.12	0.20	0.34
60-64	2,790	9.47	0.19	0.52	1.02
65-74	9,647	19.745	0.39	3.74	2.92
75-84	10,220	57.23	1.12	11.50	5.35
85+	8,642	182.91	3.60	31.07	13.20
Total (M)	37,733	n.a.	n.a.	47.23	23.27
Female					
18-19	116	0.17	0.00	0.00	0.00
20-39	1,201	0.38	0.01	0.01	0.03
40-49	1,949	1.305	0.03	0.05	0.13
50-54	1,408	2.5	0.05	0.07	0.15
55-59	1,769	4.04	0.08	0.14	0.27
60-64	2,790	6.24	0.12	0.34	0.75

	People with sight loss	Deaths per 1000	Deaths per 1000 attributable to sight loss	Total deaths due to sight loss	Discounted value of life lost
65-74	10,847	12.98	0.26	2.77	2.98
75-84	17,844	41.015	0.81	14.39	6.70
85+	23,386	154.015	3.03	70.80	30.08
Total (F)	61,309	n.a.	n.a.	88.56	41.08
Total	99,042	n.a.	n.a.	135.80	64.35
Scotland					
Male					
18-19	176	0.5	0.01	0.00	0.01
20-39	2,135	2.2	0.04	0.09	0.29
40-49	3,518	3.1	0.06	0.21	0.50
50-54	2,572	4	0.08	0.20	0.40
55-59	3,180	6.85	0.13	0.43	0.71
60-64	4,576	9.7	0.19	0.87	1.71
65-74	14,835	23.8	0.47	6.94	5.42
75-84	15,664	62.8	1.23	19.34	9.00
85+	12,122	171.9	3.38	40.96	17.40
Total (M)	58,779	n.a.	n.a.	69.05	35.44
Female					
18-19	189	0.2	0.00	0.00	0.00
20-39	2,135	0.6	0.01	0.03	0.09
40-49	3,518	1.9	0.04	0.13	0.34
50-54	2,572	2.6	0.05	0.13	0.29
55-59	3,180	4.5	0.09	0.28	0.53
60-64	5,379	6.4	0.13	0.68	1.48
65-74	17,812	16.6	0.33	5.81	6.27
75-84	30,019	49.1	0.97	28.97	13.49
85+	33,653	155.3	3.05	102.73	43.64
Total (F)	98,458	n.a.	n.a.	138.76	66.13
Total	157,237	n.a.	n.a.	207.81	101.56
N.I.					
Male					
18-19	69	0.8	0.02	0.00	0.00
20-39	759	1.2	0.02	0.02	0.05
40-49	1,177	2.5	0.05	0.06	0.14
50-54	810	3.3	0.07	0.05	0.10
55-59	984	3.9	0.08	0.08	0.13
60-64	1,354	7.9	0.16	0.21	0.41
65-74	4,428	20.2	0.40	1.75	1.37
75-84	4,549	59.0	1.16	5.27	2.46

	People with sight loss	Deaths per 1000	Deaths per 1000 attributable to sight loss	Total deaths due to sight loss	Discounted value of life lost
85+	3,610	170.1	3.34	12.07	5.13
Total (M)	17,740	n.a.	n.a.	19.51	9.79
Female					
18-19	74	0.2	0.00	0.00	0.00
20-39	759	0.5	0.01	0.01	0.02
40-49	1,177	2.5	0.05	0.06	0.15
50-54	810	3.3	0.07	0.05	0.12
55-59	984	5.5	0.11	0.11	0.20
60-64	1,535	5.5	0.11	0.17	0.36
65-74	5,213	12.9	0.25	1.32	1.42
75-84	8,649	43.6	0.86	7.41	3.45
85+	10,218	148.2	2.91	29.76	12.64
Total (F)	29,420	n.a.	n.a.	38.87	18.36
Total	47,160	n.a.	n.a.	58.38	28.15

Note: Discount rate = 1.5%. Source: ONS (2012a) and Access Economics calculations.

5.2.3 Value of a loss in the stock of health capital due to sight loss

The total cost associated with the burden of disease consists of the burden associated with years of healthy life lost due to disability and years of life lost due to premature death. Using the estimates presented in the last two sections, the total cost is estimated to be £19.47 billion in the UK in 2013.

The cost was estimated to be £16.3 billion in England, £1 billion in Wales, £1.6 billion in Scotland and £0.5 billion in Northern Ireland.

Applying the 2010 global burden of disease disability weights results in a substantially different outcome, reducing the total DALYs from 205,373 to 67,299. The estimate of the total cost associated with years of healthy life lost due to disability is reduced from £19.47 billion to £7.20 billion.

6 Comparisons

The purpose of this chapter is to provide a comparison between the findings of this report and those of the 2009 Access Economics report.

Table 6.1 presents the prevalence estimates. Between 2008 and 2013, the number of people with sight loss and blindness in UK has increased by 135,115 (i.e. 7.5%), primarily due to changes in demographics, in particular the ethnicity splits, and population size. With population ageing, it is not surprising that the prevalence of AMD has risen during this period, in line with existing literature such as Owen et al (2012). Likewise, Cataract and Glaucoma are associated with an ageing population. For DR, the increasing prevalence of diabetes in UK places more people at risk of developing DR.

The prevalence of RE has decreased over the same period. This is possibly due to more people accessing corrective services as evidenced in section 3.4 where the value of vouchers for accessing corrective glasses and the number of eye tests have increased.

Table 6.1: Comparison of estimated prevalence of sight loss and blindness in UK adults 2008 and 2013

Disease type	2008	2013	% change
AMD	299,886	445,809	48.7
Cataract	245,562	361,085	47.0
DR	62,463	90,912	45.5
Glaucoma	95,209	139,693	46.7
RE	960,758	751,487	-21.8
Other	133,110	143,119	7.5
Total	1,796,990	1,932,105	7.5

Turning to cost estimates, the total costs have increased in 2013 relative to 2008 (Table 6.2). A number of components such as the availability and inclusion of the cost of Lucentis, and a rise in productivity losses have contributed to this increase of direct costs between 2008 and 2013. It is worth noting that the rise in productivity losses was due to a fall in the employment rate for people with sight loss and blindness, thereby widening the employment gap with those of the general population. This also directly contributed to the fall in the cost associated with absenteeism which is dependent on the number of employed people with sight loss and blindness (section 4.1).

The expenditure associated with injurious falls has also decreased between 2008 and 2013. This was primarily due to a drop in unit costs even though the estimated episodes related to falls due to sight loss and blindness have increased over the years (section 3.5). Finally, the burden of sight loss and blindness has increased by more than 25%, to £19.5 billion in 2013, indicating substantial burden from sight loss and blindness still remain.

Table 6.2: Comparison of costs associated with sight loss and blindness in UK adults 2008 and 2013

Components	2008	2013	% change
Direct costs:	£ million	£ million	%
Hospital recurrent expenditure	592.7	734.9	24.0
Non-admitted expenditure	508.0	771.1	51.8
Prescribing expenditure	158.1	380.9*	140.9
General ophthalmic services	484.0	614.6	27.0
Expenditure associated with injurious falls	25.1	23.4	-6.6
Research and development	14.0	17.0	21.4
Residential care and community care services	304.7	276.8	-9.2
Capital and administration	58.2	170.7	193.2
Total – Direct costs	**2,144.9**	**2,989.3**	**39.4**
Indirect costs:			
Lower employment	1,626.7	2,427.4	49.2
Absenteeism	79.9	77.6	-2.8
Premature mortality	2.4	2.1	-10.0
Informal care costs	2,029.7	2,358.2	16.2
Devices and modifications	336.5	409.6	21.7
Deadweight loss	268.6	379.0	41.1
Total – Indirect costs	**4,343.7**	**5,653.9**	**30.2**
Burden of disease costs			
Years of life lost due to morbidity	14,530.7	18,242.3	25.5
Years of life lost due to premature death	978.4	1,224.3	25.1
Total – Burden of disease costs	**15,509.1**	**19,466.6**	**25.5**
Total –Costs	**21,997.7**	**28,109.8**	**27.8**

Note: * Includes cost of Lucentis.

Source: Deloitte Access Economics calculations.

It is worth highlighting that the findings from Deloitte Access Economics (2013), *The economic cost and burden of eye diseases and preventable blindness in the UK*, are naturally lower than those estimated in this report due to differences in the eye conditions covered, definitions of blindness and cost components included. The coverage in this report is much broader, as it includes the costs of sight loss as well as of blindness, and the definition of blindness in this report is based on best-corrected visual acuity of <6/60, while Deloitte Access Economics (2013) was based on best-corrected visual acuity of <3/60. Finally, in this report, more cost components such as costs associated with research and development, devices and modifications and deadweight losses were included. Briefly, the estimated direct and indirect costs from Deloitte Access Economics (2013) were £1.68 billion and £873.3 million respectively.

Conclusions

Deloitte Access Economics (Australia) was commissioned by the Royal National Institute of Blind People (RNIB) to update the 2009 Access Economics report on the economic impact of sight loss and blindness in the UK adult population, including the direct and indirect costs of sight loss and blindness, and the burden of sight loss and blindness on health.

Sight loss and blindness is defined in this study as best-corrected visual acuity of <6/12 or a visual field of <20° or homonymous hemianopia in the better-seeing eye. It thus comprises blindness and sight loss. Six conditions that lead to sight loss and blindness investigated in this study, including:

- AMD;
- cataract;
- DR;
- glaucoma;
- RE; and
- other causes of sight loss and blindness.

The prevalence of sight loss and blindness in 2013, and prevalence projections to 2050, were estimated using prevalence rates derived from the literature and population estimates calculated by Deloitte Access Economics. In total, it was estimated that there are around 1,932,105 people in the UK who had sight loss and blindness in 2013, the majority of these being adults 50 years and older. Of those with sight loss and blindness:

- 1,246,196 (64.5%) people had low vision;
- 431,307 (22.3%) people had partial sight; and
- 254,602 (13.2%) people had blindness (severe sight loss).

It is projected that by 2050 there will be more than 4.14 million people with sight loss and blindness in the UK, which is an increase of around 115% from 2013 estimates.

As the majority of prevalence studies are almost a decade old now, the prevalence estimates may not capture recent advances in treatment. In particular, the effects of recent growth in the use of Anti-VEGF drugs to treat AMD and DR are unlikely to be taken into account in prevalence estimates. Anti-VEGF drugs have been shown to both slow and reverse some instances of sight loss and blindness. In addition, recent healthcare or policy changes may not be captured appropriately. For example, changes in eligibility for NHS funded sight tests could alter detection rates, which might then result in earlier treatment and reduce the prevalence of sight loss and blindness.

This highlights the need for high quality, population-based epidemiological studies to track the prevalence of all eye conditions in the UK and the impacts of treatment over time. Building on the evidence base longitudinally in this manner could also capture changes that are occurring within the population (e.g. in risk factors such as smoking rates), enabling

more accurate and timely estimates of the economic costs associated with sight loss and blindness.

UK-wide population projections that include ethnicity splits would be highly beneficial for future studies estimating the economic impact of sight loss and blindness in the UK.

The large prevalence of sight loss and blindness means sight loss in the UK adult population imposes a significant cost on public funds, private expenditure, and health. The total cost of sight loss and blindness was estimated to be almost £28.1 billion in 2013. This study did not estimate the expected large, and additional costs, associated with sight loss and blindness for children (less than 18 years of age) so the total cost is expected to be underestimated.

Direct health care system costs amount to £2.99 billion and indirect costs amount to £5.65 billion in 2013. In addition, the loss of healthy life and the loss of life due to premature death associated with sight loss and blindness were estimated to have reduced the total capital stock of health by £19.47 billion in 2013.

The majority of direct health care system costs are attributable to hospital recurrent expenditure and non-admitted expenditure, totalling around £1.5 billion (or 50%). Further significant cost items include general ophthalmic services (£614.6 million or 21%), prescribing expenditure (£380.9 million or 13%), and residential and community care services (£276.8 million or 9%). Other costs include costs due to injurious falls, an attributable portion of capital and administration costs and research and development relating to sight loss and blindness.

The largest indirect costs component is attributable to lower employment participation, totalling around £2.43 billion (or 43%) in 2013. Another significant indirect cost is associated with informal care, which was estimated as £2.36 billion (or 42%). Other indirect costs associated with sight loss and blindness in 2013 include expenditure on devices and modifications (£409.6 million or 7%), inefficiency resulting from increased tax revenue to fund public expenditure known as deadweight loss (£379.0 million or 7%), absenteeism and premature mortality (together, 1% of the total).

However, the largest cost associated with sight loss and blindness is the loss in the stock of health capital due to a reduced quality of life and premature mortality. It was estimated that a reduction in the quality of life due to sight loss and blindness reduced the total stock of health capital by £18.2 billion in 2013, and a reduction in health due to premature death resulted in a reduced stock of health capital by £1.2 billion.

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Appendix A

Table A.1: HRG mapping to eye condition within reference cost data

HRG V.4+	Description	Assigned condition
BZ01A	Enhanced Cataract Surgery, with CC Score 2+	CAT
BZ01B	Enhanced Cataract Surgery, with CC Score 0-1	CAT
BZ02A	Phacoemulsification Cataract Extraction and Lens Implant, with CC Score 5+	CAT
BZ02B	Phacoemulsification Cataract Extraction and Lens Implant, with CC Score 2-4	CAT
BZ02C	Phacoemulsification Cataract Extraction and Lens Implant, with CC Score 0-1	CAT
BZ03A	Non-Phacoemulsification Cataract Surgery, with CC Score 1+	CAT
BZ03B	Non-Phacoemulsification Cataract Surgery, with CC Score 0	CAT
BZ04A	Lens Capsulotomy, with CC Score 1+	CAT
BZ04B	Lens Capsulotomy, with CC Score 0	CAT
BZ05A	Major Oculoplastics Procedures, with CC Score 1+	OTH
BZ05B	Major Oculoplastics Procedures, with CC Score 0	OTH
BZ06B	Intermediate Oculoplastics Procedures, 18 years and under	OTH
BZ06C	Intermediate Oculoplastics Procedures, 19 years and over, with CC Score 2+	OTH
BZ06D	Intermediate Oculoplastics Procedures, 19 years and over, with CC Score 0-1	OTH
BZ07B	Minor Oculoplastics Procedures, 18 years and under	OTH
BZ07C	Minor Oculoplastics Procedures, 19 years and over, with CC Score 3+	OTH
BZ07D	Minor Oculoplastics Procedures, 19 years and over, with CC Score 1-2	OTH
BZ07E	Minor Oculoplastics Procedures, 19 years and over, with CC Score 0	OTH
BZ08B	Major Orbits or Lacrimal Procedures, 18 years and under	OTH
BZ08C	Major Orbits or Lacrimal Procedures, 19 years and over, with CC Score 1+	OTH
BZ08D	Major Orbits or Lacrimal Procedures, 19 years and over, with CC Score 0	OTH
BZ09B	Intermediate Orbits or Lacrimal Procedures, 18 years and under	OTH
BZ09C	Intermediate Orbits or Lacrimal Procedures, 19 years and over, with CC Score 2+	OTH
BZ09D	Intermediate Orbits or Lacrimal Procedures, 19 years and over, with CC Score 0-1	OTH
BZ10B	Minor Orbits or Lacrimal Procedures, 18 years and under	OTH
BZ10C	Minor Orbits or Lacrimal Procedures, 19 years and over, with CC Score 2+	OTH

HRG V.4+	Description	Assigned condition
BZ10D	Minor Orbits or Lacrimal Procedures, 19 years and over, with CC Score 0-1	OTH
BZ11A	Major Cornea or Sclera Procedures, with CC Score 1+	CAT
BZ11B	Major Cornea or Sclera Procedures, with CC Score 0	CAT
BZ12A	Intermediate Cornea or Sclera Procedures, with CC Score 1+	RE
BZ12B	Intermediate Cornea or Sclera Procedures, with CC Score 0	RE
BZ13A	Minor Cornea or Sclera Procedures, with CC Score 1+	RE
BZ13B	Minor Cornea or Sclera Procedures, with CC Score 0	RE
BZ14A	Major Ocular Motility Procedures, 19 years and over	OTH
BZ14B	Major Ocular Motility Procedures, 18 years and under	OTH
BZ15B	Intermediate Ocular Motility Procedures, 18 years and under	OTH
BZ15C	Intermediate Ocular Motility Procedures, 19 years and over, with CC Score 1+	OTH
BZ15D	Intermediate Ocular Motility Procedures, 19 years and over, with CC Score 0	OTH
BZ16A	Minor Ocular Motility Procedures, 19 years and over	OTH
BZ16B	Minor Ocular Motility Procedures, 18 years and under	OTH
BZ17A	Major Glaucoma Procedures, with CC Score 1+	GLC
BZ17B	Major Glaucoma Procedures, with CC Score 0	GLC
BZ18A	Intermediate Glaucoma Procedures, with CC Score 1+	GLC
BZ18B	Intermediate Glaucoma Procedures, with CC Score 0	GLC
BZ19A	Minor Glaucoma Procedures, with CC Score 1+	GLC
BZ19B	Minor Glaucoma Procedures, with CC Score 0	GLC
BZ20A	Complex Vitreous Retinal Procedures, with CC Score 1+	DRT/AMD
BZ20B	Complex Vitreous Retinal Procedures, with CC Score 0	DRT/AMD
BZ21A	Major Vitreous Retinal Procedures, with CC Score 3+	DRT/AMD
BZ21B	Major Vitreous Retinal Procedures, with CC Score 1-2	DRT/AMD
BZ21C	Major Vitreous Retinal Procedures, with CC Score 0	DRT/AMD
BZ22A	Intermediate Vitreous Retinal Procedures, with CC Score 2+	DRT/AMD
BZ22B	Intermediate Vitreous Retinal Procedures, with CC Score 0-1	DRT/AMD
BZ23Z	Minor Vitreous Retinal Procedures	DRT/AMD
BZ24D	Non-Surgical Ophthalmology, with Interventions	OTH
BZ24E	Non-Surgical Ophthalmology, without Interventions, with CC Score 5+	OTH
BZ24F	Non-Surgical Ophthalmology, without Interventions, with CC Score 2-4	OTH
BZ24G	Non-Surgical Ophthalmology, without Interventions, with CC Score 0-1	OTH

Note: CAT = Cataract, RE = Refractive error, GLC = Glaucoma, DRT = Diabetic retinopathy, AMD = Age-related macular degeneration, OTH = Other.

Appendix B: Country prevalence

Note that numbers throughout this appendix with small values may be subject to errors, although totals are likely to be indicative of the true value.

Sight loss and blindness (<6/12) by age, gender & disease type 2013

Table B.1: Sight loss and blindness (<6/12) by age, gender & disease type, England (people) 2013

	AMD	Cataract	DR	Glaucoma	RE	Other	Total
Males							
0- 39	-	-	1,842	-	30,664	2,600	35,106
40-44	-	1,290	2,318	2,437	8,380	1,154	15,580
45-49	-	1,336	2,402	2,525	13,020	1,543	20,825
50-54	-	2,714	5,792	2,417	12,064	1,839	24,826
55-59	1,538	3,917	4,972	2,075	15,123	2,210	29,834
60-64	1,439	5,955	4,654	3,628	24,956	3,251	43,883
65-69	5,427	10,177	7,632	6,705	36,946	5,351	72,237
70-74	14,681	9,687	5,370	6,842	32,668	5,540	74,789
75-79	15,131	11,644	5,263	6,381	27,367	5,263	71,048
80-84	27,029	15,584	4,058	9,821	26,461	6,636	89,591
85-89	27,729	20,926	592	7,986	24,623	6,548	88,404
90+	24,539	14,697	44	1,236	9,798	4,025	54,339
Males	**117,512**	**97,929**	**44,938**	**52,053**	**262,070**	**45,960**	**620,462**
Female							
0- 39	-	-	1,467	-	27,320	2,303	31,091
40-44	-	1,264	1,407	1,992	11,286	1,276	17,224
45-49	-	1,312	1,462	2,068	16,527	1,710	23,078
50-54	-	3,590	3,879	2,358	15,525	2,028	27,380
55-59	1,573	5,625	3,345	2,034	18,035	2,449	33,060
60-64	1,498	9,021	3,185	3,468	28,636	3,665	49,473
65-69	12,625	16,926	4,555	6,213	36,138	6,116	82,573
70-74	9,738	19,894	3,365	5,565	39,684	6,260	84,504
75-79	22,038	26,230	1,828	5,053	52,353	8,600	116,100
80-84	54,672	33,586	2,410	11,748	51,208	12,290	165,914
85-89	69,710	49,012	3,146	12,750	39,408	13,922	187,948
90+	86,382	38,768	965	11,904	31,851	13,590	183,459
Females	**258,234**	**205,227**	**31,013**	**65,151**	**367,971**	**74,208**	**1,001,804**
Total	**375,747**	**303,156**	**75,951**	**117,204**	**630,041**	**120,168**	**1,622,266**

Source: Deloitte Access Economics modelling.

Table B.2: Sight loss and blindness (<6/12) by age, gender & disease type, Wales (people) 2013

	AMD	Cataract	DR	Glaucoma	RE	Other	Total
Males							
0- 39	-	-	91	-	1,674	141	1,906
40-44	-	69	124	129	434	60	816
45-49	-	74	133	139	703	84	1,133
50-54	-	157	334	139	673	104	1,408
55-59	93	236	300	125	884	131	1,769
60-64	93	386	301	234	1,569	207	2,790
65-69	353	662	496	434	2,326	342	4,613
70-74	992	654	363	461	2,192	373	5,034
75-79	981	755	341	414	1,775	341	4,609
80-84	1,693	976	254	615	1,657	416	5,611
85-89	1,712	1,292	37	493	1,520	404	5,459
90+	1,438	861	3	72	574	236	3,183
Males	**7,355**	**6,122**	**2,777**	**3,256**	**15,981**	**2,839**	**38,330**
Female							
0- 39	-	-	74	-	1,471	124	1,668
40-44	-	69	77	108	605	69	927
45-49	-	74	83	116	920	95	1,288
50-54	-	211	228	138	895	118	1,590
55-59	97	346	206	125	1,089	149	2,012
60-64	97	582	206	224	1,815	234	3,157
65-69	814	1,091	294	399	2,274	390	5,262
70-74	644	1,315	222	367	2,624	414	5,585
75-79	1,415	1,684	117	324	3,362	552	7,456
80-84	3,423	2,103	151	736	3,206	770	10,389
85-89	4,399	3,093	199	805	2,487	879	11,860
90+	5,427	2,436	61	748	2,001	854	11,526
Females	**16,316**	**13,005**	**1,916**	**4,089**	**22,749**	**4,646**	**62,719**
Total	**23,670**	**19,127**	**4,693**	**7,344**	**38,730**	**7,485**	**101,050**

Source: Deloitte Access Economics modelling.

Table B.3: Sight loss and blindness (<6/12) by age, gender & disease type, Scotland (people) 2013

	AMD	Cataract	DR	Glaucoma	RE	Other	Total
Males							
0- 39	-	-	169	-	2,874	243	3,286
40-44	-	125	224	233	770	108	1,460
45-49	-	136	245	255	1,270	152	2,058
50-54	-	290	619	257	1,215	191	2,572
55-59	169	431	547	227	1,571	236	3,180
60-64	155	641	501	389	2,552	339	4,576
65-69	549	1,029	772	674	3,532	524	7,080
70-74	1,519	1,003	556	705	3,398	574	7,755
75-79	1,521	1,171	529	642	2,752	529	7,144
80-84	2,571	1,482	386	934	2,517	631	8,520
85-89	2,417	1,824	52	696	2,146	571	7,705
90+	1,995	1,195	4	100	796	327	4,417
Males	**10,896**	**9,326**	**4,603**	**5,112**	**25,392**	**4,426**	**59,754**
Female							
0- 39	-	-	139	-	2,614	220	2,974
40-44	-	128	142	199	1,149	129	1,746
45-49	-	139	155	216	1,760	182	2,451
50-54	-	395	427	258	1,720	224	3,024
55-59	177	633	376	228	2,045	277	3,735
60-64	162	977	345	374	3,123	398	5,379
65-69	1,297	1,739	468	633	3,749	631	8,516
70-74	1,071	2,188	370	608	4,369	689	9,296
75-79	2,416	2,875	200	554	5,739	943	12,727
80-84	5,698	3,500	251	1,224	5,337	1,281	17,292
85-89	6,706	4,715	303	1,226	3,791	1,339	18,079
90+	7,333	3,291	82	1,011	2,704	1,154	15,574
Females	**24,860**	**20,579**	**3,258**	**6,532**	**38,100**	**7,466**	**100,794**
Total	**35,755**	**29,905**	**7,861**	**11,643**	**63,491**	**11,892**	**160,549**

Source: Deloitte Access Economics modelling.

Table B.4: Sight loss and blindness (<6/12) by age, gender & disease type, Northern Ireland (people) 2013

	AMD	Cataract	DR	Glaucoma	RE	Other	Total
Males							
0- 39	-	-	62	-	1,076	91	1,228
40-44	-	43	78	81	263	37	502
45-49	-	45	81	84	415	50	675
50-54	-	92	197	82	379	60	810
55-59	53	135	171	71	482	73	984
60-64	46	192	150	116	750	100	1,354
65-69	161	301	226	197	1,015	152	2,052
70-74	468	309	171	217	1,036	176	2,376
75-79	444	342	155	187	804	155	2,087
80-84	743	428	112	270	727	182	2,462
85-89	724	546	15	208	642	171	2,307
90+	588	352	1	30	235	97	1,303
Males	**3,227**	**2,786**	**1,418**	**1,543**	**7,824**	**1,344**	**18,141**
Female							
0- 39	-	-	51	-	971	82	1,104
40-44	-	43	48	68	379	43	582
45-49	-	45	50	70	555	58	778
50-54	-	123	133	81	518	68	922
55-59	53	190	113	68	592	81	1,097
60-64	47	284	100	109	881	114	1,535
65-69	382	512	138	187	1,057	182	2,458
70-74	318	649	110	181	1,294	204	2,755
75-79	683	813	57	157	1,623	267	3,599
80-84	1,664	1,022	73	358	1,559	374	5,050
85-89	2,031	1,428	92	371	1,148	406	5,475
90+	2,233	1,002	25	308	823	351	4,743
Females	**7,411**	**6,111**	**989**	**1,958**	**11,401**	**2,230**	**30,099**
Total	**10,637**	**8,897**	**2,407**	**3,501**	**19,224**	**3,573**	**48,240**

Source: Deloitte Access Economics modelling.

Blindness (<6/60) by age, gender & disease type 2013

Table B.5: Blindness (<6/60) by age, gender & disease type, England (people) 2013

	AMD	Cataract	DR	Glaucoma	RE	Other	Total
Males							
0- 39	-	-	470	-	195	260	925
40-44	-	-	592	678	53	115	1,439
45-49	-	-	613	703	83	154	1,553
50-54	-	655	1,478	673	77	184	3,066
55-59	-	945	1,269	578	96	221	3,108
60-64	-	1,436	1,188	2,192	159	325	5,300
65-69	230	2,455	1,948	3,006	235	535	8,408
70-74	445	2,337	1,371	3,010	208	554	7,924
75-79	5,940	667	2,091	1,976	95	440	11,209
80-84	9,825	589	840	2,011	124	744	14,134
85-89	9,137	1,627	5	1,764	145	1,269	13,947
90 and over	6,300	643	1	331	65	1,233	8,573
All Males	**31,876**	**11,353**	**11,865**	**16,923**	**1,536**	**6,034**	**79,587**
Female							
0- 39	-	-	211	-	174	230	615
40-44	-	-	203	560	72	128	962
45-49	-	-	210	581	105	171	1,068
50-54	-	817	558	663	99	203	2,340
55-59	-	1,281	481	572	115	245	2,693
60-64	-	2,054	458	2,095	182	366	5,156
65-69	655	3,853	655	2,785	230	612	8,790
70-74	1,330	4,529	484	2,448	253	626	9,670
75-79	9,706	2,076	1,004	2,336	182	3,013	18,316
80-84	18,195	1,722	677	2,406	241	2,935	26,175
85-89	19,426	4,781	34	2,817	231	2,362	29,651
90 and over	21,268	2,263	15	3,192	212	1,992	28,943
All Females	**70,580**	**23,376**	**4,991**	**20,456**	**2,095**	**12,882**	**134,380**
Total	**102,457**	**34,729**	**16,856**	**37,379**	**3,631**	**18,916**	**213,967**

Source: Deloitte Access Economics modelling.

Table B.6: Blindness (<6/60) by age, gender & disease type, Wales (people) 2013

	AMD	Cataract	DR	Glaucoma	RE	Other	Total
Males							
0- 39	-	-	23	-	11	14	48
40-44	-	-	31	36	3	6	76
45-49	-	-	34	39	4	8	85
50-54	-	36	85	39	4	10	175
55-59	-	55	76	35	6	13	185
60-64	-	90	77	142	10	21	339
65-69	15	154	126	195	15	34	539
70-74	30	152	92	203	14	37	529
75-79	385	43	135	128	6	29	727
80-84	615	37	52	126	8	47	885
85-89	564	100	0	109	9	78	861
90 and over	369	38	0	19	4	73	502
All Males	**1,979**	**706**	**733**	**1,069**	**93**	**371**	**4,951**
Female							
0- 39	-	-	11	-	9	12	32
40-44	-	-	11	30	4	7	52
45-49	-	-	12	32	6	10	60
50-54	-	47	33	39	6	12	136
55-59	-	78	30	35	7	15	164
60-64	-	130	30	135	12	23	330
65-69	42	244	42	179	14	39	561
70-74	88	294	32	161	17	41	633
75-79	623	134	64	150	12	193	1,176
80-84	1,139	108	42	151	15	184	1,639
85-89	1,226	301	2	178	15	149	1,871
90 and over	1,336	142	1	198	13	128	1,818
All Females	**4,455**	**1,478**	**309**	**1,288**	**129**	**814**	**8,473**
Total	**6,434**	**2,184**	**1,042**	**2,357**	**222**	**1,185**	**13,424**

Source: Deloitte Access Economics modelling.

Table B.7: Blindness (<6/60) by age, gender & disease type, Scotland (people) 2013

	AMD	Cataract	DR	Glaucoma	RE	Other	Total
Males							
0- 39	-	-	44	-	18	24	86
40-44	-	-	58	65	5	11	139
45-49	-	-	63	71	8	15	158
50-54	-	65	160	72	8	19	324
55-59	-	97	142	63	10	24	336
60-64	-	145	130	235	16	34	560
65-69	23	232	200	302	22	52	832
70-74	46	226	144	310	22	57	805
75-79	597	66	212	199	9	43	1,127
80-84	934	56	82	192	12	69	1,344
85-89	796	141	0	154	13	111	1,216
90 and over	512	52	0	27	5	100	697
All Males	**2,909**	**1,081**	**1,235**	**1,689**	**148**	**561**	**7,623**
Female							
0- 39	-	-	20	-	17	22	59
40-44	-	-	21	56	7	13	97
45-49	-	-	23	61	11	18	112
50-54	-	86	62	72	11	22	254
55-59	-	138	55	64	13	28	298
60-64	-	213	50	226	20	40	550
65-69	67	379	68	284	24	63	886
70-74	146	478	54	268	28	69	1,042
75-79	1,064	225	111	256	20	332	2,008
80-84	1,896	178	72	251	25	305	2,728
85-89	1,869	457	3	271	22	230	2,852
90 and over	1,806	192	1	269	18	171	2,457
All Females	**6,848**	**2,346**	**542**	**2,078**	**216**	**1,314**	**13,343**
Total	**9,757**	**3,426**	**1,777**	**3,767**	**364**	**1,875**	**20,966**

Source: Deloitte Access Economics modelling.

Table B.8: Blindness (<6/60) by age, gender & disease type, Northern Ireland (people) 2013

	AMD	Cataract	DR	Glaucoma	RE	Other	Total
Males							
0- 39	-	-	16	-	7	9	32
40-44	-	-	20	22	2	4	48
45-49	-	-	21	23	3	5	52
50-54	-	21	51	23	2	6	102
55-59	-	30	44	20	3	7	104
60-64	-	43	39	70	5	10	166
65-69	7	67	58	88	6	15	242
70-74	14	69	44	95	7	18	247
75-79	174	19	62	58	3	13	329
80-84	270	16	23	55	3	20	388
85-89	238	42	0	46	4	33	364
90 and over	151	15	0	8	2	30	206
All Males	**855**	**322**	**377**	**510**	**46**	**170**	**2,280**
Female							
0- 39	-	-	7	-	6	8	22
40-44	-	-	7	19	2	4	33
45-49	-	-	7	20	4	6	36
50-54	-	27	19	23	3	7	79
55-59	-	41	16	19	4	8	89
60-64	-	62	15	66	6	11	160
65-69	20	112	20	84	7	18	261
70-74	43	142	16	80	8	20	309
75-79	301	64	31	72	6	94	568
80-84	554	52	21	73	7	89	797
85-89	566	138	1	82	7	70	864
90 and over	550	58	0	81	5	53	748
All Females	**2,034**	**696**	**161**	**620**	**65**	**389**	**3,965**
Total	**2,888**	**1,019**	**539**	**1,129**	**111**	**559**	**6,245**

Source: Deloitte Access Economics modelling.

Sight loss and blindness by age, gender & severity 2013

Table B.9: Sight loss and blindness by age, gender & severity, England (people) 2013

	Low vision	Partial sight	Blind	Low vision	Partial sight	Blind
		Number			*%*	
Males						
0- 39	25,504	8,677	925	72.6%	24.7%	2.6%
40-44	10,570	3,571	1,439	67.8%	22.9%	9.2%
45-49	14,446	4,826	1,553	69.4%	23.2%	7.5%
50-54	15,437	6,322	3,066	62.2%	25.5%	12.4%
55-59	19,761	6,964	3,108	66.2%	23.3%	10.4%
60-64	27,898	10,685	5,300	63.6%	24.3%	12.1%
65-69	45,290	18,538	8,408	62.7%	25.7%	11.6%
70-74	50,120	16,745	7,924	67.0%	22.4%	10.6%
75-79	44,589	15,250	11,209	62.8%	21.5%	15.8%
80-84	56,775	18,681	14,134	63.4%	20.9%	15.8%
85-89	56,970	17,487	13,947	64.4%	19.8%	15.8%
90 and over	36,590	9,177	8,573	67.3%	16.9%	15.8%
All Males	**403,950**	**136,925**	**79,587**	**65.1%**	**22.1%**	**12.8%**
Female	Low vision	Partial sight	Blind	Low vision	Partial sight	Blind
0- 39	22,730	7,745	615	73.1%	24.9%	2.0%
40-44	12,354	3,908	962	71.7%	22.7%	5.6%
45-49	16,704	5,307	1,068	72.4%	23.0%	4.6%
50-54	18,083	6,957	2,340	66.0%	25.4%	8.5%
55-59	22,565	7,802	2,693	68.3%	23.6%	8.1%
60-64	32,125	12,192	5,156	64.9%	24.6%	10.4%
65-69	53,066	20,716	8,790	64.3%	25.1%	10.6%
70-74	45,221	29,613	9,670	53.5%	35.0%	11.4%
75-79	71,856	25,928	18,316	61.9%	22.3%	15.8%
80-84	105,447	34,291	26,175	63.6%	20.7%	15.8%
85-89	121,013	37,284	29,651	64.4%	19.8%	15.8%
90 and over	121,385	33,131	28,943	66.2%	18.1%	15.8%
All Females	**642,551**	**224,873**	**134,380**	**64.1%**	**22.4%**	**13.4%**
Total	**1,046,502**	**361,797**	**213,967**	**64.5%**	**22.3%**	**13.2%**

Note: Low vision <6/12-6/18; Partial sight <6/18-6/60; Blind <6/60.

Source: Deloitte Access Economics modelling.

Table B.10: Sight loss and blindness by age, gender & severity, Wales (people) 2013

	Low vision	Partial sight	Blind	Low vision	Partial sight	Blind
		Number			*%*	
Males						
0- 39	1,388	470	48	72.8%	24.7%	2.5%
40-44	553	187	76	67.8%	22.9%	9.3%
45-49	785	262	85	69.3%	23.2%	7.5%
50-54	874	359	175	62.1%	25.5%	12.4%
55-59	1,171	413	185	66.2%	23.3%	10.5%
60-64	1,772	680	339	63.5%	24.4%	12.1%
65-69	2,889	1,185	539	62.6%	25.7%	11.7%
70-74	3,379	1,127	529	67.1%	22.4%	10.5%
75-79	2,892	989	727	62.8%	21.5%	15.8%
80-84	3,556	1,170	885	63.4%	20.9%	15.8%
85-89	3,518	1,079	861	64.4%	19.8%	15.8%
90 and over	2,144	537	502	67.3%	16.9%	15.8%
All Males	**24,921**	**8,458**	**4,951**	**65.0%**	**22.1%**	**12.9%**
Female	Low vision	Partial sight	Blind	Low vision	Partial sight	Blind
0- 39	1,221	415	32	73.2%	24.9%	1.9%
40-44	665	210	52	71.7%	22.7%	5.6%
45-49	932	296	60	72.4%	23.0%	4.6%
50-54	1,049	404	136	66.0%	25.4%	8.6%
55-59	1,373	475	164	68.3%	23.6%	8.1%
60-64	2,049	778	330	64.9%	24.7%	10.4%
65-69	3,380	1,320	561	64.2%	25.1%	10.7%
70-74	2,995	1,957	633	53.6%	35.0%	11.3%
75-79	4,614	1,666	1,176	61.9%	22.3%	15.8%
80-84	6,602	2,147	1,639	63.6%	20.7%	15.8%
85-89	7,638	2,352	1,871	64.4%	19.8%	15.8%
90 and over	7,628	2,079	1,818	66.2%	18.0%	15.8%
All Females	**40,148**	**14,099**	**8,473**	**64.0%**	**22.5%**	**13.5%**
Total	**65,069**	**22,557**	**13,424**	**64.4%**	**22.3%**	**13.3%**

Note: Low vision <6/12-6/18; Partial sight <6/18-6/60; Blind <6/60.

Source: Deloitte Access Economics modelling.

Table B.11: Sight loss and blindness by age, gender & severity, Scotland (people) 2013

	Low vision	Partial sight	Blind	Low vision	Partial sight	Blind
		Number			*%*	
Males						
0- 39	2,388	811	86	72.7%	24.7%	2.6%
40-44	988	334	139	67.6%	22.9%	9.5%
45-49	1,424	476	158	69.2%	23.1%	7.7%
50-54	1,593	655	324	61.9%	25.5%	12.6%
55-59	2,104	740	336	66.2%	23.3%	10.6%
60-64	2,904	1,113	560	63.5%	24.3%	12.2%
65-69	4,431	1,817	832	62.6%	25.7%	11.8%
70-74	5,216	1,733	805	67.3%	22.4%	10.4%
75-79	4,486	1,531	1,127	62.8%	21.4%	15.8%
80-84	5,402	1,775	1,344	63.4%	20.8%	15.8%
85-89	4,968	1,522	1,216	64.5%	19.8%	15.8%
90 and over	2,974	746	697	67.3%	16.9%	15.8%
All Males	**38,879**	**13,252**	**7,623**	**65.1%**	**22.2%**	**12.8%**
Female	Low vision	Partial sight	Blind	Low vision	Partial sight	Blind
0- 39	2,175	741	59	73.1%	24.9%	2.0%
40-44	1,253	396	97	71.8%	22.7%	5.5%
45-49	1,775	564	112	72.4%	23.0%	4.6%
50-54	2,003	767	254	66.2%	25.4%	8.4%
55-59	2,558	880	298	68.5%	23.6%	8.0%
60-64	3,506	1,323	550	65.2%	24.6%	10.2%
65-69	5,498	2,132	886	64.6%	25.0%	10.4%
70-74	4,998	3,255	1,042	53.8%	35.0%	11.2%
75-79	7,886	2,833	2,008	62.0%	22.3%	15.8%
80-84	10,998	3,566	2,728	63.6%	20.6%	15.8%
85-89	11,648	3,579	2,852	64.4%	19.8%	15.8%
90 and over	10,307	2,811	2,457	66.2%	18.0%	15.8%
All Females	**64,604**	**22,847**	**13,343**	**64.1%**	**22.7%**	**13.2%**
Total	**103,483**	**36,100**	**20,966**	**64.5%**	**22.5%**	**13.1%**

Note: Low vision <6/12-6/18; Partial sight <6/18-6/60; Blind <6/60.

Source: Deloitte Access Economics modelling.

Table B.12: Sight loss and blindness by age, gender & severity, Northern Ireland (people) 2013

	Low vision	Partial sight	Blind	Low vision	Partial sight	Blind
		Number			*%*	
Males						
0- 39	893	303	32	72.7%	24.7%	2.6%
40-44	339	115	48	67.6%	22.9%	9.5%
45-49	467	156	52	69.2%	23.1%	7.7%
50-54	501	207	102	61.9%	25.5%	12.6%
55-59	651	229	104	66.1%	23.3%	10.6%
60-64	859	330	166	63.4%	24.3%	12.3%
65-69	1,283	527	242	62.5%	25.7%	11.8%
70-74	1,599	531	247	67.3%	22.4%	10.4%
75-79	1,310	448	329	62.8%	21.4%	15.8%
80-84	1,561	513	388	63.4%	20.8%	15.8%
85-89	1,487	456	364	64.5%	19.7%	15.8%
90 and over	877	220	206	67.3%	16.9%	15.8%
All Males	**11,827**	**4,033**	**2,280**	**65.2%**	**22.2%**	**12.6%**
Female	Low vision	Partial sight	Blind	Low vision	Partial sight	Blind
0- 39	807	275	22	73.1%	24.9%	2.0%
40-44	417	132	33	71.7%	22.7%	5.6%
45-49	563	179	36	72.4%	23.0%	4.7%
50-54	609	234	79	66.1%	25.4%	8.5%
55-59	750	259	89	68.3%	23.6%	8.1%
60-64	998	378	160	65.0%	24.6%	10.4%
65-69	1,581	616	261	64.3%	25.1%	10.6%
70-74	1,481	965	309	53.7%	35.0%	11.2%
75-79	2,229	802	568	61.9%	22.3%	15.8%
80-84	3,212	1,041	797	63.6%	20.6%	15.8%
85-89	3,528	1,083	864	64.4%	19.8%	15.8%
90 and over	3,139	856	748	66.2%	18.0%	15.8%
All Females	**19,315**	**6,820**	**3,965**	**64.2%**	**22.7%**	**13.2%**
Total	**31,142**	**10,853**	**6,245**	**64.6%**	**22.5%**	**12.9%**

Note: Low vision <6/12-6/18; Partial sight <6/18-6/60; Blind <6/60.

Source: Deloitte Access Economics modelling.

Sight loss and blindness (<6/12) by age, gender & ethnicity 2013

Table B.13: Sight loss and blindness (<6/12) by age, gender & ethnicity, England (people) 2013

<6/12	White	Black	Asian	Other	Total
Males					
0- 39	28,027	1,482	3,545	2,052	35,106
40-44	12,410	566	2,094	510	15,580
45-49	17,765	680	1,800	580	20,825
50-54	21,192	702	2,374	559	24,826
55-59	25,873	500	2,919	542	29,834
60-64	41,356	370	1,618	539	43,883
65-69	68,493	636	2,337	771	72,237
70-74	70,447	942	2,611	790	74,789
75-79	67,404	793	2,171	679	71,048
80-84	86,259	637	1,936	758	89,591
85-89	86,028	405	1,334	637	88,404
90 and over	52,994	192	762	391	54,339
All Males	578,247	7,905	25,502	8,808	620,462
Male % of population	**2.6%**	**0.9%**	**1.3%**	**0.8%**	**2.3%**
Female					
0- 39	24,846	1,450	3,042	1,754	31,091
40-44	13,968	619	2,066	571	17,224
45-49	19,813	718	1,890	658	23,078
50-54	23,181	858	2,735	607	27,380
55-59	28,196	745	3,514	605	33,060
60-64	46,073	610	2,152	638	49,473
65-69	77,649	1,286	2,780	857	82,573
70-74	79,517	1,330	2,842	815	84,504
75-79	110,727	1,290	3,093	991	116,100
80-84	160,779	1,002	2,981	1,152	165,914
85-89	184,412	572	1,990	974	187,948
90 and over	180,162	494	1,853	951	183,459
All Females	949,322	10,972	30,937	10,573	1,001,804
Total	**1,527,569**	**18,878**	**56,438**	**19,381**	**1,622,266**
Female % of population	**4.1%**	**1.1%**	**1.6%**	**1.0%**	**3.7%**
Total % of population	**3.3%**	**1.0%**	**1.5%**	**0.9%**	**3.0%**

Source: Deloitte Access Economics modelling.

Table B.14: Sight loss and blindness (<6/12) by age, gender & ethnicity, Wales (people) 2013

<6/12	White	Black	Asian	Other	Total
Males					
0- 39	1,770	19	57	61	1,906
40-44	761	6	34	14	816
45-49	1,084	7	26	17	1,133
50-54	1,352	6	31	19	1,408
55-59	1,714	4	32	18	1,769
60-64	2,750	3	19	17	2,790
65-69	4,551	6	30	26	4,613
70-74	4,951	9	46	28	5,034
75-79	4,550	8	24	27	4,609
80-84	5,562	6	17	26	5,611
85-89	5,411	9	11	27	5,459
90 and over	3,157	4	6	16	3,183
All Males	37,616	88	333	294	38,330
Male % of population	**2.6%**	**0.9%**	**1.1%**	**0.9%**	**2.5%**
Female					
0- 39	1,560	14	46	47	1,668
40-44	875	5	32	16	927
45-49	1,240	5	24	19	1,288
50-54	1,531	6	35	18	1,590
55-59	1,949	5	42	16	2,012
60-64	3,111	4	23	18	3,157
65-69	5,198	8	28	27	5,262
70-74	5,525	9	27	24	5,585
75-79	7,392	8	25	30	7,456
80-84	10,320	8	23	38	10,389
85-89	11,804	5	16	35	11,860
90 and over	11,472	5	15	34	11,526
All Females	61,977	82	337	324	62,719
Total	**99,592**	**169**	**670**	**618**	**101,050**
Female % of population	**4.1%**	**1.0%**	**1.2%**	**1.1%**	**4.0%**
Total % of population	**3.4%**	**0.9%**	**1.2%**	**1.0%**	**3.3%**

Source: Deloitte Access Economics modelling.

Table B.15: Sight loss and blindness (<6/12) by age, gender & ethnicity, Scotland (people) 2013

<6/12	White	Black	Asian	Other	Total
Males					
0- 39	3,067	42	110	68	3,286
40-44	1,375	11	59	15	1,460
45-49	1,984	9	48	17	2,058
50-54	2,489	7	58	18	2,572
55-59	3,092	5	63	19	3,180
60-64	4,517	6	34	20	4,576
65-69	7,004	5	49	21	7,080
70-74	7,656	6	67	26	7,755
75-79	7,072	3	50	20	7,144
80-84	8,457	3	41	20	8,520
85-89	7,660	4	27	14	7,705
90 and over	4,393	2	14	8	4,417
All Males	58,766	102	620	266	59,754
Male % of population	**2.4%**	**0.5%**	**1.1%**	**0.8%**	**2.3%**
Female					
0- 39	2,791	32	90	62	2,974
40-44	1,662	8	59	17	1,746
45-49	2,375	7	50	20	2,451
50-54	2,927	8	71	18	3,024
55-59	3,634	8	73	20	3,735
60-64	5,312	7	41	19	5,379
65-69	8,436	9	50	21	8,516
70-74	9,218	6	51	22	9,296
75-79	12,635	6	58	28	12,727
80-84	17,189	5	63	34	17,292
85-89	18,010	3	39	28	18,079
90 and over	15,517	2	32	24	15,574
All Females	99,704	102	676	312	100,794
Total	**158,471**	**204**	**1,295**	**579**	**160,549**
Female % of population	**3.8%**	**0.6%**	**1.3%**	**0.9%**	**3.7%**
Total % of population	**3.1%**	**0.6%**	**1.2%**	**0.8%**	**3.0%**

Source: Deloitte Access Economics modelling.

Table B.16: Sight loss and blindness (<6/12) by age, gender & ethnicity, Northern Ireland (people) 2013

<6/12	White	Black	Asian	Other	Total
Males					
0- 39	1,198	4	12	14	1,228
40-44	486	1	10	4	502
45-49	665	1	5	4	675
50-54	797	1	7	5	810
55-59	975	1	5	4	984
60-64	1,345	1	4	5	1,354
65-69	2,041	0	5	5	2,052
70-74	2,365	0	5	6	2,376
75-79	2,082	0	2	3	2,087
80-84	2,456	0	2	3	2,462
85-89	2,301	0	2	3	2,307
90 and over	1,300	0	1	2	1,303
All Males	18,011	11	62	57	18,141
Male % of population	**2.0%**	**0.5%**	**1.0%**	**0.8%**	**2.0%**
Female					
0- 39	1,078	3	11	11	1,104
40-44	568	1	8	5	582
45-49	768	1	5	5	778
50-54	909	1	7	5	922
55-59	1,088	1	5	3	1,097
60-64	1,525	1	4	5	1,535
65-69	2,450	1	4	3	2,458
70-74	2,747	1	4	4	2,755
75-79	3,591	0	3	5	3,599
80-84	5,039	0	4	7	5,050
85-89	5,463	0	4	8	5,475
90 and over	4,733	0	3	7	4,743
All Females	29,960	9	64	67	30,099
Total	**47,970**	**19**	**126**	**125**	**48,240**
Female % of population	**3.3%**	**0.6%**	**1.0%**	**1.0%**	**3.2%**
Total % of population	**2.7%**	**0.5%**	**1.0%**	**0.8%**	**2.6%**

Source: Deloitte Access Economics modelling.

Appendix C: Projections of prevalence

Note that numbers throughout this appendix with small values may be subject to errors, although totals are likely to be indicative of the true value.

Projection of sight loss and blindness (<6/12) by gender & ethnicity, 2013 to 2050

Table C.1: Projection of sight loss and blindness (<6/12) by gender & ethnicity England (people)

	2013	2020	2030	2040	2050	% increase 2050/2010
Males	620,462	743,110	967,165	1,203,409	1,395,537	125%
% pop'n	2.3%	2.7%	3.2%	3.8%	4.2%	
Females	1,001,804	1,143,205	1,456,580	1,824,412	2,117,222	111%
% pop'n	3.7%	4.0%	4.8%	5.8%	6.4%	
All ethnicities	**1,622,266**	**1,886,315**	**2,423,746**	**3,027,821**	**3,512,759**	**117%**
% pop'n	3.0%	3.3%	4.0%	4.8%	5.3%	
% share	100.0%	100.0%	100.0%	100.0%	100.0%	
Males	578,247	684,207	878,750	1,075,718	1,205,642	108%
% pop'n	2.6%	2.9%	3.6%	4.2%	4.6%	
Females	949,322	1,068,104	1,339,103	1,648,724	1,847,952	95%
% pop'n	4.1%	4.4%	5.4%	6.4%	7.1%	
White	**1,527,569**	**1,752,311**	**2,217,853**	**2,724,441**	**3,053,594**	**100%**
% pop'n	3.3%	3.7%	4.5%	5.3%	5.8%	
% share	94.2%	92.9%	91.5%	90.0%	86.9%	
Males	7,905	10,224	14,282	18,749	25,211	219%
% pop'n	0.9%	1.0%	1.3%	1.6%	1.9%	
Females	10,972	15,174	23,262	33,357	48,988	346%
% pop'n	1.1%	1.4%	1.9%	2.5%	3.2%	
Black	**18,878**	**25,397**	**37,544**	**52,106**	**74,199**	**293%**
% pop'n	1.0%	1.2%	1.6%	2.1%	2.6%	
% share	1.2%	1.3%	1.5%	1.7%	2.1%	
Males	25,502	35,478	52,543	75,056	112,164	340%
% pop'n	1.3%	1.6%	2.1%	2.7%	3.5%	
Females	30,937	43,873	66,824	96,664	144,812	368%
% pop'n	1.6%	2.0%	2.8%	3.7%	4.8%	
Asian	**56,438**	**79,351**	**119,367**	**171,720**	**256,976**	**355%**

	2013	2020	2030	2040	2050	% increase 2050/2010
% pop'n	1.5%	1.8%	2.4%	3.2%	4.1%	
% share	3.5%	4.2%	4.9%	5.7%	7.3%	
Males	8,808	13,202	21,590	33,887	52,520	496%
% pop'n	0.8%	1.0%	1.3%	1.8%	2.3%	
Females	10,573	16,054	27,391	45,667	75,470	614%
% pop'n	1.0%	1.2%	1.7%	2.6%	3.5%	
Other	**19,381**	**29,256**	**48,981**	**79,554**	**127,990**	**560%**
% pop'n	0.9%	1.1%	1.5%	2.2%	2.9%	
% share	1.2%	1.6%	2.0%	2.6%	3.6%	

Source: Deloitte Access Economics modelling.

Table C.2: Projection of sight loss and blindness (<6/12) by gender & ethnicity Wales (people)

	2013	2020	2030	2040	2050	% increase 2050/2010
Males	38,330	44,939	57,064	67,984	75,045	96%
% pop'n	2.5%	2.9%	3.5%	4.0%	4.4%	
Females	62,719	70,285	88,219	107,193	118,631	89%
% pop'n	4.0%	4.4%	5.4%	6.5%	7.1%	
All ethnicities	**101,050**	**115,223**	**145,283**	**175,177**	**193,677**	**92%**
% pop'n	3.3%	3.6%	4.4%	5.2%	5.7%	
% share	100.0%	100.0%	100.0%	100.0%	100.0%	
Males	37,616	43,938	55,539	65,759	71,735	91%
% pop'n	2.6%	3.0%	3.6%	4.2%	4.5%	
Females	61,977	69,221	86,528	104,578	114,497	85%
% pop'n	4.1%	4.5%	5.6%	6.7%	7.3%	
White	**99,592**	**113,159**	**142,067**	**170,338**	**186,232**	**87%**
% pop'n	3.4%	3.8%	4.6%	5.4%	5.9%	
% share	98.6%	98.2%	97.8%	97.2%	96.2%	
Males	88	119	171	227	316	261%
% pop'n	0.9%	1.1%	1.4%	1.7%	2.2%	
Females	82	113	170	244	362	342%
% pop'n	1.0%	1.2%	1.7%	2.4%	3.1%	
Black	**169**	**232**	**341**	**471**	**678**	**300%**
% pop'n	0.9%	1.1%	1.5%	2.0%	2.6%	
% share	0.2%	0.2%	0.2%	0.3%	0.4%	
Males	333	434	607	807	1,129	239%
% pop'n	1.1%	1.3%	1.6%	2.0%	2.5%	
Females	337	452	644	873	1,254	272%
% pop'n	1.2%	1.5%	2.0%	2.6%	3.3%	
Asian	**670**	**887**	**1,251**	**1,681**	**2,382**	**256%**
% pop'n	1.2%	1.4%	1.8%	2.3%	2.9%	
% share	0.7%	0.8%	0.9%	1.0%	1.2%	
Males	294	448	747	1,190	1,865	534%
% pop'n	0.9%	1.1%	1.5%	2.2%	2.9%	
Females	324	498	877	1,497	2,519	678%
% pop'n	1.1%	1.4%	2.1%	3.2%	4.5%	
Other	**618**	**946**	**1,624**	**2,687**	**4,384**	**609%**
% pop'n	1.0%	1.2%	1.8%	2.7%	3.6%	
% share	0.6%	0.8%	1.1%	1.5%	2.3%	

Source: Deloitte Access Economics modelling.

Table C.3: Projection of sight loss and blindness (<6/12) by gender & ethnicity Scotland (people)

	2013	2020	2030	2040	2050	% increase 2050/2010
Males	59,754	70,582	89,609	109,974	124,676	109%
% pop'n	2.3%	2.6%	3.2%	3.8%	4.3%	
Females	100,794	114,737	142,703	175,364	200,589	99%
% pop'n	3.7%	4.1%	4.9%	5.9%	6.7%	
All ethnicities	**160,549**	**185,319**	**232,313**	**285,338**	**325,265**	**103%**
% pop'n	3.0%	3.4%	4.1%	4.9%	5.5%	
% share	100.0%	100.0%	100.0%	100.0%	100.0%	
Males	58,766	69,239	87,649	107,216	120,616	105%
% pop'n	2.4%	2.7%	3.3%	4.0%	4.4%	
Females	99,704	113,218	140,418	172,006	195,422	96%
% pop'n	3.8%	4.2%	5.1%	6.1%	6.9%	
White	**158,471**	**182,456**	**228,067**	**279,222**	**316,038**	**99%**
% pop'n	3.1%	3.5%	4.2%	5.0%	5.6%	
% share	98.7%	98.5%	98.2%	97.9%	97.2%	
Males	102	128	162	188	250	145%
% pop'n	0.5%	0.6%	0.7%	0.8%	1.0%	
Females	102	133	181	227	322	216%
% pop'n	0.6%	0.7%	0.9%	1.2%	1.5%	
Black	**204**	**261**	**343**	**416**	**572**	**181%**
% pop'n	0.6%	0.6%	0.8%	1.0%	1.2%	
% share	0.1%	0.1%	0.1%	0.1%	0.2%	
Males	620	834	1,205	1,688	2,515	306%
% pop'n	1.1%	1.3%	1.7%	2.3%	3.0%	
Females	676	933	1,372	1,956	2,966	339%
% pop'n	1.3%	1.6%	2.2%	2.9%	4.0%	
Asian	**1,295**	**1,766**	**2,578**	**3,644**	**5,481**	**323%**
% pop'n	1.2%	1.5%	1.9%	2.6%	3.4%	
% share	0.8%	1.0%	1.1%	1.3%	1.7%	
Males	266	381	593	882	1,294	386%
% pop'n	0.8%	0.9%	1.2%	1.6%	2.0%	
Females	312	454	731	1,175	1,879	502%
% pop'n	0.9%	1.1%	1.6%	2.3%	3.1%	
Other	**579**	**835**	**1,324**	**2,057**	**3,173**	**449%**
% pop'n	0.8%	1.0%	1.4%	2.0%	2.5%	
% share	0.4%	0.5%	0.6%	0.7%	1.0%	

Source: Deloitte Access Economics modelling.

Table C.4: Projection of sight loss and blindness (<6/12) by gender & ethnicity Northern Ireland (people)

	2013	2020	2030	2040	2050	% increase 2050/2010
Males	18,141	22,182	29,737	37,937	44,762	147%
% pop'n	2.0%	2.4%	3.0%	3.8%	4.4%	
Females	30,099	35,040	45,317	57,649	69,033	129%
% pop'n	3.2%	3.6%	4.5%	5.7%	6.7%	
All ethnicities	**48,240**	**57,221**	**75,054**	**95,586**	**113,795**	**136%**
% pop'n	2.6%	3.0%	3.8%	4.7%	5.6%	
% share	100.0%	100.0%	100.0%	100.0%	100.0%	
Males	18,011	21,998	29,461	37,543	44,168	145%
% pop'n	2.0%	2.4%	3.1%	3.8%	4.5%	
Females	29,960	34,838	45,001	57,162	68,239	128%
% pop'n	3.3%	3.7%	4.6%	5.7%	6.8%	
White	**47,970**	**56,836**	**74,461**	**94,705**	**112,408**	**134%**
% pop'n	2.7%	3.1%	3.9%	4.8%	5.7%	
% share	99.4%	99.3%	99.2%	99.1%	98.8%	
Males	11	13	16	18	23	119%
% pop'n	0.5%	0.6%	0.7%	0.8%	0.9%	
Females	9	12	16	19	26	192%
% pop'n	0.6%	0.7%	0.9%	1.0%	1.3%	
Black	**19**	**25**	**32**	**37**	**49**	**152%**
% pop'n	0.5%	0.6%	0.8%	0.9%	1.1%	
% share	0.0%	0.0%	0.0%	0.0%	0.0%	
Males	62	86	124	170	263	323%
% pop'n	1.0%	1.1%	1.5%	2.0%	2.8%	
Females	64	89	134	192	310	387%
% pop'n	1.0%	1.3%	1.8%	2.5%	3.7%	
Asian	**126**	**175**	**257**	**363**	**574**	**355%**
% pop'n	1.0%	1.2%	1.7%	2.3%	3.2%	
% share	0.3%	0.3%	0.3%	0.4%	0.5%	
Males	57	85	136	205	307	434%
% pop'n	0.8%	0.9%	1.2%	1.7%	2.1%	
Females	67	100	166	276	458	581%
% pop'n	1.0%	1.1%	1.6%	2.5%	3.5%	
Other	**125**	**185**	**303**	**481**	**765**	**514%**
% pop'n	0.8%	1.0%	1.4%	2.1%	2.7%	
% share	0.3%	0.3%	0.4%	0.5%	0.7%	

Source: Deloitte Access Economics modelling.

Projection of sight loss and blindness (<6/12) by disease type, 2013 to 2050

Table C.5: Projection of sight loss and blindness (<6/12) by disease type, England (people), 2013 to 2050

	AMD	Cataract	DR	Glaucoma	RE	Other
Share of total cases						
2013	23.2%	18.7%	4.7%	7.2%	38.8%	7.4%
2020	24.0%	19.2%	4.5%	7.2%	37.7%	7.4%
2030	26.1%	20.0%	3.9%	7.2%	35.3%	7.4%
2040	28.4%	20.8%	3.4%	7.0%	33.0%	7.4%
2050	29.6%	21.5%	3.1%	7.0%	31.4%	7.4%
Cases						
2013	375,747	303,156	75,951	117,204	630,041	120,168
2050	1,038,804	755,975	110,106	244,943	1,101,993	260,938
% change	176%	149%	45%	109%	75%	117%

Source: Deloitte Access Economics modelling.

Table C.6: Projection of sight loss and blindness (<6/12) by disease type, Wales (people), 2013 to 2050

	AMD	Cataract	DR	Glaucoma	RE	Other
Share of total cases						
2013	23.4%	18.9%	4.6%	7.3%	38.3%	7.4%
2020	24.4%	19.3%	4.4%	7.2%	37.3%	7.4%
2030	27.0%	20.0%	3.8%	7.1%	34.7%	7.4%
2040	29.6%	20.6%	3.2%	6.9%	32.2%	7.4%
2050	31.0%	21.0%	3.0%	6.8%	30.7%	7.4%
Cases						
2013	23,670	19,127	4,693	7,344	38,730	7,485
2050	60,043	40,682	5,799	13,267	59,531	14,356
% change	154%	113%	24%	81%	54%	92%

Source: Deloitte Access Economics modelling.

Table C.7: Projection of sight loss and blindness (<6/12) by disease type, Scotland (people), 2013 to 2050

	AMD	Cataract	DR	Glaucoma	RE	Other
Share of total cases						
2013	22.3%	18.6%	4.9%	7.3%	39.5%	7.4%
2020	23.5%	19.1%	4.6%	7.2%	38.2%	7.4%
2030	25.9%	19.7%	4.0%	7.1%	35.9%	7.4%
2040	28.4%	20.4%	3.5%	6.9%	33.4%	7.4%
2050	30.3%	20.9%	3.1%	6.8%	31.4%	7.4%
Cases						
2013	35,755	29,905	7,861	11,643	63,491	11,892
2050	98,555	68,054	10,136	22,278	102,161	24,080
% change	176%	128%	29%	91%	61%	102%

Source: Deloitte Access Economics modelling.

Table C.8: Projection of sight loss and blindness (<6/12) by disease type, Northern Ireland (people), 2013 to 2050

	AMD	Cataract	DR	Glaucoma	RE	Other
Share of total cases						
2013	22.1%	18.4%	5.0%	7.3%	39.9%	7.4%
2020	23.2%	18.9%	4.7%	7.2%	38.5%	7.4%
2030	25.7%	19.6%	4.1%	7.2%	36.0%	7.4%
2040	28.2%	20.3%	3.6%	7.0%	33.5%	7.4%
2050	30.4%	20.9%	3.1%	6.9%	31.3%	7.4%
Cases						
2013	10,637	8,897	2,407	3,501	19,224	3,573
2050	34,641	23,765	3,515	7,822	35,625	8,427
% change	226%	167%	46%	123%	85%	136%

Source: Deloitte Access Economics modelling.

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