Investment in eye health to prevent sight loss

Final Report

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Glossary

Acronym	Full name
£	British pound
AAMC	American Association of Medical Colleges
ACA	Affordable Care Act
AGS	American Glaucoma Society
AMD	Age-related macular degeneration
anti-VEGF	Anti-vascular endothelial growth factor
AU$	Australian dollar
BCVA	Best corrected visual acuity
CAO	Canadian Association of Optometrists
CATT study	Comparison of AMD Treatments Trials study
CCHS	Canadian Community Health Survey
CDC	Centers for Disease Control and Prevention
CHIP	Children's Health Insurance Programs
CHMS	Canadian Health Measure Survey
CIHI	Canadian Institute for Health Information
COVID-19	Coronavirus disease 2019
CPI	Consumer price index
DR	Diabetic retinopathy
ECIM	Eye care indicator menu
GBD	Global Burden of Disease
GDP	Gross domestic product
IAPB	International Agency for the Prevention of Blindness
INR	Indian rupee
Kr	Swedish krona
LASIK	Laser assisted in situ keratomileusis
LVPEI	L V Prasad Eye Institute
MSVI	Moderate-severe vision impairment
NAEVR/AEVR	National Alliance for Eye and Vision Research
NEI	National Eye Institute
NGO	Non-governmental organisation
NHS	National Health Service
NICE	National Institute for Health and Care Excellence

Acronym	Full name
NIH	National Institutes of Health
NNJS	Nepal Netra Jyoti Sangh
NPCBVI	National Programme for Control of Blindness and Visual Impairment
NPP	National Prevention Plan
OA	Ophthalmic assistants
OECD	Organisation for Economic Co-operation and Development
OOP	Out-of-pocket
PCR	Posterior capsule rupture
PHC	Primary Health Centres
PVA	Presenting visual acuity
RE	Refractive error
RNIB	Royal National Institute of Blind People
SEED Study	Singapore Epidemiology of Eye Disease Study
SERI	Singapore Eye Research Initiative
S$	Singapore dollar
SNEC	Singapore National Eye Centre
UAE	United Arab Emirates
UK	United Kingdom
UN	United Nations
US	United States
US$	US dollar
VA	Visual acuity
VC	Vision centre
VHI	Vision Health Initiative
VLEG	Vision Loss Expert Group
WHO	World Health Organisation

Key findings report

The current issues:

2.2 bn. people around the world are living with the consequences of sight loss[1].

90% of sight loss can be prevented or treated.

$410.9 billion lost in economic productivity due to sight loss.

With a rapid increase in **global ageing population**, between 2010-20, crude prevalence of vision impairment in the ten countries examined[2] has **increased**.

However, with growing prevalence there is a crucial opportunity to better identify opportunities for eye health investment, given **five of nine** countries examined did not collect eye health expenditure data at a national level. Of those that did, **1.5-2.7%** of total health expenditure was spent on eye care, with Canada lowest and Japan highest.

To improve eye health outcomes, targeted investment in the following areas is most important:

Collect more comprehensive data

Why is this a call to action?

Funding to improve national data collection around eye health prevalence, drivers, outputs and outcomes will support policymakers to understand eye health need and inform policy decisions.

What are the current gaps?

67% Of countries examined publicly report **eye disease prevalence** data.

44% Of countries examined publish national **eye health expenditure** data.

Plan and prioritise eye health

Why is this a call to action?

Funding to develop a strategic eye health plan will help to elevate the vision, policy directions and strategies around eye health and bring together key factors.

What are the current gaps?

22% of countries examined have published national eye health plans and an identified priority eye condition.

Improve workforce supply

Why is this a call to action?

Dedicated programs to develop and train a larger and more equitably-distributed eye health workforce will open access for all and prevent unmet need.

What are the current gaps?

78% of countries examined had an identified shortage of optometrists and/or ophthalmologists.

Leverage preventative care

Why is this a call to action?

Investment in preventative and early intervention eye care services will promote better eye health outcomes and reduce system costs.

What are the current gaps?

Surgery is the most subsidised area of eye healthcare.

Lenses and eye screening were the least subsidised area.

THE WORLD IS **LOSING SIGHT** AT A GROWING RATE AND URGENT ACTION IS NEEDED

See the WHO World Report on Vision for more.

Addressing eye health need is a crucial factor in achieving the UN Sustainable Development Goals (SDGs).

This investment in eye health will enable improved outcomes to meet the UN SDGs.

This investment will lead to improved eye health outcomes through:

- Improved understanding of eye health need.
- Opportunities to evaluate appropriateness of funding.
- Priority focus on eye health.
- Equitable and universal access to eye care.
- Effective and efficient care early in the condition progression.

1. Sight loss includes vision impairment and vision loss.
2. Nine countries were examined fully in this study, including Canada, the United States, Italy, Sweden, the United Kingdom, India, Australia, Japan and Singapore, while Nepal was examined as a case study.

1 Executive Summary

Introduction

The ability to see the world around us is vital to every human. With healthy vision, we are better able to safely move in and interact with our surroundings, socialise and care for ourselves and others, work, and more easily contribute within our community. At a population level, eye health and vision health is critical to broader health. Loss of sight can have wide-ranging impacts on a person's life, including on their cognitive development, motor skills, physical activities, socialisation, and overall wellbeing. Sight loss is not only a health issue, but also an economic issue. In 2020, it was estimated that sight loss resulted in lost economic productivity to the value of $410.9 billion.[1] This loss calculation is predominantly determined through a reduction in employment of people with blindness or moderate-severe vision impairment.

Vision impairment is a prevalent and pervasive condition globally, affecting a total of 2.2 billion people in 2020.[2] Of concern, about half of the people living with the consequences of sight loss (1.1 billion) do so because of the lack of access and availability to eye care services. However, 90% of sight loss can be prevented or treated. It is therefore more critical than ever to ensure that there are adequate levels of investment, such as in the form of resources allocated (e.g., funding), into services, infrastructure (e.g., workforce, facilities) and effective eye interventions to address the unmet need associated with eye conditions and vision impairment. Importantly, the majority of the world's sight loss can be addressed by investing in improving population eye health through highly cost-effective interventions such as cataract and refractive error. Doing so will not only improve the quality of life for millions of people globally, but also reduce the financial burden to the economy.

Deloitte was engaged by Roche to establish an evidence-based understanding of the relationship between investment in eye health and vision outcomes. In this context, investment is defined as costs involved in policies and practices in health care delivery and vision outcomes across different countries.[3] This study has been commissioned to support the International Agency for the Prevention of Blindness (IAPB)'s ongoing efforts to increase awareness that eye health has significant development, economic and social outcomes, and to provide an evidence-based rationale for policymakers and donors to prioritise eye health. The intended audience of this report includes policymakers, government decision makers, advocacy organisations and members of the general public, with an interest in preventing blindness and preserving sight by advancing the full spectrum of eye health.

To the best of the authors' knowledge, this is the first global study of its kind to systematically analyse the evidence base on eye heath expenditure and its association with eye outcomes. However, it builds on the momentum generated by multiple organisations around the importance of eye health. This includes the IAPB's *Vision 2020* – which was a global initiative set up to intensify and accelerate the prevention of blindness activities so as to achieve the goal of eliminating avoidable blindness by 2020, and the subsequent *2030 In Sight* strategic initiative.[45] Through the World Report on Vision, the WHO has also recognised the important contribution of vision to the United Nations Sustainable Development Goals (SDGs).[6] The role of the UN Resolution on Eye Care, and the WHO Report of the 2030 targets on effective coverage of eye care, are also acknowledged.[7,8]

Methodology

This global study is primarily drawn from an in-depth review of publicly available data and reports. Deloitte first developed an indicator framework across three key domains – investment in eye health system components, eye health system outputs and outcomes. Results on the initial data scan (which used the analytical framework) informed the selection of the ten countries for this study. These countries include Canada, the United States (US), Italy, Sweden, the United Kingdom (UK), India, Nepal (case study), Australia, Japan and Singapore. Given the minimal publicly available data on Nepal's eye health system, expenditure and outcomes, its findings have not been included in the in-depth reviews, unless specifically referenced in the report. As such, nine countries are considered in the reporting of findings in the in-depth review. Deloitte also validated findings from selected countries (Nepal, India, Japan and Singapore) through stakeholder interviews with local country experts.

This report presents key thematic findings from in-depth research on the eye health systems of the ten selected countries and makes concrete recommendations (in the form of calls to action) for policymakers, government and health system stakeholders to consider as they prepare to meet WHO's two new ambitious global eye care targets for 2030: a 30 percentage point increase in effective cataract surgery coverage, and a 40 percentage point increase in effective refractive error coverage.[8] These findings focus on the drivers of investment in eye health, the allocation of resources across the continuum of eye care (promotion, prevention, treatment and rehabilitation) and the relationship between eye health expenditure and vision outcomes observable in available country data.

This report has a particular focus on eye health expenditure. The definition of expenditure used in this report is the final consumption of health care goods and services, including personal health care (curative care, rehabilitative care, long-term care, ancillary services and medical good) and collective services (prevention and public health services as well as health administration), but excludes spending on investments.[9] This definition is consistent with the definition used by the Organisation for Economic Co-operation and Development (OECD).

Key findings

What is the magnitude of eye health need?

The nature and magnitude of eye health need is closely linked to the size and structure of individual countries' eye health expenditure and systems. Greater expenditure can reflect greater health needs within a certain country. Conversely, decisions to increase resource allocation to address eye health needs may also contribute to improvements in eye health outcomes and an eventual reduction in need.

Eye health need is driven by several key factors, some of which, such as investment in services and the structure of the health system, are related to government policy decisions, while others, such as genetics and socioeconomic status, are linked to biological and social causes. In recent decades, ageing has become the primary determinant of growing eye care needs.

The ageing of the world's population will have critical ramifications on the burden of age-related conditions, including age-related blindness from cataract, glaucoma, age-related macular degeneration and presbyopia and myopia. Between 2010-20, the prevalence of vision impairment (crude rate) of all ten countries examined has increased. This trend contrasts with the observed trends for age-standardised prevalence rates for both blindness and vision impairment, which have been more stable in the past decade. This indicates the significant role of age as a driver of vision impairment. Further, the decreases in age-standardised prevalence of vision impairment or blindness observed in some countries indicates the existence of strategies to mitigate growing prevalence, however this being a minority of countries indicates a need to identify and action these for the remaining majority of countries examined.

Vision outcomes in each country are also driven by different eye conditions that are more prevalent among its population.

This means that even two countries with similar rates of vision impairment and blindness could have very different disease mixes, and the nature of eye health need could vary significantly. For example, Singapore has the highest prevalence of myopia (80%) compared to the remaining nine countries (49-53%). India has also reported a significantly higher prevalence of cataract (25-32%) than other countries included in this study (1-9%).

What proportion of health expenditure is allocated to eye health?

Data on eye health expenditure is highly variable and many countries do not report it. Among the five countries who do, the proportion of health expenditure that is spent on eye health varies between 1.5% to 2.7%.

Despite growing prevalence and evidence of unmet need, investment in eye health is not measured in many countries. Globally, there are significant gaps for many countries in eye health expenditure reporting. Only four of the nine countries examined collect eye health expenditure data at a national level, and one at a subnational level (i.e., only Wales had this data across the four nations which make up the UK). Among the five countries for which it was reported, eye health expenditure ranges from 1.5% of total health expenditure in Canada, to 2.7% of total health expenditure in Japan.

The trend data on eye health expenditure has been mixed – the proportion of eye health expenditure to total health expenditure has decreased for two out of four countries but remained stable for the remaining two countries.

For Canada and the UK (specifically Wales), the proportion of health expenditure that is allocated towards eye health has decreased by 50 percentage points, albeit across differing time periods. This contrasts with Australia and Japan, which reported relatively stable trends. These differences may reflect several factors – including population demographics, the emergence of other competing health priorities in selected countries, changes in political climate and greater increases in the cost of treatment for other health areas.

What is the relationship between countries' level of expenditure on eye health and prevention and vision outcomes achieved?

The relationship between eye health expenditure and vision outcomes is complex and has many influencing factors. However, it appears that when the prevalence of vision loss increases, so does the share of health expenditure allocated to eye health.

There are two mechanisms by which eye health outcomes relate to expenditure, and both can be considered dependent variables:

- In response to high or increasing prevalence of eye disease or vision impairment, governments may increase expenditure allocated towards eye health
- Expenditure on eye health is spent on services which reduce the prevalence of eye disease and vision impairment.

It is challenging to discern which of these factors proves a more powerful explanatory factor given the lack of data available. Further, there are many exogenous variables which influence this relationship, for instance the varying age and demographic profiles of the countries, which make it very difficult to understand the relationship from this data alone. This report also explores the unmet needs of eye care within each country. However, given the lack of a universally adopted metric for this measure and of reported and publicly available data, the ability to assess the association between eye health expenditure and unmet need of eye care and services was limited.

Though, it can be observed that there are areas of targeted investment which, if pursued, can provide benefits in terms of improving understanding of the eye health space, creating a national plan that focuses on all aspects of eye care service delivery, addressing need and providing early intervention and preventative care.

Where is targeted expenditure required to improve eye health systems and outcomes?

Four factors have emerged through this study as key barriers and enablers to the effective and efficient functioning of eye health systems – information, leadership, workforce and decisions to invest in specific aspects of eye care services.

There is significant variation in the structure and focus of eye health systems worldwide. This study has identified four key areas of the eye health system that require sustained and growing investment and can have a substantial impact on the eye care and eye health outcomes. They include:

Information: Reporting of comprehensive eye health data

Workforce: Adequate supply of eye care professionals to meet population need

Leadership: Creation of a national plan applying to eye health

Services: Focus on preventative eye care

Information: Countries allocate varied levels of investment into the collection, management and reporting of eye health expenditure and outcomes data.

Data collection on various aspects of the eye health system is critical to inform strategic policy decisions. For example:

- Data collection on eye disease prevalence and outcomes enables policymakers to understand the key drivers of vision impairment and blindness in a country
- Eye health expenditure data enables assessments of whether funding decisions have been appropriate and sufficiently address eye health need
- Output data on quality, accessibility and access to eye care services helps track and measure the efficiency of eye health systems and their service delivery.

Data collection on eye disease prevalence enables policymakers to understand the drivers of vision impairment and blindness and the magnitude of eye health need in a country. The availability and usage of eye health expenditure data in particular help inform strategic policy decisions to address vision impairment and blindness, as well as ensure funding decisions are appropriate and sufficiently address needs.

Among the nine countries reviewed, six publicly reported national and government-sourced eye disease prevalence data, and only four publish national and government-sourced eye health expenditure data (in addition, the UK reports subnational data). This indicates scope to invest in strengthening data collection systems which pertain to eye health.

Leadership: Many countries lack a comprehensive and overarching national plan needed to elevate eye health in strategic decision making.

National plans play a vital role in defining a country's vision, policy directions and strategies for ensuring the health of its population. Planning and prioritisation is crucial in eye health care, given the important role of detection and prevention in reducing the severity of eye disease.

Despite the recognition of eye health as a significant global health issue, just two out of the nine countries examined have published national eye health plans *and* identified a priority eye condition, and only four countries have either identified an eye health condition of priority *or* published a national eye health plan.

Workforce: The size and distribution of the eye care workforce is crucial in meeting need and ensuring access to care; however, many countries experience eye care workforce gaps.

The size and distribution of the eye care workforce is crucial in meeting eye health need and ensuring equitable access to services, however many countries experience eye care workforce gaps. Four out of nine countries (Australia, India, Italy and the UK) had an identified shortage in both optometrists and ophthalmologists in reviewed documentation, while three countries (Canada, Singapore and the US) had identified eye care workforce shortages.

Shortages in the eye health workforce can limit access for particular populations, such as those living in regional, rural and remote areas, and can lead to extended wait times and gaps in preventative care. This makes the size of the workforce a key factor determining the nature of eye health services provided and their outcomes.

Services: Countries tend to subsidise eye health treatments more so than early intervention or preventative care. This could potentially lead to eye diseases being treated only once they have progressed.

Investment in eye health can be directed to one of the following four areas – promotion, prevention, treatment and rehabilitation. The areas of eye health care which are publicly subsidised, or around which eye health programs are focused, provide a useful indication on the accessibility, affordability and focus of eye health care within countries.

This study found that the most subsidised area of eye healthcare across the nine countries examined was eye surgeries, and the least subsidised were corrective lenses and eye screening services. This suggests that government spending on eye health seems to be concentrated at the later stages of the care pathway, such as treatment, as compared to the earlier stages which involve screening and prevention. However, it is important to consider this on a disease by disease approach, as each eye condition has its own disease progression and its own prevention and treatment strategy.

Conclusion

Calls to action

This report, as well as previous reports by the WHO and the IAPB,[6,10] have identified a substantial unmet need for eye care worldwide. In order to achieve the UN and WHO goals of delivering eye health for the 1.1 billion people living with preventable sight loss by 2030,[7] further investment is required in the following areas. These will help to ensure eye care and eye health initiatives are universally accessible and available to all individuals, to reduce the rates of avoidable blindness.

These priority calls to action, informed by analysis of the ten countries examined in this review, are summarised in Table i.

Table i: Calls to action

Aspect	Recommended action	Cases of excellence
Information	Funding to improve national data collection around eye health prevalence, drivers, outputs and outcomes will support policymakers to understand eye health need and inform policy decisions.	**Australia** collects detailed and comprehensive data on eye health prevalence, which plays a key role in understanding need. **Nepal** conducts semi-regular surveys of eye health system outputs to inform planning.
Leadership	Funding to develop a strategic eye health plan will help to elevate the vision, policy directions and strategies around eye health and bring together key actors.	**Italy's** national plan for eye health mobilises and unites elements of the eye health system. **Australia** has identified AMD as a priority condition, and has consequently tripled funding for this condition, through the creation of a national strategy to meet the needs of its ageing population.
Workforce	Dedicated programs to develop and train a larger and more equitably-distributed eye health workforce will open access for all and prevent unmet need.	**India** upskills and trains rural medical practitioners and local voluntary assistants to carry out preliminary eye tests. **Nepal** trains and utilises ophthalmic assistants as mid-level ophthalmic professional to perform primary eye care services.
Services	Investment in preventative and early intervention eye care services will promote better eye health outcomes and reduce system costs.	**Italy** provides free mobile eye screening for those aged 40+ in town squares, increasing awareness of eye health and boosting early intervention. **Sweden** implements a subsidy for spectacles for those aged 8-19 years to address equity. **The UK** has several effective national population screening programmes, including targeted screening for diabetics and pre-school age children, to prevent sight loss through early detection.

Source: Deloitte.

Deloitte

2 Introduction

2.1 Eye health and vision impairment

Eye health is the state in which vision, ocular health and functioning ability is maximised.[11] Eye health can be affected by a range of eye conditions, some of which can lead to irreversible vision impairment and blindness (discussed in Section 2.1.3).[6] As the most dominant of human senses, the loss of sight can result in wide-ranging impacts on a person's life including cognitive development, motor skills, physical activities, socialisation, mental health, economic participation, and overall wellbeing.[6]

Vision impairment refers to limitations in one or more functions of the eye or visual system. This usually occurs through impairment of visual acuity (VA) (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), and colour vision.[12]

There are four main categories of vision impairment, i.e., mild, moderate, severe, and blindness, which are measured using visual acuity in epidemiological surveys and studies (Table 2.1). Visual acuity is assessed using a vision chart at a fixed distance (commonly 6 metres - or 20 feet)) and is reported as presenting or best corrected VA (BCVA).

Table 2.1: Classification of severity of vision impairment based on visual acuity in the better eye

Category	VA in the better eye
Mild vision impairment	<6/12 but ≥6/18
Moderate vision impairment	<6/18 but ≥6/60
Severe vision impairment	<6/60 but ≥3/60
Blindness	<3/60

Source: Deloitte, based on WHO International Classification of Disease 11th Revision.[13] The smallest line read on the chart is written as a fraction, where the numerator refers to the distance at which the chart is viewed, and the denominator is the distance at which a "healthy" eye is able to read that line of the vision chart. For example, a visual acuity of 6/18 means that, at 6 metres from the vision chart, a person can read a letter that someone with normal vision would be able to see at 18 metres. "Normal" vision is taken to be 6/6.

The reporting of vision impairment and blindness prevalence can differ based on the way VA is measured. In the case of "presenting VA (PVA)", people who wear spectacles or contact lenses during examination will be categorised as not having a vision impairment. This measurement is useful for estimating the number of people who need eye care, most often related to refractive errors.

However, it should be noted that this measure does not refer to the total number of people with vision impairment. Some studies, such as the World Health Organisation (WHO) World Report on Vision, distinguish between the two prevalence measures and also report the rate based on VA measured without spectacles or contact lenses.

For the purpose of this study, prevalence of vision impairment and blindness is reported aligning with BCVA definition, as is standard for epidemiological studies reviewed as part of this work.

The reporting of vision impairment and blindness prevalence can differ based on the way VA is measured. In the case of "PVA", people who wear spectacles or contact lenses during examination will be categorised as not having a vision impairment. This measurement is useful for estimating the number of people who need eye care, most often related to refractive errors. However, it should be noted that this measure does not refer to the total number of people with vision impairment. Some studies, such as the WHO World Report on Vision, distinguish between the two prevalence measures and also reported the rate based on VA measured without spectacles or contact lenses.

2.1.2 Current state of vision impairment

Vision impairment is a prevalent and pervasive condition globally, affecting a total of 2.2 billion people in 2020.[6] An estimated 1.1 billion people, of whom 43 million are blind, around the world live with the consequences of sight loss because they do not have access to eye care services. This is equivalent to a global prevalence of 14% for vision impairment and 0.5% for blindness. The burden of sight loss is disproportionately shouldered by low- and middle-income countries.[10] Compared to the global average of 14%, people living in the South Asian, East and South-East Asian, and Eastern Europe-Central Asian regions (Global Burden of Disease [GBD] regional classification system) experience greater prevalence of sight loss (at 18.2%, 17.5% and 17.3% respectively).

Within a region, underserved groups often experience greater prevalence of sight loss. These groups can include women, migrants, indigenous peoples, persons with disability, and those in rural communities.[6] For example, globally 55% of all sight loss is experienced by females, with women being 8% more likely to be blind.

While high-income regions, including North America, Western Europe, and Oceania, have better eye health outcomes with a comparatively low sight loss prevalence of 6.8%, both their incidence and prevalence have been increasing in recent times as a result of a rapidly ageing population.

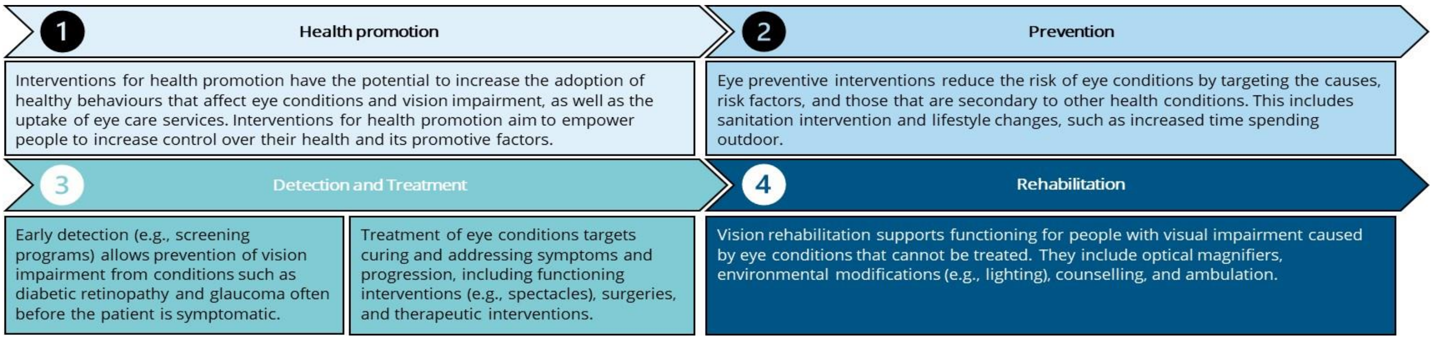
In the coming decades, it is expected that population growth and ageing, along with behavioural and lifestyle changes and urbanisation, will dramatically increase the number of people with sight loss globally, posing a considerable challenge to health systems.[10]

In response to these challenges, international bodies like the United Nations, World Health Organisation, and the IAPB have committed to resolutions, goals, and plans to improve eye health access and outcomes for countries around the world. The United Nations General Assembly has adopted the renewed 'Vision for Everyone; accelerating action to achieve the Sustainable Development Goals' Resolution by 2030,[7] while the WHO in 2021 has committed to two ambitious global targets in effective cataract surgery coverage (a 30 percentage point increase) and effective refractive error coverage (a 40 percentage point increase).[8]

2.1.3 Eye health care pathway

Effective eye health interventions encompassing promotion, prevention, treatment and rehabilitation are employed to address the needs associated with eye conditions and vision impairment (Figure 2.1). As different eye conditions have varied causes and characteristics, they require distinct targeted responses. The use of eye care services is determined by the availability, accessibility, affordability, and acceptability of such services.

Figure 2.1: Interventions and strategies to address eye health care needs.



Source: Deloitte, based on WHO world Report on Vision.[6]

There is a diverse range of eye conditions, some of which can lead to sight loss. Eye health care services are crucial in preventing the worsening of conditions which will impact eye health. Common sight-threatening conditions and specific interventions to address them are shown in Table 2.2.

Table 2.2: Common sight-threatening conditions and specific interventions

Condition	Description	Prevention/promotion	Intervention
Age-related macular degeneration (AMD)	Damage to the central part of the retina responsible for detailed vision leads to dark patches, shadows or distortion of the central vision. The risk of developing macular degeneration increases with age.	Cigarette smoking is the main modifiable risk factor for AMD. As such, smoking cessation is recommended for people who have, or at risk, of AMD.	Anti-vascular endothelial growth factor (anti-VEGF) injections, age-related Eye Disease Studies 2 (AREDS2) supplements, photodynamic therapy, laser, and new mechanisms of action
Cataract	Cloudiness in the lens of the eye, leading to increasingly blurred vision. The risk of developing cataract increases with age.	Main modifiable risk factors includes limiting/reducing risk to UV-B exposure, ciagarette smoking, corticosteriod use and diabetes.	Cataract surgeries
Diabetic retinopathy (DR)	Damage to blood vessels in the retina which become leaky or blocked. Abnormal blood vessels can also grow from the retina, which can bleed or cause scarring of the retina and blindness.	As diabetes is the main cause of DR, health promotion initiatives are important to raise awareness of the importance of regular eye examinations among people with diabetes. After diabetes onset, optimal management of DR risk factors (such as hyperglycaemia and hypertension) can delay and prevent the onset and progression of DR.	Early diagnosis of diabetes and appropriate management. Laser, anti-VEGF injections, corticosteroids, and new mechanisms of action
Glaucoma	Progressive damage to the optic nerve. Initially, loss of sight occurs in the periphery and can progress to severe vision impairment.	Given glaucoma is asymptomatic in the early stages, health promotion is targeted at improving awareness of the importance of regular eye examinations.	Glaucoma surgeries
Refractive error (RE)	Due to an abnormal shape or length of the eyeball, light does not focus on the retina resulting in blurred vision. Common types of refractive error are myopia and presbyopia.	The delay and prevention of myopia includes increasing children's time spent outdoors and reducing near-work activity. Optical, pharmacological, behavioural and surgical interventions can delay the onset or slow down the progression of myopia to more advanced forms and severe complications.	Refractive correction through prescription glasses or contact lenses, or surgeries
Trachoma	Caused by a bacterial infection. After many years of repeated infections, the eyelashes can turn inwards (known as trichiasis) which can lead to corneal scarring and, in some cases, blindness.	Promotion and prevention of trachoma come in the forms of antibiotic treatment to reduce the risk of, or clear, ocular *Chlamydia trachomatis* infection, facial cleanliness and environmental improvements.	Cornea transplantation, trichiasis surgery, SAFE strategy

Source: Deloitte, based on WHO world report on vision.[6] Reported in alphabetical order.

2.2 Structure of this report

This report is structured in the following chapters:

- Chapter 1 presents an executive summary of the findings and conclusion of this report
- Chapter 2 details the background, purpose, and scope of this project
- Chapter 3 provides an overview of the methodology used to review and analyse data on eye health expenditure and outcomes on an in-country basis as well as cross country comparison
- Chapter 4 presents the key findings from this study and discusses the existing evidence base to answer the research questions on eye health expenditure and outcomes
- Chapter 5 discusses evidence-informed recommendations and possible policy implications.

This report is supplemented by detailed methodology appendix (see Appendix A) and individual country data reports (see Appendix C to Appendix L).

2.3 Project purpose

This project has three key objectives, which are to:

1. Collect data to inform an understanding of expenditure on eye health and eye health/vision outcomes across different countries, with the aim to collaborate with the IAPB to enrich the Vision Atlas
2. Contribute to IAPB's key priorities to raise awareness for eye care, enable data and information sharing, strengthen international collaboration and further educate the public and governments on eye health
3. Undertake an assessment of the feasibility of designing a sustainable database to enable ongoing additions and tracking of information across countries, as well as define key messages to support broader coalition building between public and private organisations.

2.4 Key research questions

Based on the objectives of this project, the following key research questions were designed and developed in collaboration with eye healthcare Deloitte country experts (Table 2.3).

Table 2.3: Key research questions according to study domain

Domain	Key research questions
Expenditure level and sources	1. What proportion of overall health expenditure in countries is allocated to eye health?
	2. What are countries' overall expenditure (per capita) on eye health? (breakdown by public funding, private funding & investment sources, estimated out-of-pocket funding by individuals & families?)
Expenditure distribution within eye health care system	3. What are countries' breakdown of expenditure and resource utilisation on eye health?
	4. What is the mix of expenditure on preventing and managing eye disease?
Associations between expenditure and eye health outcomes	5. How does expenditure compare to eye health needs in a country?
	6. What is the relationship between countries' level of expenditure on eye health and prevention and vision outcomes achieved (e.g., rates of vision impairment and blindness)? What is the level of expenditure that is necessary to achieve good outcomes?

Source: Deloitte.

3 Methodology

3.1 Overview of project approach

The approach to undertaking this study is summarised in Figure 3.1. The study methodology was guided by five stages, which were undertaken to ensure a robust and evidence-based approach was embedded into each stage. Each stage of the study approach is further detailed in the remainder of this chapter.

Figure 3.1: Study approach

	Stage 1 Analytical framework	Stage 2 Data and literature scan	Stage 3 Deep dive	Stage 4 Analysis	Stage 5 Reporting
KEY QUESTION	How can the analysis be set up to drive robust analysis and a buildable research frame?	What data and literature is available to inform this analysis?	What are the key findings and trends observed across selected countries? Do our findings accord with local understanding of selected countries?	What are the practical implications and interpretations of key findings across all countries?	How can the analytical framework developed in this research be turned into a sustainable database?
ACTIVITIES	• Develop indicator framework	• Assess data quality and availability	• Country selection • Deep dive analysis of 10 countries • Interviews with selected subject matter experts	• Develop key themes • Workshop with IAPB and Roche	• Draft and final report development • Framework and data sources

Source: Deloitte.

3.2 Analytical framework

An analytical framework was developed to support data collection to answer the key research questions. The WHO's *Eye Care Indicator Menu* was adapted and used to develop a purpose-built analytical framework for this project, which provided a comprehensive set of metrics covering three domains: investment, outputs and outcomes. The metrics facilitated the monitoring of strategies and actions for eye care at national and subnational level and guided the approach to data collection. The analytical framework is shown in Figure 3.2.

Figure 3.2: Analytical framework for data collection

DOMAINS		
1. Investment	2. Output	3. Outcome
METRICS		
Investment in eye health prevention, detection and management	Availability of eye health services	Service utilisation
Eye health workforce	Affordability of eye health services	Quality of services
Systems	Wait times for services	Prevalence of vision impairment and blindness
		Causes of vision impairment and blindness
		Prevalence of specific eye diseases

Source: Deloitte.

In undertaking the initial data collection scan, a detailed analytical framework with specific indicators was developed and mapped against the domains and metrics detailed in Figure 3.2. This was done to ensure a systematic and comprehensive approach was applied to the data scan. The final list of indicators is shown in Appendix A (Section A.1).

There was a particular focus on expenditure among the indicators. Expenditure is defined as measuring the final consumption of health care goods and services, including personal health care (curative care, rehabilitative care, long-term care, ancillary services and medical good) and collective eservices (prevention and public health services as well as health administration), but excludes spending on investments. The definition used in this report is consistent with the definition used by the Organisation for Economic Co-operation and Development (OECD).

3.3 Data and literature scan

A data scan of publicly available sources from an extensive list of countries (see Section A.1.2 for full list of 17 countries) was initially undertaken to understand the existing data landscape for each country. This was intentionally undertaken to select countries which were representative of all six WHO regions and had varying income levels.

Country-specific Roche affiliates in Brazil, India, Italy, Poland, Sweden, Thailand, United Arab Emirates (UAE), Cambodia and Rwanda, and an IABP affiliate in Nepal were approached to validate the findings from the data scan. This was undertaken to confirm that the correct and most updated data had been sourced through the data scan, to provide alternative data sources which had not been considered yet, and to provide 'on the ground' insights of the country's healthcare system and/or eye care system.

All search strategies were conducted in English. For countries where English is not the primary language, Google Translate was used to identify words in the primary language which were then subsequently used in the search strategy for that country. The search strategy can be found in Appendix A.1.3.

From the initial data scan, ten countries were shortlisted for the next phase of the project (in-depth review). Countries were shortlisted based on one or more of four criteria:

- **Data availability.** What data exists to support answering of each indicator of the analytical framework?
- **Data quality.** What is the condition of the data based on its accuracy, completeness, reliability and how recent the data was collected, to inform each indicator of the analytical framework?
- **High prevalence of sight loss.** Which countries have relatively high prevalence of sight loss?
- **Unique eye health system and approach to vision care.** What component of that country's eye health system (and more broadly the health system) and approach to vision care can be used as a learning for other countries to improve access to care and outcomes?

The 10 countries selected for the in-depth review are shown in Table 3.1.

Table 3.1: Countries shortlisted for in-depth review by basis of selection

Region of the world	Country	Selection rationale			
		Data quality *(quality of data available)*	Data availability *(comprehensiveness of available data)*	High prevalence of sight loss	Unique eye health system and approach to vision care
Regions of the Americas	Canada	✓			✓
	US	✓			✓
European region	Italy		✓		✓
	Sweden		✓		✓
	United Kingdom	✓			✓
Southeast Asian region	India		✓	✓	✓
	Nepal*			✓	✓
	Australia	✓			✓

Region of the world	Country	Selection rationale			
		Data quality *(quality of data available)*	Data availability *(comprehensiveness of available data)*	High prevalence of sight loss	Unique eye health system and approach to vision care
Western Pacific region	Japan	✓			✓
	Singapore	✓			✓

Source: Deloitte. Note: *Given the lack of available data an in-depth review was not undertaken. Instead, Nepal was included as a case study.

3.4 In-depth review

3.4.1 Approach to in-depth review

In response to the analytical framework used in the initial data scan, the indicator list was adjusted to comprehensively capture all relevant information about eye health expenditure / systems / outcomes. The updated indicator list is shown in Appendix A.

3.4.2 Data sources

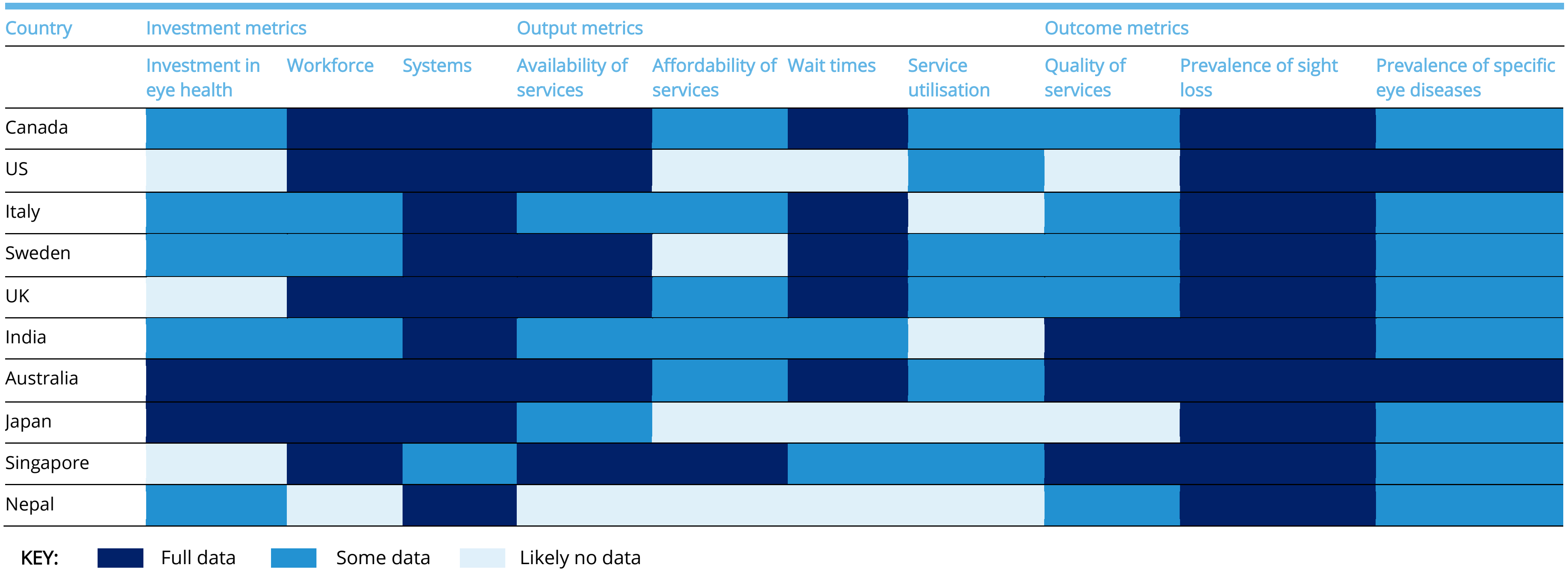
A combination of primary data sources (literature search and through engagement with local experts) and grey literature were used in the in-depth reviews. Due to the varying nature of data sources, this has implications for the comparability of the data which are detailed further in Section 3.5.2.

The findings for Japan, Singapore and India were validated with local experts for each jurisdiction within Deloitte's international health and life sciences network. The Deloitte country experts conducted a quality assurance review of findings, provided insights into information gaps and supported in addressing any language issues. A comprehensive write-up of the data found during the in-depth review for each country can be found in the country-specific data reports (see Appendix C onwards).

Given the lack of publicly available data for Nepal, the Deloitte team engaged with a local expert from Nepal. Together with information sourced from this consultation and existing publicly available information, a case study summary of Nepal's eye care system and approach to eye health is found in Appendix L.

Over the course of the project, each stage of the data scan and desktop review revealed more information to inform the findings of this project. The availability of the data for each country were represented on a heat map at two timepoints during the project (end-June 2022 and mid-August 2022). The heat map for mid-August 2022 is shown below (Figure 3.3) and the heap map for end-June 2022 can be found in Appendix A (Section A.2 in Table A.4). The availability of data was considered as full (data was available to completely answer the metric), some (data was available to partially answer the metric) or likely no data (data was not available to answer the metric).

Figure 3.3: Heat map for initial findings on data scan, 18 August 2022



Source: Deloitte

3.5 Analysis and reporting

3.5.1 Country comparison

Country comparisons were undertaken where data was comparable (common units and definition). Due to the varying nature of the availability and quality of the data for each country, some data caveats should be considered when interpreting the key findings from this study. The data caveats and limitations are detailed below in Section 3.5.2.

3.5.2 Caveats and considerations

This study has robustly considered the existing data landscape to answer the research questions outlined in Section 2.4. However, there are certain considerations to note regarding the data sources and methodology used in this study, which are outlined below:

- **Limited eye health expenditure data.** One of the primary objectives of this study was to understand the magnitude of spending on eye health and if possible, any further granular information on spending in this health discipline. However, data on eye health expenditure is highly variable and many official sources across countries do not report this data. As such, any conclusions/findings observed for eye health expenditure should be interpreted with these caveats in mind and considered to be conservative.
- **Varying availability of data.** There exists a varying availability of data to inform each component of the eye health system (as outlined in the Analytical Framework outlined in Figure 3.2) for each country. Where possible, high quality and reputable sources from official sources (e.g., government agencies, multilateral bodies) were included in this analysis. In some cases where high quality and reputable sources were not publicly available to inform key findings for specific countries, these countries have been omitted from that particular analysis. Because of this, any country comparisons should be interpreted with this limitation in mind, particularly in figures where there was a small sample size.

  - **Vision impairment and blindness prevalence estimates.** Only three countries - the US, UK and Italy - have publicly available national prevalence estimates of vision impairment and blindness. National level data is based on actual prevalence observations; however, definitions and availability vary amongst countries and so may the methodology/approach underpinning the data collection. Given the small sample size, any reference of vision impairment and blindness prevalence estimates, unless otherwise stated in the body of the report, were obtained from the Global Burden of Disease (GBD) Study.[14] The Global burden of Disease Study data offers the advantage of being comparable across countries, however as the prevalence data are derived from a modelling analysis, the following should be considered when interpreting the estimates including some country prevalence estimates which are based on estimates of neighbouring countries/regions, due to the lack of country-specific data. Further, there is a lack of epidemiological data both in high- and low-income countries.

- **Varying quality of data.** Data quality varies between countries including government, non-profit, peer-review literature and grey literature. Where possible, reputable primary sources (such as those published by the nation's health body/government agencies) were used in the first instance for any analysis. In some countries, sources published by non-profit/non-government organisations were considered for analysis as these organisations are primarily responsible for the delivery of eye care services in the country. The quality of the data was determined on a case-by-case basis. Because of this, any country comparisons should be interpreted with this limitation in mind.
- **Limitation of establishing a causal relationship.** Given the limited number of data points in the analysis, it is difficult to draw a conclusion relating to the relationship between eye health expenditure and eye health outcomes. Further, any associations observed in the analysis may be due to other factors influencing the variables of interest.
- **Limitation in search strategies conducted in English.** For countries in which the primary language was not English, Google Translate was used to determine country's national language equivalent terminology, and search strategies were conducted using the translated words/phrases. Whilst a thorough and comprehensive approach to the data scan/ review was undertaken throughout this study, it may be likely that given language barriers some sources were missed from the research.

4 Key findings

There were three key questions examined in this research – (1) what are the key areas of eye care need, (2) what the magnitude and nature of spending on eye care is, and (3) what is the relationship between these two factors. These questions were thoroughly examined in a series of in-depth reviews of selected countries. This section summarises the key findings from and across those reviews, to provide a sense of the global eye health and eye care landscape, and to begin to identify the factors which are most important in reducing the prevalence of vision impairment and eye disease.

Assessments of eye health need (Section 4.1) and expenditure (Section 4.2) are explained in the following chapter. The relationships between these variables and outcomes are further examined in Section 4.3.

4.1 What is the magnitude of eye health need?

The nature and magnitude of eye health needs are closely linked to the size and structure of individual countries' eye health expenditure and systems. Greater expenditure can reflect greater need within a certain country. Conversely, decisions to increase resource allocation to address eye health needs may also contribute to improvements in eye health outcomes and an eventual reduction in need. Assessments of eye health need, expenditure and the relationships between these factors are explained in Section 4.1, Section 4.2 and Section 4.3. The importance of how expenditure is targeted and distributed is examined in Section 4.4.

4.1.1 Eye health need is driven by five key factors – age, genetics, social factors, investment, and the broader structure of the national health system.

Eye health need is driven by several factors, some of which reflect policy decisions made at central or state government levels. These include:

Age: The prevalence of age-related conditions such as cataract, glaucoma, diabetic retinopathy and age-related macular degeneration is disproportionately higher among older people (aged >60).[10]

Genetics: Individual traits – such as age, sex, race and biological factors also affect vision outcomes. Genetics is found to be at least partially associated with the incidence of macular degeneration and glaucoma.[15]

Social factors: Social and socioeconomic factors, such as poverty, rurality, lifestyle and environmental factors, and health seeking behaviours are key determinants of eye health through their impact on eye health care access, quality, awareness, and affordability.[16]

Investment in services: The availability and accessibility of best practice eye treatments influence vision outcomes. For example, the reducing incidence of blindness due to age-related macular degeneration has been driven in part by widespread clinical introduction of anti–VEGF therapy.[14]

Health system structure: Health systems differ on the basis of who funds eye health and what is funded. This means that the affordability and access to eye care services vary across countries.

The impact of age on vision outcomes is explored further in Section 4.1, whereas other drivers (such as health system structure, investment in services) are further explored in Section 4.2 to Section 4.3.

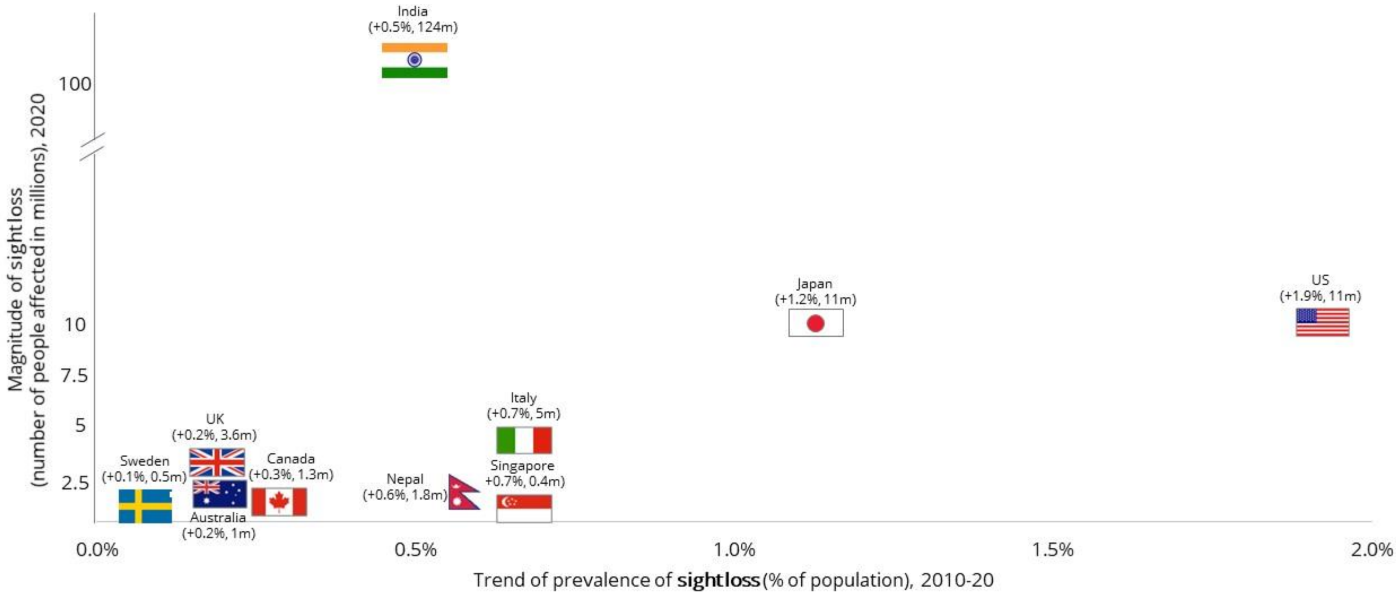
4.1.2 The ageing of the world's population will have critical ramifications on the burden of age-related conditions, including age-related blindness from cataract, glaucoma and age-related macular degeneration.

Similar to the rest of the body, the eyes and vision can change over time. The lens of the eye becomes thicker and less flexible, the muscles which surround the lens become tighter and the muscles which control the pupil become weaker.[17,18] Taken together, the structures of the eyes do not function effectively as they used, which leads to worsening eyesight, making it difficult to perform everyday tasks such as reading.[19] Given the association between age and eye disease, the ageing of the world's populations means that in many countries rates of sight loss are on the rise. Chart 4.1 shows the trend of each country's prevalence rate (crude), as a proportion of the population for sight loss over 2010-20. Based on this chart, **there is an observed increase in the prevalence of sight loss in all ten countries examined in the past decade**, ranging from 0.1% (Sweden) to 1.9% (the US). The definition of vision impairment includes mild (visual acuity <6/12 but >6/18) and moderate-severe (visual acuity <6/18 but >3/60) vision impairment.

The crude prevalence rate for blindness has exhibited a more stable trend (Chart 4.2). The prevalence rates are reported as a proportion of the population, and as such, take into account population growth overtime. These rates are also not adjusted to reflect the demographics of the population. These simply reflect the total number of people with visual impairment or blindness as a share of the total population.

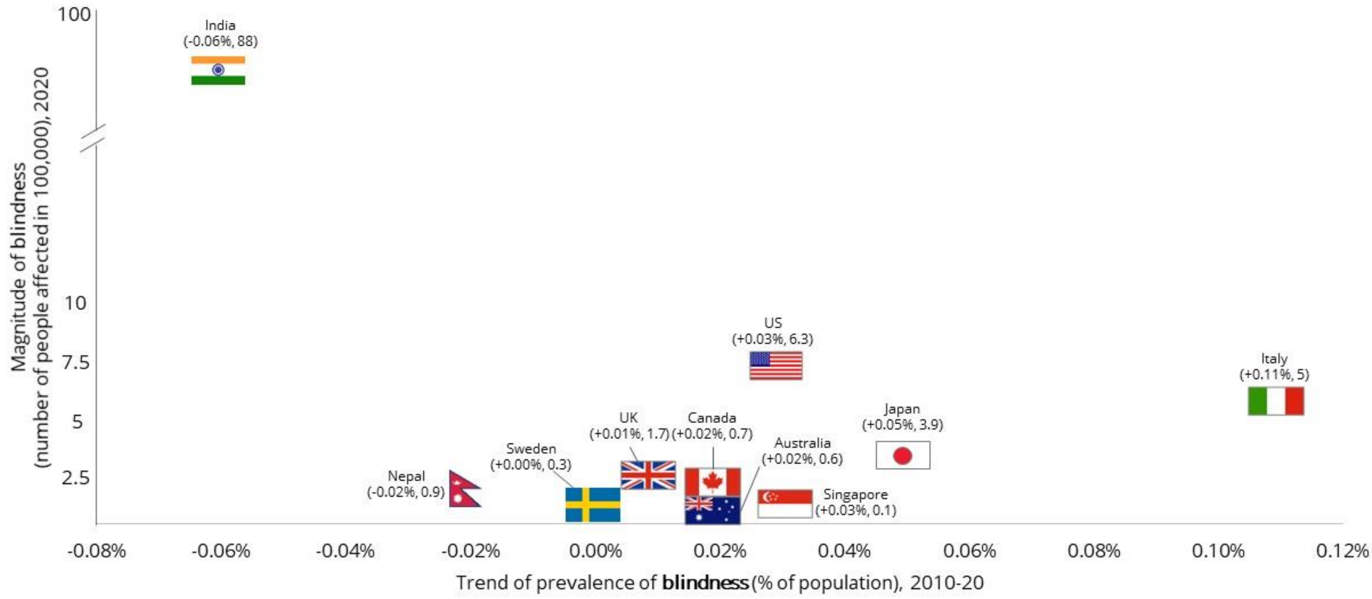
Between 2010-20, five out of ten countries reported no change in the crude prevalence of blindness (visual acuity <3/60). India's crude prevalence for blindness has decreased by 0.1%. In contrast, the crude prevalence for blindness increased in Italy and Japan by 0.1% respectively. Note the change in the x-axis width between Chart 4.1 and Chart 4.2.

Chart 4.1: Trend of prevalence rate (% of the population) and magnitude (number of people affected in millions) of **sight loss,** 2010-20



Source: Global Burden of Disease (2020). Note: Sight loss is defined as VA <6/18 (i.e., includes moderate-severe vision impairment and blindness). Number in parentheses reflects the net change in crude prevalence over this period, while magnitude (i.e., number of people affected) is reported for 2020 only. X-axis refers to the age-adjusted cumulative ten-year change in prevalence rate between 2010-20, y-axis refers to the point estimate of crude sight loss in 2020.

Chart 4.2: Trend of prevalence rate (% of the population) and magnitude (number of people affected in 100,000) of **blindness**, 2010-20



Source: Global Burden of Disease (2020). Note: Blindness is defined as VA <3/60. Note: Number in parentheses reflects the net change in crude prevalence over this period, while magnitude (i.e., number of people affected) is reported for 2020 only. X-axis refers to the age-adjusted cumulative ten-year change in prevalence rate between 2010-20, y-axis refers to the point estimate of crude blindness in 2020.

Box 1: Driving down the rate of blindness in India

India is home to one of the world's largest blind populations for decades. In 2020, an estimated 9.2 million people in India were blind and 260 million people live with visual impairment.[20]

Both non-governmental organisations (NGOs) and the India Government has taken concerted steps to address this issue. India was the first country in the world to launch a National Program for Control of Blindness in 1976, with the goal of reducing blindness prevalence to 0.3% in 2020. The India Government also launched the National Programme for Control of Blindness and Visual Impairment (NPCBVI)[21] – to combat sight loss. According to World Bank definition, NGOs are "private organizations that pursue activities to relieve suffering, promote the interests of the poor, protect the environment, provide basic social services or undertake community development".

Examples of NPCBVI activities sponsored include training programs, awareness raising initiatives and mobile detection and treatment services in regional areas. NGOs have also contributed to ongoing efforts to tackle this public health issue – for example, the Aravind Eye Care Centre has established 300 vision centres across the country to deliver primary eye care services to semi-rural and rural communities.[22,23]

Many of these programs focus on detection and treatment of cataract, the main cause of blindness in India. Currently, 6 million cataract surgeries are conducted in India per year. Cataract surgical coverage in India is also high (~75%), as a result of NGO and government initiatives to improve affordability and access.

These initiatives and efforts have led to a successful reduction of prevalence of blindness in India over the past 30 years (from 0.83% in 1990 to 0.64% in 2020), representing a significant sight-saving of over 200 million people in India.[20] During the same period, the prevalence of moderate to severe vision impairment increased from 4.75% to 5.55%, while the prevalence of mild vision impairment increased from 3.31% to 3.45%.[20] This can be partly attributed to the slowing of progression from vision impairment to blindness, as well as the ageing population.

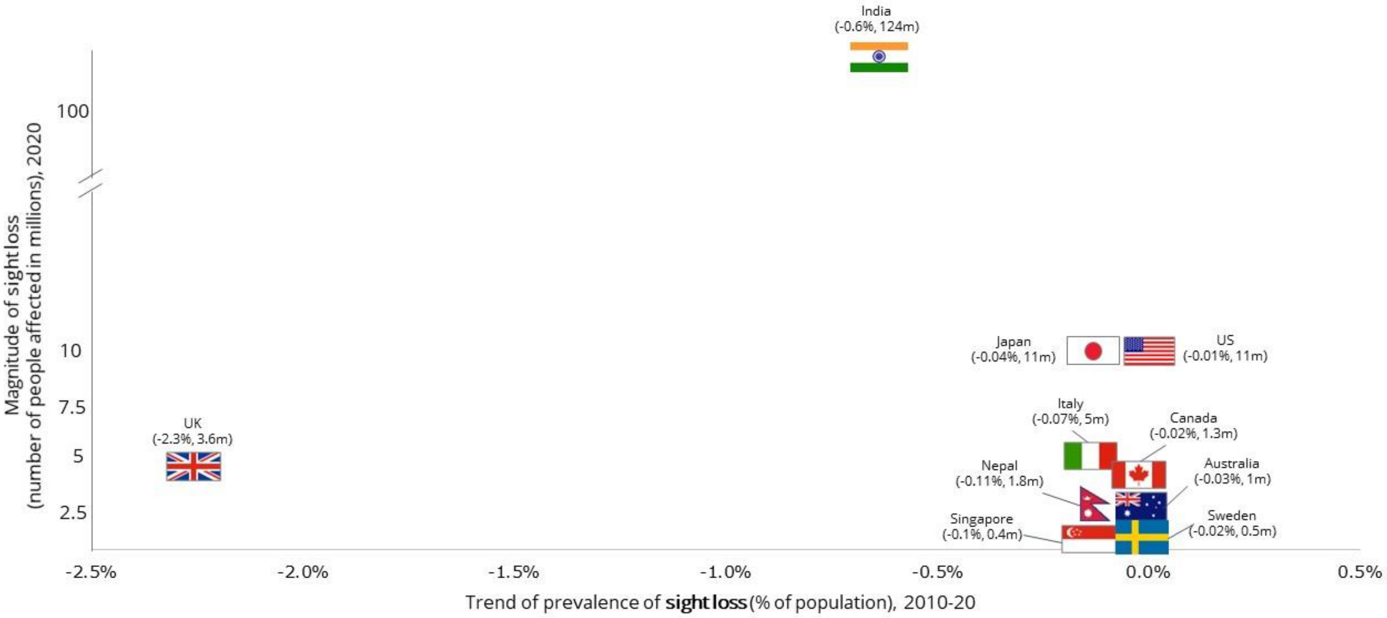
Following India's successful efforts in tackling cataract, there has been calls for similar efforts to be put in to address other eye conditions such as glaucoma, diabetic retinopathy, and refractive errors, to further reduce the prevalence of sight loss in India.[24,25] These initiatives will align the country with the new WHO global eye care targets for 2030 on effective cataract surgery coverage and effective refractive error coverage.[8]

4.1.3 Vision outcomes across different nations are strongly associated with age distribution – however, other country-specific factors also drive outcomes.

The observed trends for age-standardised prevalence rates are distinct from crude prevalence rates, indicating the significant role of age as a driver of sight loss.

- In contrast with crude prevalence rate trends (as shown in Chart 4.1 and Chart 4.2), the age-standardised prevalence of sight loss for five of ten countries has been stable in the past decade (see Chart 4.3; 'stable' is defined as <0.05% change).
- The remaining five countries (Singapore, Nepal, Italy, India and the UK) observed recorded decreases in age-standardised prevalence of sight loss. The level of decrease ranged between -0.1% to -2.3%.

Chart 4.3: Trend of age-standardised prevalence rate (% of the population) and magnitude (number of people affected in millions) of **sight loss**, 2010-20

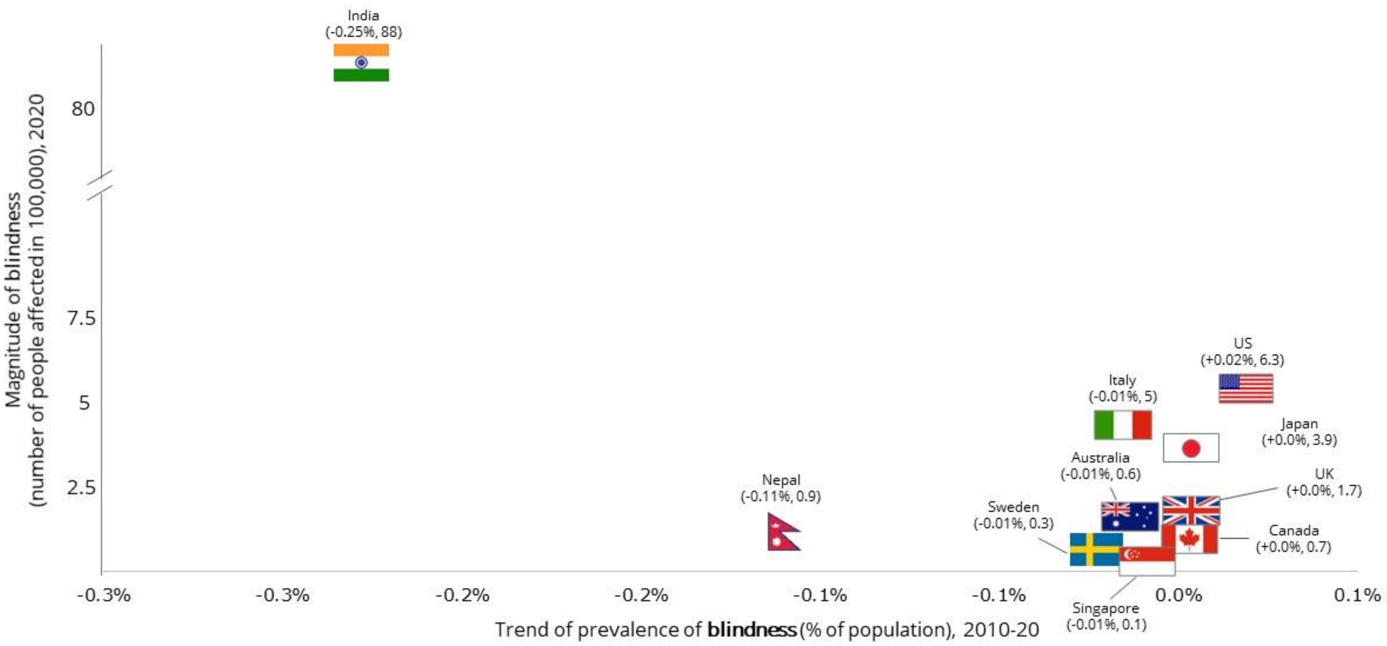


Source: Global Burden of Disease (2020). Note: Sight loss is defined as VA <6/18 (i.e., includes moderate-severe vision impairment and blindness). Number in parentheses reflects the net change in age-adjusted prevalence over this period, while magnitude (i.e., number of people affected) is reported for 2020 only. X-axis refers to the age-adjusted cumulative ten-year change in prevalence rate between 2010-20, y-axis refers to the point estimate of crude sight loss in 2020.

Age is also an important driver of blindness. Based on age-standardised data, all but two countries (India and Nepal) have observed stable prevalence of blindness from 2010-20 (see Chart 4.4). India experienced a decreasing trend of age-standardised prevalence for blindness from 2010-20. However, while age is an important driver, it is not the only driver, and the other factors mentioned in Section 4.1.1, such as genetics and social factors, also play a key role in determining need.

These decreases in age-standardised prevalence of vision impairment or blindness observed in some countries point to the existence of strategies to mitigate growing prevalence. The UK has experienced the largest decrease in vision impairment between 2010 and 2020. Whilst there are likely many drivers, one possible reason is the highly effective screening programs that exist in the country including the Diabetic Eye Screening and Pre-school Children Eye Screening programs.[26] These programs are highly effective in preventing sight loss in sub-groups of the population and detecting conditions as soon as they manifest. However, prevalence trends such as these being present in only a minority of countries indicate a need to identify and action areas of focus for the remaining majority of countries examined.

Chart 4.4: Trend of age-standardised prevalence rate (% of the population) and magnitude (number of people affected in 100,000) of **blindness**, 2010-20



Source: Global Burden of Disease (2020). Note: Blindness is defined as VA <3/60. Number in parentheses reflects the net change in age-adjusted prevalence over this period, while magnitude (i.e., number of people affected) is reported for 2020 only. X-axis refers to the age-adjusted cumulative ten-year change in prevalence rate between 2010-20, y-axis refers to the point estimate of crude blindness in 2020.

Box 2: Prevalence of sight loss from primary sources

Data on sight loss (which includes all forms of vision impairment and blindness) does not appear to be regularly published by official sources. This study found that only official sources in three out of nine countries - US, UK and Italy - reported the prevalence of sight loss. Nepal is not included in this count because it was not the subject of a full data review. The estimates were obtained from primary sources (i.e., official government websites for the US and Italy and the Royal National Institute of Blind People [RNIB; a charity organisation] in the UK).

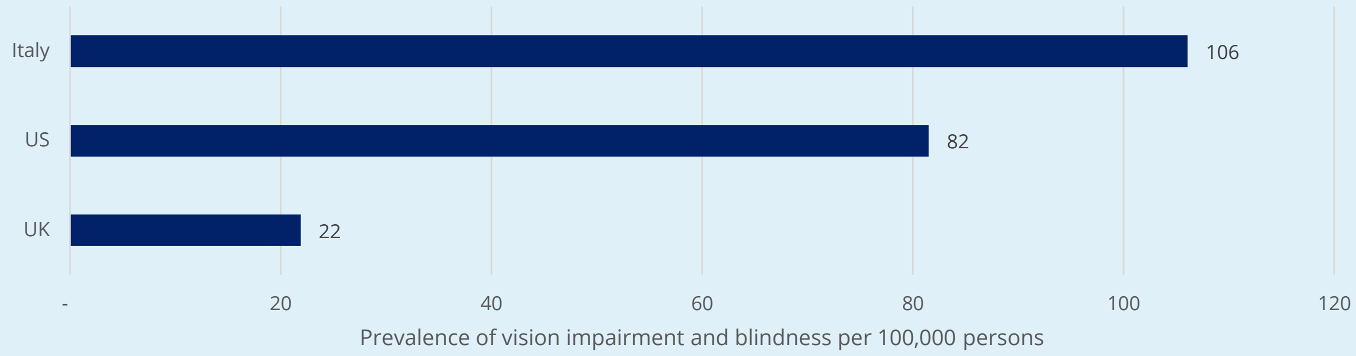
It is estimated that the prevalence of sight loss for the UK (2021), the US (2017) and Italy (2019) were 22, 82 and 106 per 100,000 persons in the population (Chart 4.5). The prevalence sight loss for Italy is nearly 5-folds of that reported in the UK. This may be explained by factors which influence sight loss such as age, genetics, social factors, investment in services and health system structures, as well as data limitations such as the varying definitions of sight loss (described in detail below), which taken together, all contribute to the existing prevalence of sight loss.

Several data caveats and limitations need to be considered when interpreting this data:

- **The varying definitions of vision impairment and blindness across each country.** For the US and UK, vision impairment has been defined as having VA less than 6/60. The source from which the prevalence of vision impairment and blindness was obtained for Italy did not define vision impairment and/or blindness and instead showed prevalence by 'moderate' and 'serious' 'limitations to vision.
- **The inclusion of age restriction in reported prevalence data for Italy.** The prevalence estimates for Italy include only those 15 years and older, whereas no age restriction is placed on the prevalence estimate of sight loss for the US and UK.

- **The different years of reported data.** The most recent data across the three countries vary. In the UK, this prevalence estimates are for 2021, in the US this is for 2017 and in Italy this was in 2019.

Chart 4.5: Prevalence of sight loss, per 100,000 persons



Source: RNIB Data Tool (2021), Centers for Disease Control and Prevention (2020) and Istat (2022).

4.1.4 Vision outcomes in each country are driven by different eye conditions

Vision impairment is a key measure of the magnitude of need in a particular country, however when prevalence is examined in terms of specific eye diseases, more information can be discerned as to the nature of the eye health landscape in the country.

Table 4.1 summarises the best available data for the prevalence of specific eye conditions in each country (a mix of crude and age-adjusted prevalence rates have been reported across each country). While the data reported here are obtained from primary sources (in most cases government reports and databases), it should be noted that methodologies vary between sources. The most recent year of available data also varies and is noted in the table below. Given these methodological differences, such discrepancies may be present and should be considered when interpreting the table below.

The key takeaway from Table 4.1 is that the disease drivers of vision impairment vary to a significant degree across countries. This means that even two countries with similar rates of vision impairment and blindness could have very different disease mixes, and the nature of eye health need could vary significantly. It is therefore important to understand the demographics and characteristics underpinning the causes of sight loss within a country.

There are a number of key findings from this table relating to specific eye diseases, for instance:

- **AMD.** The prevalence of AMD varies widely across countries. Canada has the highest prevalence of AMD, while Australia has the lowest prevalence of AMD. This variability may be due to inconsistency in data reporting, where some countries report all forms of AMD whilst others report only late-stage AMD.
- **Cataract.** India has a significantly higher prevalence of cataract due to reduced access to detection and treatment, while Australia and the UK have amongst the lowest prevalence of cataract in the population.
- **DR.** India has the highest prevalence of DR as a result of lower access to eye healthcare and an increased rate of diabetes in recent years. For all other countries, the prevalence of DR ranges between 1.4-3.5%.
- **Glaucoma.** The prevalence of glaucoma ranges between 0.8-3.6%.
- **Other conditions (specifically myopia).** Singapore has the highest prevalence of myopia of countries which report this information (80%). For other countries with this data, prevalence of myopia ranges between 49-53%.

As can be seen in Table 4.1, many countries have a focus on a particular eye disease, which is helpful in understanding the broader eye health system of the country. In some cases, such as Singapore, the focus on a particular eye disease reflects an unusually high prevalence of the disease. For others, such as Australia, it reflects a focus on a disease which particularly impacts older people as the population ages.

Table 4.1: Prevalence of eye conditions (as a share of total population unless otherwise specified)

		Australia	Canada	India	Singapore	Sweden	United Kingdom	United States	Key messages by condition
AMD		0.7% (2018); remained stable between 2012-2018	8.7% (2019)	1.8-4.7% (2009); 48% for people aged>60 (2010)	5.6% (2014)	1.0% (late-stage AMD, 2012); projected to increase to 1.8% by 2040.	1.0% (late-stage AMD, 2021), projected to increase to 1.2% by 2030	3.0% (2009)	Prevalence of AMD varies widely across countries. Canada has the highest prevalence of AMD, while the Australia has the lowest prevalence of AMD.
Cataract		1.4% (2018); remained stable between 2012-2018	9.2% (2020); increased from 0.93-3.5 million between 2010-2020	25-32% (2019)	9.7% (2013); 79% among people aged>60 (2022)	-	1.0% (2021), projected to increase to 1.3% by 2030	7.4% (2010); projected to increase to 11.7% by 2050	India has a significantly higher prevalence of cataract, while Australia and the UK have amongst the lowest prevalence of cataract in the population.
DR		-	3.5% (2020); 25.1% among people living with diabetes (2020)	16.9% among people aged>50 (2019)	1.4% (2018); 28% among people living with diabetes (2018)	-	-	2.3% (2010); projected to increase to 3.4% by 2050	India has the highest prevalence of DR at 16.9%. For all other countries, the prevalence of DR ranges between 1.4-3.5%.
Glaucoma		0.6%; increased since 2012.	2.5% (2019); increased from 1.8% in 2002	3.2% (2010)	3.2% (2015)	-	1.1% (2021), projected to increase to 1.2% by 2030	0.8% (2010); projected to increase to 1.4% by 2050	The prevalence of glaucoma ranges between 0.8-3.6%. The top three countries with the highest prevalence of glaucoma are Canada, India and Singapore.
RE	Total	49% (2018); increased since 2012.	51% among adults (2020)	53% (2019)	80% (myopia, 2020)	-	-	-	Singapore has the highest prevalence of myopia of countries that report this data (80%). For other countries with this data, prevalence of myopia ranges between 49-53%.
	Uncorre	-	2.7% (distant, 2020); 2.2% (near, 2020)	10% (uncorrected myopia and hyperopia, 2019)	22% (2006)	-	-	-	Uncorrected refractive error has the highest prevalence in Singapore followed by India, indicating a lack of services.
Key messages for each country		Compared to other countries, Australia has a relatively lower rate of AMD, Despite this, AMD is an area of national focus.	Canada has a higher AMD and cataract rate than other high-income countries.	India has a very high cataract prevalence and a slightly higher uncorrected RE.	Singapore has a very high myopia prevalence and associated high uncorrected RE.	Sweden will see an increase in AMD (and possibly other age-related eye conditions) over the next several decades.	The prevalence rates of AMD, cataract and glaucoma are consistent and lower than other high-income countries.	Cataract is the leading cause of sight loss in the US and is expected to increase over the next several decades.	High prevalence No prevalence data Low prevalence Average prevalence

Sources: Various country-specific sources, see data review appendices for specific insights and citations. Note: Italy and Japan do not have any prevalence data for specific eye conditions. A hyphen (-) indicates that this data was not available or able to be sourced. Cells are shaded based on the level of prevalence in a country compared to other countries in this study. Prevalence of DR are those reported in a population with diabetes

Box 3: Prioritisation of myopia in Singapore

Singapore is considered the "myopia capital of the world" due to its high prevalence of the refractive error.[27] Myopia is prevalent in Singapore across various age groups, with approximately 20% of Singaporean children (age 7 and under), 50% of adolescents, and over 80% of college students are estimated to live with myopia.[28,29] As a result, it is estimated that the lifetime cost of myopia per capita is Singapore dollar (S$) 21,616 (assuming 80 years' of living with the condition).[30] In aggregate, myopia costs Singaporeans around Singapore dollar (S$) 959 million per year.[30]

In response to this, the Singaporean Government has implemented different initiatives since 2001 to address the high prevalence of myopia, including:

- The National Myopia Prevention Programme which performs annual vision screening in pre-schools, primary and secondary schools,
- NurtureSG which promotes awareness of parents on the importance of preventing early onset myopia.
- SNEC's Myopia Centre, established to provide care and early detection for myopia, educate the public on preventive measures, as well as advance clinical research.[27]

These initiatives demonstrate the Singaporean's government's commitment to address a specific eye condition that is a significant public health issue in the country, by focussing resources into eye health care services that target myopia.

As seen in Section 4.1.2, the number of people living with sight loss has grown across all countries. When it comes to blindness, rates have increased across all but three countries: India, Nepal and Sweden. These trends are seen to be strongly associated with the ageing of the population. This presents challenges in addressing the Vision 2020 goals, set in 1999, of eliminating avoidable blindness by the year 2020, and the further goals set out in 2030 In Sight of eliminating unnecessary and preventable sight loss. Box 1 highlights the progress made by India towards elimination of preventable blindness, and the clear outcomes of this effort. While progress has been made against the Vision 2020 goals, clearly there is still considerable work to be done in addressing need.

4.2 What proportion of health expenditure is allocated to eye health?

***RQ1:** "What proportion of overall health expenditure in countries is allocated to eye health?"*
***RQ2:** "What are countries' overall expenditure (per capita) on eye health?"*

As has been examined in Section 4.1, the level and nature of eye health need varies significantly across the countries examined. This is closely linked to the expenditure countries allocate to eye health, and therefore the relative 'size' of the eye health system within the broader health system. This section discusses the volume of funding allocated to eye health in each of the ten countries examined.

Two measures of eye health expenditure are used in this section:

1. Eye health expenditure as a share of total health expenditure, which gives a sense of the prominence of eye health in the broader health system
2. Eye health expenditure as a share of gross domestic product (GDP), which provides a measure of the size of the eye health system in relation to its economic output, regardless of the country's investment in health more broadly.

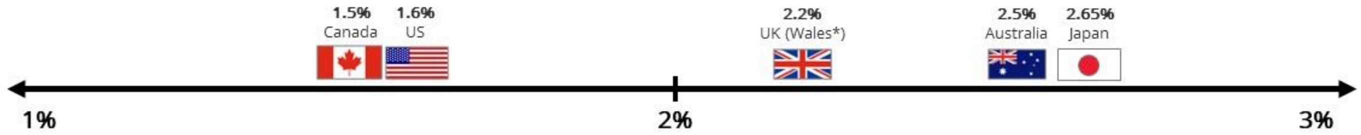
Neither of these figures are adjusted to reflect the differences in demographics between countries. Given the association between age and eye disease,[20] countries with more aged populations may need to spend more on eye health in order to meet need.

4.2.1 Data on eye health expenditure is highly variable and many countries do not report it. Among countries who do, eye health expenditure ranges from 1.5% to 2.7% of total health expenditure.

Globally, there are significant gaps for many countries in eye health expenditure reporting. As can be seen in Figure 4.1, only four of the ten countries examined collect eye health expenditure data at a national level, and one at a subnational level. These largely reflect more general reporting of health expenditure data disaggregated by disease or disease area.

In countries that report eye health expenditure data, the proportion of health expenditure that is spent on eye health varies between 1.5% and 2.7%. Among the five countries for which it was reported, eye health expenditure ranges from 1.5% of total health expenditure in Canada and the US, to 2.7% of total health expenditure in Japan. It should be noted that the share of the population that is over 65 varies between these countries, with Japan having the highest share at 29%, Canada at 19%, and Australia and the United States having the lowest at 17%. Although the ageing population share does not directly reflect the level of expenditure, there is likely to be a relationship between these factors given age is a driver of eye disease.[20]

Figure 4.1: Eye health expenditure as a share of total health expenditure

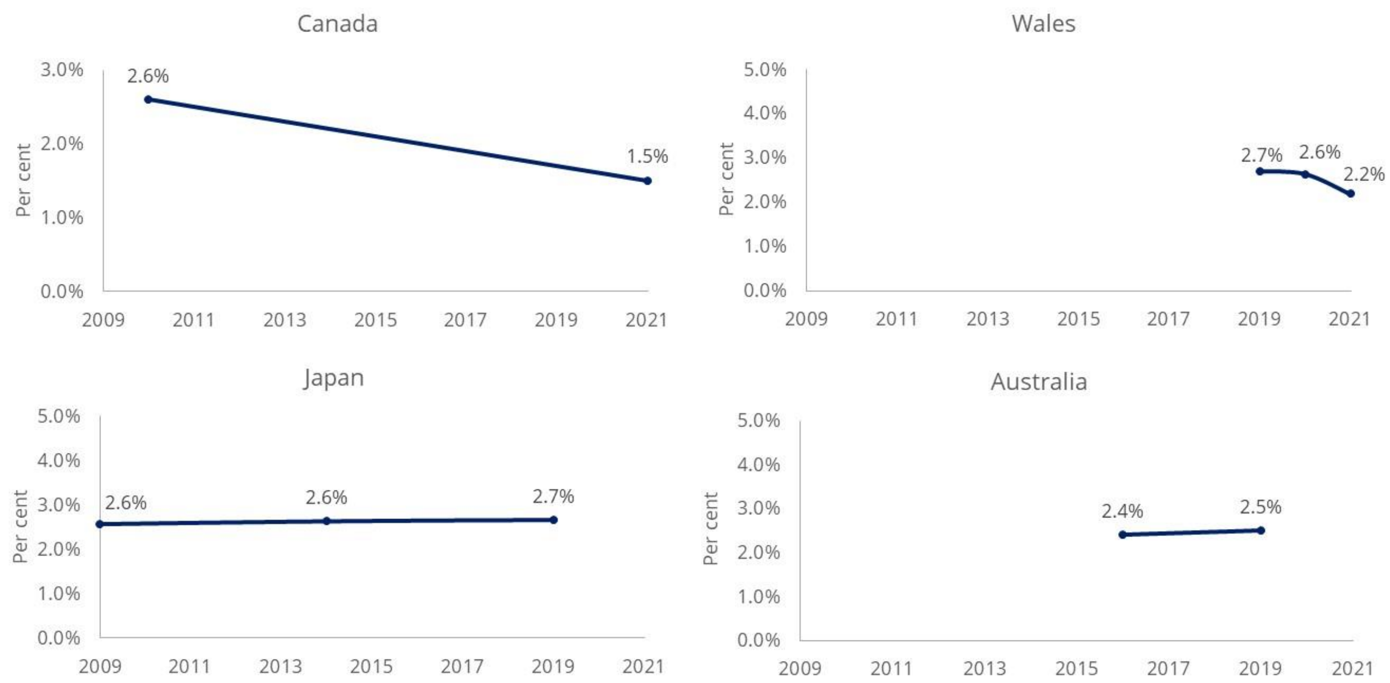


Source: Various country-specific government datasets, see data review appendices for specific insights and citations. Note 1: Aggregated eye health expenditure was not available for the UK but was available for Wales only. Note 2: The most recent year for eye health expenditure data for each country includes: Canada (2021), US (2017), Wales (2021), Australia (2019) and Japan (2019). * Only data for Wales was available for the UK.

4.2.2 The trend data on eye health expenditure has been mixed – the proportion of eye health expenditure to total eye health expenditure has decreased for two out of four countries but remained stable for the remaining two countries.

Trend data on eye health expenditure is available for some countries. Across the four countries which have trend data on eye health expenditure, the time at which this data has been collected varies from 1999 to 2021. Across these four countries, total expenditure on eye health has increased in level terms, likely due in large part to higher expenditure on age-related eye conditions such as macular degeneration, glaucoma and cataract. However, the proportion of eye health expenditure to total health expenditure has decreased for two out of four countries (Wales and Canada) in the past five years as seen in Chart 4.6. This may be driven by the emergence of other competing health priorities, such as mental and substance use disorders, cancer, cardiovascular disease and reproductive and maternal health, or larger increases in the treatment costs of other health areas compared to eye health.

Chart 4.6: Eye health expenditure as a share of total health expenditure, trend in selected countries

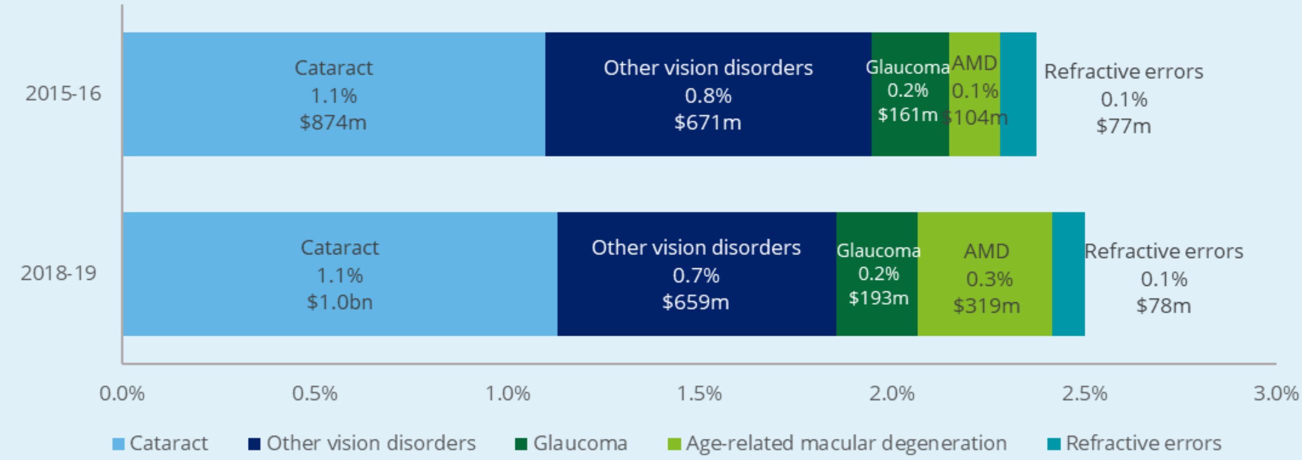


Source: Various country-specific government datasets, see data review appendices for specific insights and citations. Note: Trend data is not available for the US.

Box 4: Australia's disaggregation of eye health expenditure

Only Australia provides disaggregated eye health expenditure data. This data, as seen in Chart 4.7, shows that the increase in Australia's eye health expenditure is driven by a tripling of expenditure on macular degeneration, a 20% increase in spending on glaucoma and 18% higher expenditure on cataract between 2015-16 and 2018-19.

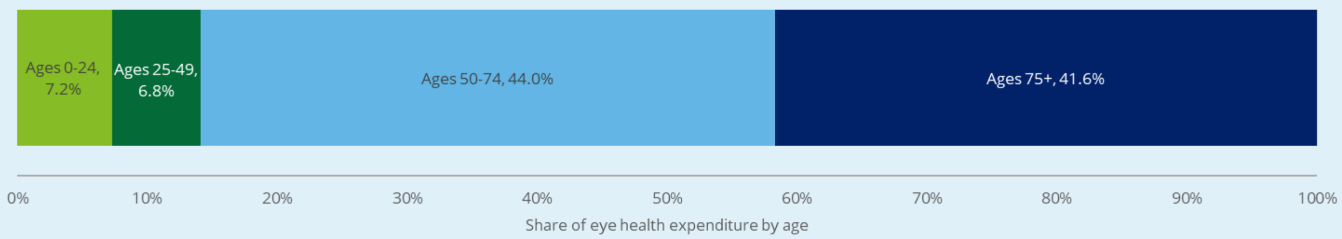
Chart 4.7: Change in eye health expenditure as a % of total health expenditure and value (US dollar, US$), disaggregated by expenditure by condition



Source: Australian Institute of Health and Welfare (2021).

The focus on eye health expenditure in older Australians is highlighted in Chart 4.8, where 85.6% of total eye health expenditure is directed towards those aged 50 and above.[31]

Chart 4.8: Share of total eye health expenditure by age group.



Source: Australian Institute of Health and Welfare (2021).

This level of diaggregation of expenditure data allows for a more complete picture of resource allocation in eye health by specific disease areas, and the key age groups who benefit from eye health expenditure. Countries can also consider collecting eye health data by service type – for example the level of expenditure directed towards early intervention compared to treatment of specific diseases. This will enable more robust assessments on whether countries are investing sufficient level of resources earlier in the eye care continuum (see Section 4.4.4).

4.2.3 Most countries report some measure of eye health expenditure, although it is often only available for a subset of the health system or of the country.

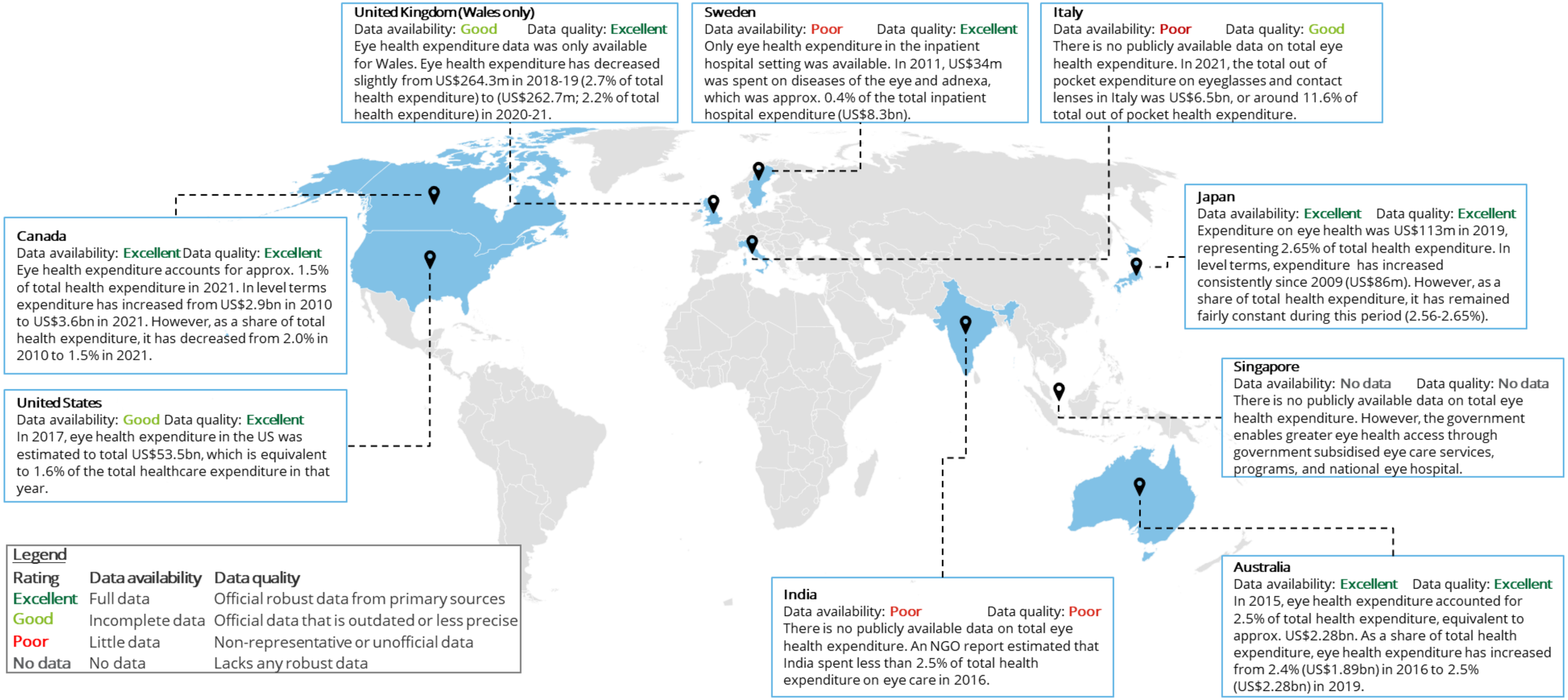
As can be seen in Figure 4.2, only five of the ten countries examined having cross-comparable expenditure data on the total eye health system. Three additional countries report some level of expenditure data, which is used to estimate a subset of the total eye health system. As can be seen in Table 4.2, the data quality of eye health expenditure is more commonly reported to be excellent compared to data availability. This reflects the fact that many governments report some official data, however the data reported does not directly answer the question of the total magnitude of eye health expenditure.

Table 4.2: Availability and quality of eye health expenditure data among countries examined

	Australia	Canada	India	Italy	Japan	Singapore	Sweden	UK	US	Nepal
Eye health expenditure data **availability**	Excellent	Excellent	Poor	Poor	Excellent	No data	Poor	Good	Good	No data
Eye health expenditure data **quality**	Excellent	Excellent	Poor	Good	Excellent	No data	Excellent	Excellent	Excellent	No data

Source: Deloitte.

Figure 4.2: Snapshot of the existing eye health expenditure data that exists for all countries



Source: Various country-specific government datasets, see data review appendices for specific insights and citations.

Italy provides an example of a country which does not collect comprehensive data on eye health expenditure, but for which there are indicators of the size of the eye health system. Data is collected as part of consumer price index (CPI) measures around out-of-pocket consumer expenditure on eyeglasses and contact lenses, which amounts to 11.6% of total out-of-pocket health expenditure. While this cannot be used to infer the size of the broader eye health system, it provides a useful indication of the cost pressures of this element of vision care on consumers.

Similarly, Sweden does not collect comprehensive data on eye health expenditure, only reporting on the total eye health expenditure for inpatients. In 2011, the spending on diseases of the eye and adnexa totalled US$34m, which is approximately 0.4% of Sweden's total inpatient hospital expenditure (US$8.3bn) in that year.[32] Although this is a small proportion of inpatient, this is not surprising given a large proportion of eye treatments and procedures (e.g., cataract, anti-VEGF treatments) are performed in outpatient settings.

India, as the only example of a low- to-middle-income country in this group, carries out data collection more frequently for eye health outcomes and outputs, such as cataract surgical coverage rates, post cataract surgery visual outcomes, and the number of people accessing government-subsidised services.[33] However, in terms of eye health expenditure, there is a lack of systematic reporting, resulting in poor data availability and quality for this metric. However, the magnitude, trend, sources, and distribution of eye healthcare investment in India can be gleaned through the significant increase in total health expenditure (nearly five-folds in the last two decades on level terms) and the abundance of government- and NGO-driven eye health initiatives. In the absence of comprehensive eye health expenditure data, this secondary information can be used as proxies to the level of eye health investment and prioritisation. India should also consider extending their data collection to include eye health expenditure in order to inform future policy and resource allocation decisions

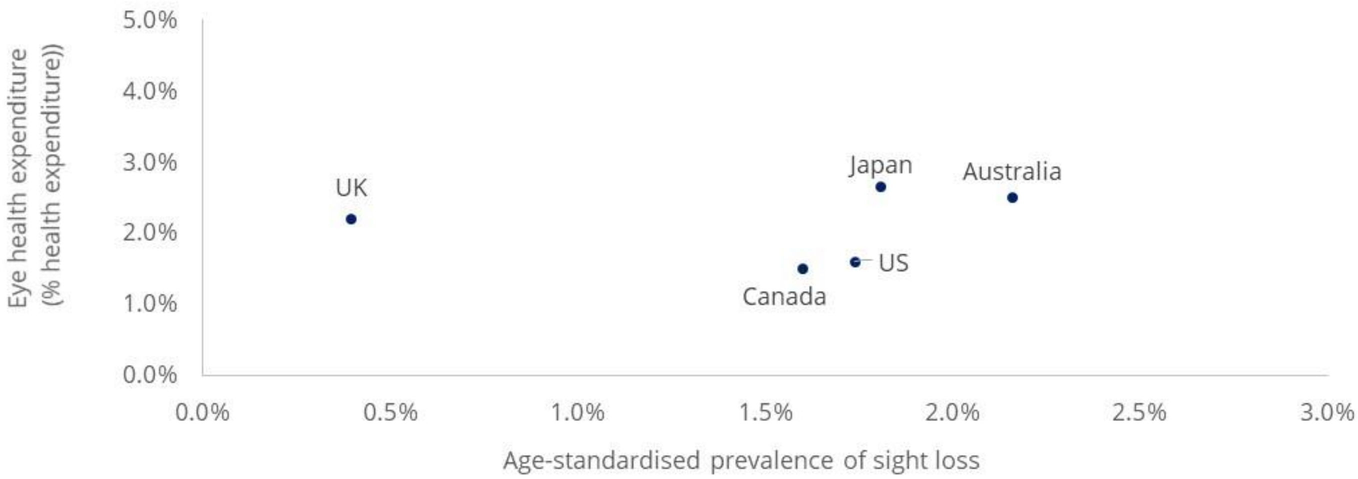
This demonstrates that although only half of the countries examined have available data on total eye health expenditure as a percentage of health expenditure, 80% have some measure of eye health expenditure. While measures of elements of the eye health system expenditure cannot be compared to expenditure on the entire eye health system, these can be useful indicators and provide the basis for governments to expand eye health expenditure reporting.

4.3 What is the relationship between countries' level of expenditure on eye health and prevention and vision outcomes achieved?

The relationship between eye health expenditure and vision outcomes is complex, and as discussed in the previous sections, has many influencing factors. There are three measures used to determine the size of eye health expenditure. These include eye health expenditure as a share of total health system expenditure (indicating the relative size of the eye health system compared to other parts of the health system), eye health expenditure as a share of GDP (indicating the size of the eye health system independent of the size of the health system more broadly), and eye health expenditure in USD per capita (which importantly does not take into account affordability differences across countries, but provides indications on the relationship between expenditure and the population).

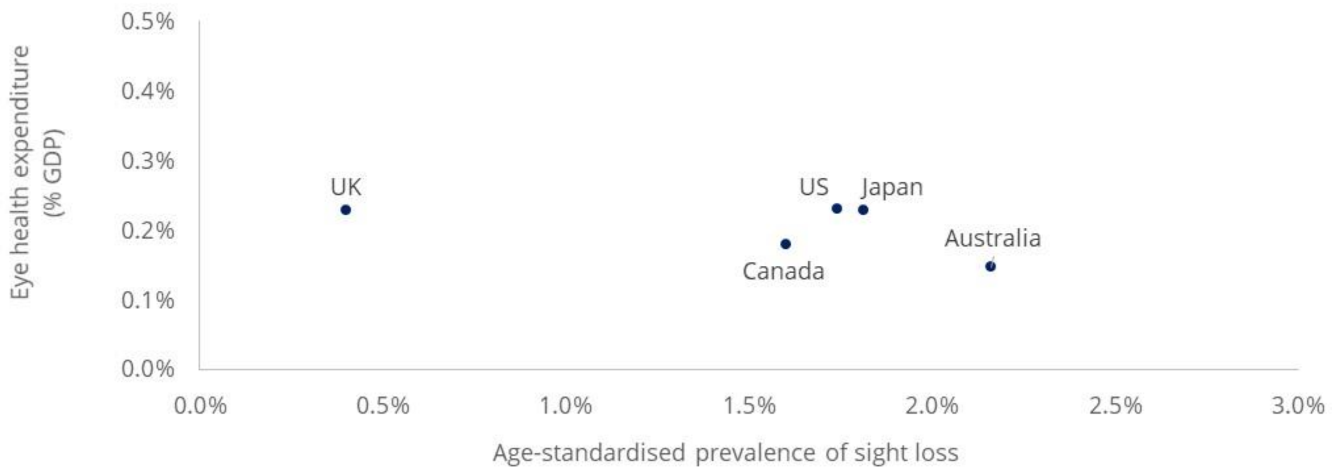
As shown in Chart 4.9, though the relationship is difficult to clearly discern, it would seem that as prevalence of sight loss (which includes MSVI and blindness - moderate-severe vision impairment is defined as: VA <6/18 but >3/60. Blindness is defined as VA<3/60) increases, so does the share of health expenditure allocated to eye health. This points to a higher level of investment prioritisation around eye health by countries in response to greater eye health need. When prevalence is compared to eye health expenditure as a share of GDP (Chart 4.10) or to the per capita value of eye health expenditure (Chart 4.11), the relationship appears to be negative. This could indicate that the size of the eye health system, regardless of its prioritisation within the health system more broadly, can lead to lower rates of sight loss. However, it should be noted that this data represents not only a very small sample, but also a sample which is heavily biased towards high-income countries with mature health systems which are able to produce data on health system expenditure.

Chart 4.9: Prevalence of sight loss (moderate to severe vision impairment and blindness) and eye health expenditure (% health expenditure)



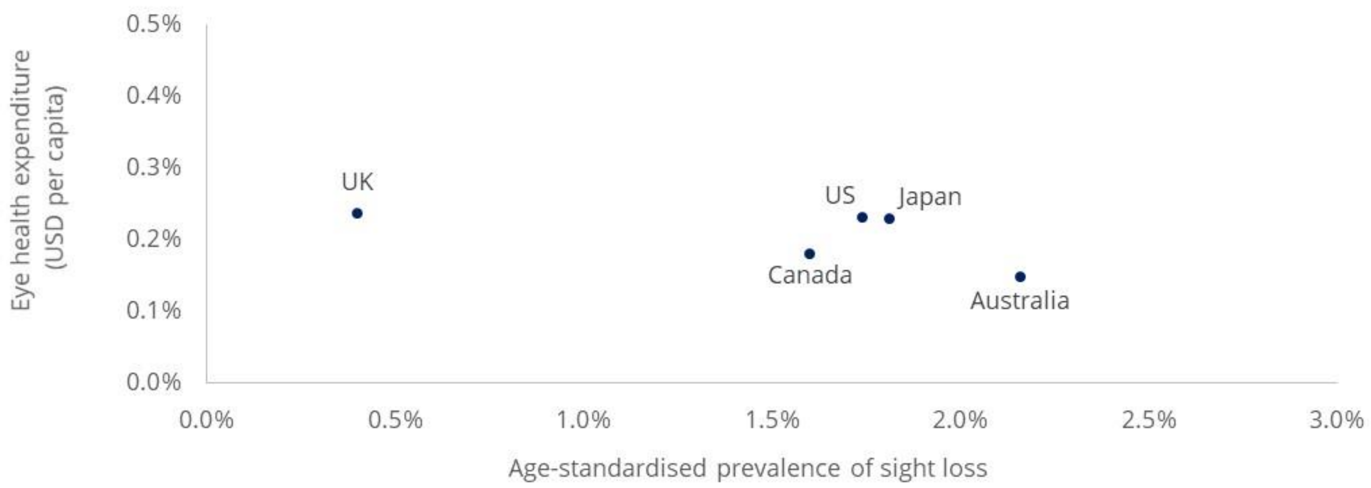
Source: Deloitte using various country-specific qualitative sources. Note: age-standardised prevalence rate.

Chart 4.10: Prevalence of sight loss (moderate to severe vision impairment and blindness) and eye health expenditure (% GDP)



Source: Deloitte using various country-specific qualitative sources. Note: age-standardised prevalence rate. Sight loss includes both MSVI and blindness. This chart includes the prevalence of MSVI and blindness (MSVI: VA <6/18 but >3/60; Blindness VA<3/60).

Chart 4.11: Prevalence of sight loss (moderate to severe vision impairment and blindness) and eye health expenditure (USD per capita)



Source: Deloitte using various country-specific qualitative sources. Note: age-standardised prevalence rate. Sight loss includes both MSVI and blindness. This chart includes the prevalence of MSVI and blindness (MSVI: VA <6/18 but >3/60; Blindness VA<3/60).

There are two mechanisms by which eye outcomes relate to expenditure, and both can be considered dependent variables:

- In response to high or increasing prevalence of eye disease or vision impairment, governments may increase expenditure allocated towards eye health
- Expenditure on eye health is spent on services which reduce the prevalence of eye disease and vision impairment.

It is challenging to discern which of these factors proves a more powerful explanatory factor given the lack of data available. Further, there are many omitted variables which influence this relationship, for instance the varying age and demographic profiles of the countries, which make it very difficult to understand the relationship from this data alone. It should also be noted that a key limitation of this analysis is that the reporting of eye health expenditure data itself is related to broader institutional maturity in the health system. As can be seen above, the countries represented in this expenditure data (Canada, the US, Australia, the UK and Japan) are all high-income nations. The countries which do not report eye health expenditure data (Sweden, Nepal, Italy, Singapore and India) would potentially also show different relationships between expenditure and outcomes.

However, when drawing on the insights from Section 4.3, it can be observed that there are areas of targeted investment which, if pursued, can provide benefits in terms of improving understanding of the eye health space, creating national focus, addressing need, and providing early intervention and preventative care. These are further explored in Section 5.

4.4 Where is targeted expenditure required to improve eye health systems and outcomes?

A key finding that has emerged through this review is the significant variation in the structure and focus of eye health systems worldwide. A number of factors in the design or implementation of the eye health system have a significant impact on the eye care and eye health outcomes. **Four factors have emerged as the key barriers and enablers among eye health systems examined in this review. These will be examined in this section and include:**

- **Information:** Reporting of comprehensive eye health data
- **Workforce:** Supply of eye care professionals meets need
- **Leadership:** Creation of a national plan applying to eye health
- **Services:** Focus on preventative eye care

4.4.1 Information: Countries allocate varied levels of investment into the collection, management and reporting of eye health expenditure and outcomes data.

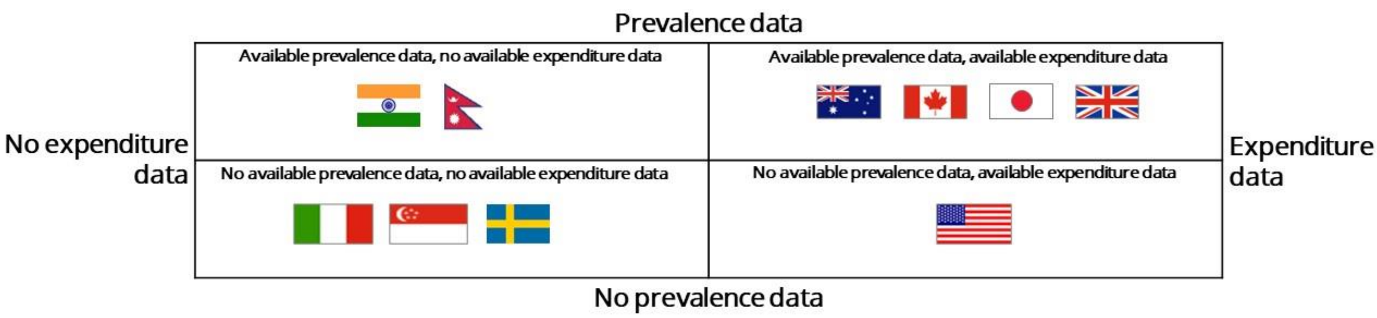
As has been explored in Section 4.1 and Section 4.2, there are significant gaps globally in the reporting of eye health expenditure and outcomes data. As seen in Figure 4.3, among the ten countries reviewed, just six publicly reported national and government-sourced eye disease prevalence data, and only four reported publicly reported national and government-sourced eye health expenditure data (in addition, the UK reports expenditure at a subnational level). This has significant implications for the broader eye care system. Without data collection around eye disease prevalence, policymakers may not be able to:

- Understand the magnitude of eye health need
- Understand the drivers of vision impairment and blindness
- Be able to gauge the level of investment required into the eye health system and the return on investment.

Without data measuring the level of expenditure being directed towards eye health, it could be difficult for policymakers to:

- Ensure funding decisions are appropriate and sufficiently address need (an example is the use of cataract surgery wait times to inform resource allocation decisions – see below)
- Understand magnitude of eye health need, and how this has evolved over time
- Inform strategic policy decisions such as the formulation of national plans to tackle specific eye diseases.

Figure 4.3: Data availability among ten countries reviewed (national level publicly available government-sourced data)



Source: Deloitte using various country-specific qualitative sources. Note: Prevalence refers to prevalence of vision loss. While UK prevalence data is reported at a national level, expenditure is reported only at a sub-national level, for Wales only.

A key point to note around data collection is the differences in maturity among data collection systems in the countries observed. Some countries examined have more robust and established structures around health outcomes and health expenditure data more broadly, such that collecting eye health data in these areas would require a relatively small step-up in costs, time and capability. Others, however, have very little existing data collection, meaning this infrastructure would need to be developed in order to then collect eye health data. Some examples of approaches to data collection in different environments of institutional maturity can be seen in Box 5 and Box 6.

Box 5: Collecting eye health data at a community level in Nepal

In 1981, the government of Nepal, with the support of WHO, conducted the Nepal Blindness Survey, a large population-based survey of 39,887 Nepalese people on eye health.[34] The survey was designed to gather data that was representative of the roughly 15 million person Nepalese population, in order to estimate the prevalence and causes of blindness for the entire country as well as for certain geographical, demographic and community subgroups.[34]

The design of the survey was carried out in consultation with ophthalmologists, survey research specialists, epidemiologists, and other professionals. Within five months of the survey implementation, ten ophthalmologists, along with ophthalmic assistants and medical officers, examined 39,887 persons in all 14 administrative zones and all five development regions across Nepal.[34] The ophthalmic examination protocol involved VA assessment by the ophthalmic assistant, a full eye examination by the ophthalmologists, and auxiliary studies of specific eye conditions including cataract, trachoma and eye trauma.

In addition to collection of eye health data, the enumeration team also collected background data about each site including households and persons (e.g., information about ethnic group, water supply, migration history, health services utilisation, and other characteristics) which were used later in the epidemiological analyses. Data management and analyses were then carried out collaboratively by the administration and scientific staff in Nepal and the Seva Foundation in the US.[34]

The survey findings revealed the severity and prevalence of blindness in the country: an estimated 0.84% (approximately 126,000 people) of its population self-reported to be affected by blindness and vision impairment.[3434] Data from this study has led to the initiation of the Public Private Partnership model by the Nepalese government. Under this model, the Nepal Netra Jyoti Sangh (NNJS), an NGO that works closely with the Nepalese government, was delegated full responsibility of coordination of eye care workforce and resources, and delivery of eye care initiatives and programs. This has led to significant mobilisation of resources and support to address the needs of the Nepalese population living with vision impairment and blindness.

Since then, two more recent population-based surveys have been conducted in 2010 and 2019 (data from the 2019 survey has not yet been published). Eye health data collected from these surveys allowed monitoring and tracking of progress, with evidence supporting significant improvements in eye health outcomes in Nepal. The prevalence of blindness has fallen from 0.84% in 1981 (n=117,600) to 0.35% in 2010 (n=93,400), representing a reduction of 58% during this period. The decline in the prevalence of blindness has continued in the most recent decade, as evidenced by an upcoming 2019 survey publication that has estimated that the prevalence of blindness has decreased to 0.28% of the population.

Compared to 1981, the prevalence of blindness caused by cataract and trachoma has decreased in 2010 by 76% (from 0.56% to 0.19%) and 75% (from 2.4% to 0.6%) respectively. This may be partly attributable to the NNJS-related eye programs including the National Eye Sight Program, National Trachoma Program, and National Low Vision Program. The number of cataract surgeries conducted has increased from 1,000 in 1981 to over 200,000 in 2010.

This case study on Nepal's approach to eye health and care highlighted the importance of data collection to improve eye health outcomes. The 1981 population-based survey was a significant driver for the actions, investments, and resource mobilisation in eye health, and was followed up with surveys in subsequent years to track progress. The presence of sufficient and representative data can enable countries to direct their resources to the best efficient use.

Box 6: Collecting eye health data as part of established national data collection in Japan

Many of the countries which hold data on total eye health expenditure do so because they report health expenditure data disaggregated by disease area, one of which is diseases of the eye. This is most often data held by a national health department or agency.

In the case of Japan, data on health expenditure disaggregated by disease area up to 2019 is collected by the Japanese Ministry of Health, Labour and Welfare in their national health expenditure dataset. This disaggregation by major disease area has been collected since 1977, and aims to provide information on whether care is meeting need within the Japanese health system. The disaggregation by major disease area is based on the Survey on Medical Benefits data, which covers all medical fee statements and dispensing fee statements for those in the medical insurance system (a national system). Under the disease category "Diseases of the eye" data on the total value of eye health expenditure is presented. Disaggregations are also presented for expenditure on the population by age, and by place of expenditure (hospital and non-hospital).[35]

While Japanese government data sources do not hold prevalence statistics for specific diseases, it is possible to extract an aggregated figure for the number of individuals at hospitals and general clinics with aggregated diseases of the eye and adnexal from the Ministry of Health, Labour and Welfare Patient Survey.[36]

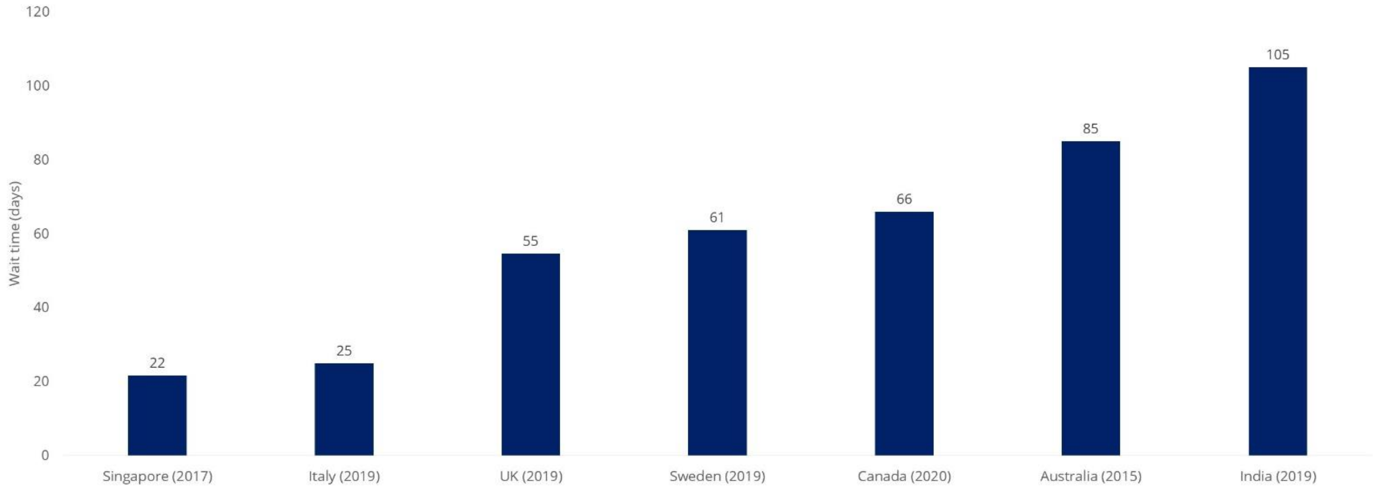
While Japan's system for collecting disaggregated disease expenditure is mature, there is a need to develop the disaggregation of its prevalence data to understand eye disease drivers, given the variation in the causes of eye disease.

In addition to eye health expenditure and outcomes data in terms of prevalence of vision impairment and blindness, output data is also important information to track and measure the efficiency of eye health systems and their service delivery. These include eye care coverage (e.g., cataract surgery, refractive correction, retina screening), eye care service quality (e.g., cataract surgical outcomes), and eye care service access (e.g., cataract surgery rate and wait time).

Cataract, as discussed in Section 4.1, is the leading cause of blindness in many countries including the US and India. Timely delivery of cataract surgery is therefore critical to treat the condition and reduce the likelihood of hazards caused by poor vision.[37] Recording of wait time data is a useful measurement to monitor the efficiency and output of cataract surgeries. This has been commonly implemented in many OECD countries but should become a routine data collection process for other countries as well as in local regions.

As shown in Chart 4.12, wait times for cataract surgery (prior to COVID-19 pandemic) – considered as a non-urgent procedure - show significant variation across countries, ranging from 22 days in Singapore to 105 days in India. This suggests that the majority of cataract surgeries in these countries fall within the general wait time benchmark of around 110-120 days.[38,39] However, reduction and minimisation of wait times for cataract surgery should remain a goal. A systematic review found that a wait time for cataract surgery of less than 6 weeks is associated with lower visual loss, better quality of life and fewer falls.[40] In contrast, wait times of 6 months or longer were associated with poorer prognoses,[40] leaving people living with cataract exposed to significant limitations in their overall functioning and risks of permanent vision impairment and blindness.[41] Monitoring and reporting of eye care output data such as wait time of cataract surgery can help countries allocate their resources to improve eye care service access. This is particularly important for rapidly progressive diseases such as neovascular AMD (nAMD), which can lead to irreversible vision loss if not treated in a timely matter.

Chart 4.12: Wait time for cataract surgery

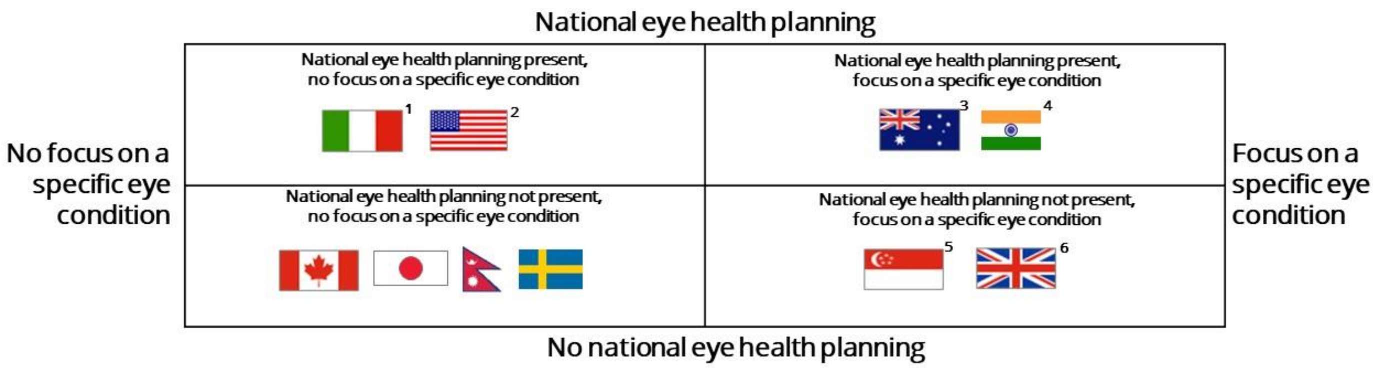


Note: Median wait times were reported for all countries except Sweden and India where average wait times were reported. The latest data for each country prior to 2020 was referenced here to exclude the effect of the pandemic. No data is available for the United States and Japan.

4.4.2 Leadership: Many countries lack a comprehensive and overarching national plan needed to elevate eye health in strategic decision making.

With data collection key to identifying and understanding eye health, national planning is crucial in securing national focus and coordination around eye health. As can be seen in Figure 4.4, just two countries examined have **both** national planning around eye health and an identified priority eye condition, and four more countries have **either** national planning or an eye health condition of priority. Planning and prioritisation is crucial in eye health care, given the important role of detection and prevention in reducing the severity of eye disease.

Figure 4.4: Heap map of strategies and planning among ten countries reviewed



Source: Deloitte, using various country-specific qualitative sources. Note: [1] Italy's eye health strategy includes the National Prevention Plan and the National Technical Committee for the Prevention of Blindness; [2] The US has the National Eye Institute Strategic Plan: Vision for the Future; [3] Australia has a National Strategic Action Plan for Macular Disease and has a specific focus on Macular Disease' [4] India launched the National Programme for Control of Blindness and Vision Impairment (NPCBVI) since 1976 to mobilise resources, deliver initiatives, and create settings for NGO participation in eye care delivery. Further, cataract has been a focus government and NGO efforts in as it is the primary cause of blindness in India. There has been calls for additional focus on DR, refractive error and glaucoma in recent years; [5] The Singaporean government has established a special focus on Myopia given its high prevalence; [6] There is a focus on the rise of glaucoma over the next decades across the UK.

Planning around eye health provides benefits to countries across the spectrum of eye health system maturity. For countries where the eye health system is dominated by non-government actors, national-level planning is key to coordinating these services and assuming there is no inefficiency and duplication. For countries with government-centric eye health systems, planning is crucial to ensure the particular complexities of eye health are addressed and not confounded with other elements of the health system. As shown in Box 7 and Box 8, planning and prioritisation can look very different across different countries, given they reflect the variation in local need and eye health system structure.

Prioritisation

Box 7: Australia's macular disease plan

As of 2019, Australia's Department of Health and Aged Care has a *National Strategic Action Plan for Macular Disease*. The plan's focus on AMD reflects its status as the leading cause of sight loss in Australia. This identification and focus on a specific disease to drive action is seen as key to unite actors and stakeholders in the AMD space and execute the key actions.

The plan was developed with the Macular Disease Expert Advisory Group (formed by an advocacy group for macular disease in Australia). The advisory group consisted of peak bodies in the AMD and vision spaces, the college of ophthalmologists, the peak body for optometry and prominent clinicians and researchers in the AMD space.

It aims to provide a framework for collaborative efforts by governments and other parts of the community, including people living with macular disease, health care professionals, non-government organisations, researchers, families, carers, communities and industry, to reduce the incidence and impact of macular disease. The plan focuses on four pillars:

- Prevention and early detection
- Treatment
- Support
- Data & research.[42]

The plan has led to tangible investment into AMD, with the government committing Australian dollar AU$3 million in the disease area at the plan's release in 2019. This includes AU$1.5 million to increase awareness of risk factors among the population, with AU$1 million of this to support work in this area by the Macular Disease Foundation Australia, the peak body in the area. The remaining $1.5 million was allocated to the delivery of awareness campaigns aimed at improving knowledge of the disease and its management among health professionals. However, the impact this has had on macular disease outcomes in Australia is not yet clear through the available data.[43]

Box 8: India's national eye health plan

Eye health in India has been a primary focus of many initiatives by public and private organisations in light of the country's high blindness rate. The India Government, through policy and collaboration, has created an enabling environment for NGOs and private sector to jointly deliver eye health services. NGOs in particular have supported the delivery of eye care services, particularly in rural and remote areas.

In 1976, the Central Government of India established the National Programme for Control of Blindness and Visual Impairment (NPCBVI),[21] with the central mission of providing free eye care to the population. The NPCBVI delivers several programs under universal health coverage to reduce consumer out-of-pocket (OOP) expenses, including:

- Free cataract surgery at district hospitals and specified NGO eye hospitals/private practitioners
- Eye screening and distribution of free spectacles to school children and elderly
- Collection of donated eyes through network of eye banks and eye donation centres
- Diagnosis and treatment of other eye diseases (glaucoma, childhood blindness, squint etc.) at district hospitals and identified NGO eye hospitals
- The training of para medical ophthalmic assistants posted at Primary Health Centres (PHC)/district hospitals.

As part of the NPCBVI, the Government also sets targets for eye health service delivery outputs and collects data to track the progress. For example, the School Eye Screening Program is implemented to detect refractive errors and provide free spectacles in school children. As of 2017-18, 2.7 million children have been screened (roughly 2% of children aged 7-12 in

India), resulting in 1 million people detected with refractive errors (roughly 0.7% of children in India), and ~47,000 provided with free spectacles.

However, given the low proportion of children who have been screened through the national program, it is likely that a significant proportion of the population either receives care services through the private health system (consumer OOP spending) or do not have access to preventative eye care services. This at least partially explains the comparatively higher uncorrected refractive error in India.

Government support for eye health created an enabling environment for eye care delivery in India. This includes funding allocation, favourable policies for importing equipment, promotion of local eye care industry, and encouragement for human workforce development. There is also an increasing trend of private and corporate philanthropy and private and NGO investment into the eye care sector.

Innovative measures from these initiatives, such as cross-subsidisation models in NGO hospitals, free universal eye screening under the government's NPCBVI and the Vision 2020 global initiative have resulted in India providing highly cost-effective eye care to its population.

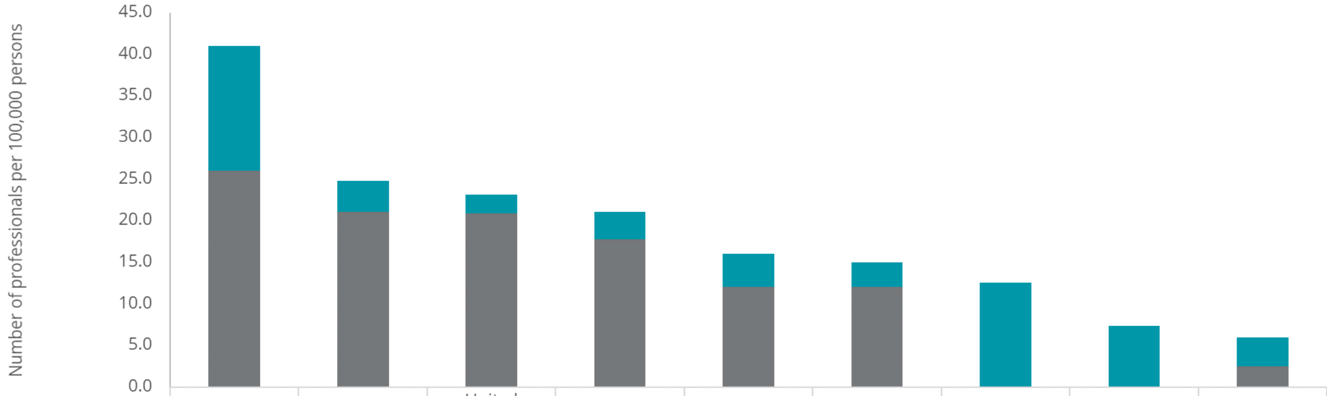
4.4.3 Workforce: The size and distribution of the eye care workforce is crucial in meeting need and ensuring access to care, however many countries experience eye care workforce gaps.

The eye care workforce is made up of a wide range of eye care professionals, including optometrists, ophthalmologists, specialised nurses, opticians and dispensing technicians, among others. These specialised clinicians and technicians have varying qualifications and duties, and exist in some form in most countries worldwide. Despite this, their duties and roles vary from country to country to reflect differences in eye health system structure and design.

The size and distribution of the eye care workforce is crucial in meeting eye health need and ensuring equitable access to services, however many countries experience eye care workforce gaps. Shortages in the eye health workforce can limit access for particular populations, such as those living in regional and remote areas, or can lead to extended wait times and gaps in preventative care. This makes the size of this workforce a key factor determining the nature of eye health services provided and their outcomes.

The size of the eye health workforce is one of the more widely available indicators around the size and design of the eye health system more broadly. As can be seen in Chart 4.13 all nine countries for which a full data review was conducted report the number of ophthalmologists (defined as medical doctors who have been trained in ophthalmic medicine and/or surgery and who evaluate and treat diseases of the eye)[44] in practice, and all report the number of optometrists (primary healthcare practitioners of the eye and visual system who provide comprehensive eye and vision care)[44] except for Italy, which does not have data available, and Japan, where optometry is not a profession. Specifically, Japan does not have any optometrists, as roles performed in other countries by optometrists performed by ophthalmologists in Japan.

Chart 4.13: Number of eye care professionals per 100,000 population



	Sweden	Australia	United Kingdom	Canada	India	United States	Japan	Italy	Singapore
Ophthalmologist	15.0	3.8 ⚠	2.2 ⚠	3.4 ⚠	4.0 ⚠	3.0 ⚠	12.5	7.3 ⚠	3.5 ⚠
Optometrist	26.0	21.0 ⚠	20.9 ⚠	17.7	12.0 ⚠	12.0	No data available	No data available	2.5

⚠ Indicates the presence of an identified eye health workforce shortage in the country (identified either by government or non-government organisations)

Source: Deloitte, based on various country-specific sources (details are available in review appendix for respective country). Note: Sweden's optometrists count includes both opticians and optometrists as these professions are combined in the data source given the similarity in responsibilities and role in Sweden. The statistics for India are estimates only.[45]

There are a number of insights which can be drawn from workforce data. Firstly, it provides an indication of the size of the eye health system in respect to eye health services available, for instance screening and treatment services which are conducted by eye care professionals. Secondly, it provides an indication of the structure of the health system, when comparing the number of ophthalmologists to the number of optometrists. The division of care between optometrists and ophthalmologists varies by country, with some countries like Japan employing ophthalmologists across the care continuum (from screening and diagnosis to treatment), and other countries like Australia splitting the roles between optometrists who conduct screening and make referrals to ophthalmologists who then provide diagnosis and treatment. Optometrists in Australia are also involved in the provision of primary eye care and treatment, which may not necessarily be the case in other countries in the scope of this study.

As can be seen in Chart 4.13, there is significant variation in the rate of optometrists and ophthalmologists per 100,000 population. The number of optometrists ranges from 2.5 per 100,000 population for Singapore up to 26 optometrists/opticians per 100,000 population for Sweden (noting that these roles are combined given their similarity in the Swedish eye health system). There is also similarly significant variation in the number of ophthalmologists, from just 2.2 per 100,000 population in the UK up to 15 per 100,000 population in Sweden.

As mentioned above, the size of the eye health workforce can be a key indicator on the ease of accessing eye care services. Seven countries examined in this report had identified shortages in their eye care workforce, either nationally or in particular geographic areas. Of the countries examined:

- Four out of nine countries (Australia, India, Italy and the UK) had an identified shortage **in both optometrists and ophthalmologist**s. Australia in particular reported more significant shortages in regional and remote areas.
- Three out of nine countries (Canada, Singapore and the US) **reported eye care workforce shortages** (no apparent optometrist workforce shortage). The presence of ophthalmologist shortages across most countries examined, both of middle and high income, demonstrates the magnitude of the issue.

The demand for eye care is increasing and is expected to rise given the ageing population. The increasing demand for eye care services will need to be met with an adequately skilled and sized workforce, which will need to work to clear the existing backlog of people living with eye conditions waiting for surgery (cataract and other eye care procedures) caused by the coronavirus disease (COVID-19) pandemic and condition to open capacity to diagnose and treat new cases.

4.4.4 Services: Countries tend to subsidise eye health treatments more so than early intervention or preventative care. This could potentially lead to eye diseases being treated only once they have progressed.

The areas of eye health care which are publicly subsidised, or around which eye health programs are focused, provide an indication of both the accessibility and focus of eye health care within countries. Intervention at the right point in the individual's journey is particularly crucial in the eye health context, given sight loss is difficult to reverse, and early detection and intervention can significantly improve outcomes.[46]

As can be seen in Table 4.3, the most subsidised area of eye health care across the nine countries examined is eye surgeries, and the least subsidised are corrective lenses and eye screening services. This suggests that **government spending on eye health seems to be concentrated at the later stages of the care pathway, such as treatment, as compared to the earlier stages of vision care, such as prevention and screening.** However, it is important to consider this on a disease by disease approach, as each eye condition has its own disease progression and its own prevention and treatment strategy. This could mean there are missed opportunities across these countries to leverage the benefits of early intervention and detection from eye screening, or to provide low-cost interventions like corrective lenses, with relatively higher-cost interventions such as treatments being more subsidised.

It should be noted that that this definition of screening being distinct from the category of treatment does not align with the World Health Organisation's definition as presented in the World Report on Vision. This is because this report separates these categories to proxy prevention and treatment given a lack of detail country-level insights are available.

Table 4.3: Funding of eye care services across the journey of care

	Eye screening services	Corrective lenses (glasses and lenses)	Medication (including eye drops and anti-VEGF treatment)	Eye surgeries
Australia	Publicly funded for the population	Partially subsidised	Partially subsidised	Publicly funded for the population
Canada	Partially subsidised	Not publicly funded for the population	Partially subsidised	Publicly funded for the population
India	Partially subsidised	Partially subsidised	Partially subsidised	Publicly funded for the population
Italy	Partially subsidised	Not publicly funded for the population	Publicly funded for the population	Publicly funded for the population
Japan	Partially subsidised	Partially subsidised	Partially subsidised	Partially subsidised
Singapore	Partially subsidised	Not publicly funded for the population	Partially subsidised	Partially subsidised
Sweden	Publicly funded for the population	Partially subsidised	Publicly funded for the population	Publicly funded for the population
UK – England	Partially subsidised	Partially subsidised	Partially subsidised	Publicly funded for the population
UK – Northern Ireland	Partially subsidised	Partially subsidised	Partially subsidised	Publicly funded for the population
UK – Scotland	Partially subsidised	Partially subsidised	Partially subsidised	Publicly funded for the population
UK – Wales	Publicly funded for the population	Publicly funded for the population	Partially subsidised	Publicly funded for the population
US	Partially subsidised	Partially subsidised	Partially subsidised	Partially subsidised

KEY: Not publicly funded for the population; Partially subsidised (for a proportion of cost or for certain population groups); Publicly funded for the population

Source: Deloitte using various country-specific qualitative sources. The table is based on qualitative insights, given data sources to allocate funding across the patient journey were not available. Instead, this table and its analysis has been proxied through the degree to which eye health services are subsidised by the government.

There have, however, been significant advances in treatment of eye disease which have implications for the effectiveness of treatment. The role and importance of anti-VEGF treatments are described in Box 9: below:

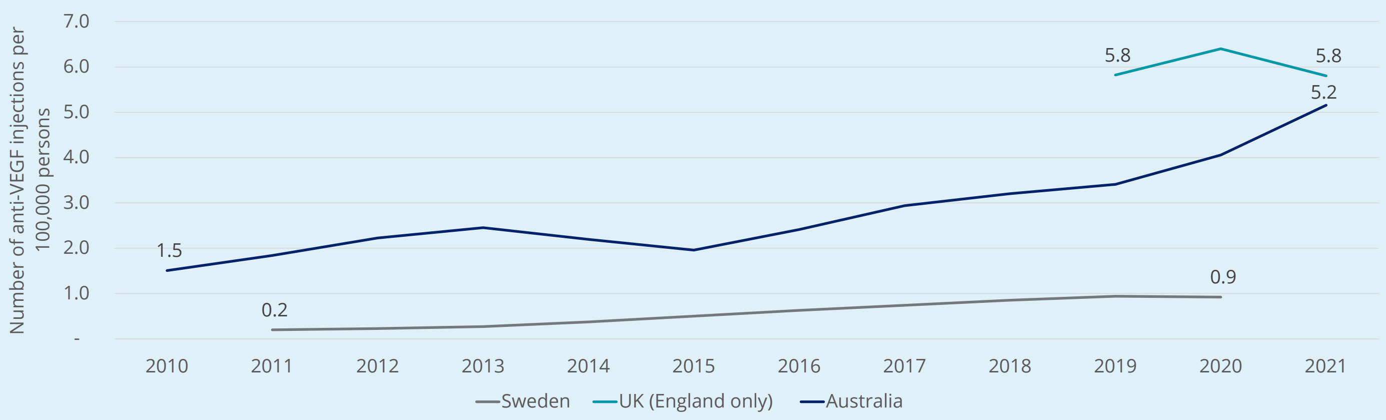
Box 9: Innovative eye health treatments: Anti-VEGF

The development of anti-VEGF injections has provided a medical option to people living with certain eye conditions to resolve retinal pathologies, that simply did not exist before. Anti-VEGF treatment slows the growth of blood vessels in the eye, and therefore reduces or stops damage from the abnormal blood vessels and slows down sight loss.[47] The use of anti-VEGF treatment has shown to reduce the prevalence of blindness caused by age-related macular degeneration and diabetic macular edema.[48] Globally, there are four anti-VEGF treatments that are available for retinal disorders including aflibercept, ranibizumab, brolucizumab and faricimab. (Note: Bevacizumab has also been used even though it has never been licensed for the treatment of retinal disorders or for intra-ocular use.).

Vascular endothelial growth factor (VEGF) is a protein that stimulates the growth of new blood vessels. Specifically in the eye, VEGF encourages the over-production of blood vessels underneath the retina, which increase the risk of blood vessels to break and leak fluid and blood into the retina.[47] As a result, this can lead to retinal damage, and loss of sight. Disorders of the blood vessels in the retina are responsible for some of the leading causes of blindness in the world including DR and AMD, amongst other retinal conditions such as retinal vein occlusions.[47]

Chart 4.14 illustrates the trend of anti-VEGF injections per 100,000 persons for Sweden, England (one of four countries which make up the UK) and Australia. The number of anti-VEGF injections per 100,000 persons was highest for England, with 5.8 injections delivered per 100,000 per person in 2021. In the UK, the rate of anti-VEGF treatment dropped from 2020, most likely due to the coronavirus pandemic which coincided with a decline in outpatient activity across England and more broadly the UK.[49] For Sweden and Australia, the past decade has seen an increase in anti-VEGF treatment use. In 2021, 5.2 anti-VEGF injections were delivered per 100,000 persons for all retinal conditions where anti-VEGF treatment could be used in Australia.[50] In 2020, 0.9 anti-VEGF injections were delivered per 100,000 persons for only AMD in Sweden.[51] As AMD is only one condition for which anti-VEGF injection is a treatment, it is likely that this is a conservative estimate of the use of anti-VEGF treatment in Sweden.

Chart 4.14: Anti-VEGF treatment use per 100,000 persons, 2010-21



Source: Medicare Statistics (2022), Sweden Macular Registry (2020), National Health Scheme England (2022).

The demand for treatment has and will continue to grow globally as most treated conditions, particularly AMD, are highly age dependent.[52] With an ageing population, the number of individuals at risk of these conditions and who may require anti-VEGF treatment is likely to increase overtime. Furthermore, within each condition, there is an increasing spectrum of indications. For example, neovascular AMD is being treated at an earlier stage in individuals with better VA than in the past and clinical trial data has shown proliferative diabetic retinopathy may be successfully delayed with anti-VEGF treatment.[53] For these reasons, the demand for sight-saving treatment will continue to rise globally.

5 Conclusion

Vision impairment is a serious and growing problem globally. As populations age, this will only become a more pressing concern. As such, there is a need for countries to address key gaps in eye health systems, and to direct targeted investment towards the following four categories:

- **Information:** Reporting of comprehensive eye health data
- **Workforce:** Supply of eye care professionals meets need
- **Leadership:** Creation of a national plan applying to eye health
- **Services:** Focus on preventative eye care

This section explores the four calls to action which have emerged under these categories. These are each linked to the recommendations in the 2019 WHO World Report on Vision (WRoV), UN Resolution on Eye Care, and the WHO Report of the 2030 targets, which sets out proposals to address challenges in eye care.[6,54,8]

5.1.1 Calls to action

Four priority calls to action have emerged from this research, informed by analysis of the ten countries examined in this review. In order to achieve the UN and WHO goals of delivering eye care for the 1.1 billion people living with preventable sight loss by 2030,[54] targeted investment is required in these four key areas:

Information

Action: Funding to improve national data collection around eye health prevalence, drivers, outputs and outcomes will support policymakers to understand eye health need and inform policy decisions.

Gap: Most countries do not collect comprehensive eye health data. See section 4.4.1 for more detail.

WHO WRoV category: *Recommendation 1-1: Collecting and reporting information on the met and unmet eye care needs of the national population.*

Description of this call to action:

As described in Section 4.4.1, among the ten countries reviewed just six publicly reported national and government-sourced eye disease prevalence data, and only five reported publicly reported national and government-sourced eye health expenditure data.

With investment into improved data collection around eye disease prevalence, policymakers can understand the magnitude of eye health need, understand the drivers of sight loss, and gauge the level of investment required into the eye health system.

With data measuring the level of expenditure being directed towards eye health, policymakers can ensure funding decisions are appropriate, understand magnitude of eye health need and how this has evolved over time, and inform strategic policy decisions such as the formulation of national plans to tackle specific eye diseases.

Data on eye care outputs and outcomes, such as cataract surgery wait times, effective cataract surgery and refractive error coverage, and post-operative visual acuity outcomes, allow monitoring of eye care delivery efficiencies and performance improvements.

Cases of excellence:

Australia collects detailed and comprehensive data on eye health prevalence, which plays a key role in understanding need.

Nepal conducts semi-regular surveys of eye health system outputs to inform planning.

Leadership

Action: Funding to develop a strategic eye health plan will help to elevate the vision, policy directions and strategies around eye health and bring together key actors.

Gap: Most countries do not have a national plan which covers eye health. See Section 4.4.2 for more detail.
WHO WRoV category: *Recommendation 2-1: Integrating eye care into national health strategic plans.*

Description of this call to action:

As described in the section 'Leadership', just two countries examined have both national planning around eye health and an identified priority eye condition, and four more countries have either national planning or an eye health condition of priority. Planning and prioritisation is crucial in eye health care, given the important role of detection and prevention in reducing the severity of eye disease.

Specific investment into the development of an eye health plan or strategy provides benefits to countries across the spectrum of eye health system maturity. For countries where the eye health system is dominated by non-government actors, national-level planning is key to coordinating these services and ensuring there is no inefficiency and duplication. For countries with government-centric eye health systems, planning is crucial to guarantee that the particular complexities of eye health are addressed and not confounded with other elements of the health system.

Further, any such strategy must be contextualised and linked to strategic planning around diabetes, ageing population and non-communicable disease, given the importance of coordination around these drivers of sight loss.

Cases of excellence:

- **India** has created a system that leverages NGO resources and roles in eye care delivery.
- **Italy's** national plan for eye health mobilises and unites elements of the eye health system.
- **Australia** has identified AMD as a priority condition, and has consequently tripled funding for this condition, through the creation of a national strategy to meet the needs of its ageing population.

Workforce

Action: Dedicated programs to develop and train a larger and more equitably-distributed eye health workforce will open access for all and prevent unmet need.

Gap: Many countries have significant eye health workforce shortages. See section 4.4.3 for more detail.
WHO WRoV category: *Recommendation 2-6: Ensuring that eye care workforce planning is an integral part of health workforce planning.*

Description of this call to action:

As described in Section 4.4.3, seven of the nine countries examined had shortages in some part of the eye health workforce. The presence of workforce shortages across most countries examined, both of middle and high income, demonstrates the magnitude of the issue.

Investment into programs to ensure adequate supply and distribution of the eye care workforce is crucial in meeting eye health need and ensuring equitable access to services. This enables access for populations like those living in regional and remote areas and can lead to reduced wait times and increased preventative care.

Cases of excellence:

- **India** upskills and trains rural medical practitioners and local voluntary assistants to carry out preliminary eye tests.
- **Nepal** trains and utilises ophthalmic assistants as mid-level ophthalmic professional to perform primary eye care services.

Services

Action: Investment in preventative and early intervention eye care services will promote better eye health outcomes and reduce system costs.

Gap: Many countries have too little focus on preventative eye care. See Section 4.4.4 for more detail.
WHO WRoV category: *Recommendation 2-4: Managing and delivering eye care services so that people receive a continuum of interventions addressing promotion, prevention, treatment, and rehabilitation across service delivery levels and sites.*

Description of this call to action:

As described in Section 4.4.4, the areas of eye health care which are publicly subsidised, or around which eye health programs are focused, provide an indication of both the accessibility and focus of eye health care within countries. Intervention at the right point in the individual's journey is particularly crucial in the eye health context, given sight loss is difficult to reverse, and early detection and intervention can significantly improve outcomes.

The most subsidised area of eye health care across the nine countries examined is eye surgeries, and the least subsidised are corrective lenses and eye screening services. This suggests that government spending on eye health seems to be concentrated on the later stages of the care pathway, such as treatment, as compared to the earlier stages of vision care, such as prevention and screening. This could mean there are missed opportunities across these countries to invest more significantly in early intervention and detection from eye screening, or to provide low-cost interventions like corrective lenses, with relatively higher-cost interventions such as treatments being more subsidised.

Cases of excellence:

Italy provides free mobile eye screening for those aged 40+ in town squares, increasing awareness of eye health and boosting early intervention.

Sweden implements a subsidy for spectacles for those aged 8-19 years to address equity.

The UK has several effective national population screening programmes including one for Diabetic Eye Screening and Pre-school Children Eye Screening, to prevent sight loss through early detection.

Appendix A: Detailed methodology

A.1. Analytical framework

The analytical framework used in the initial data scan stage is presented in Table A.1.

A.1.1. Initial data scan

Table A.1: Analytical framework used in the initial data scan stage

Domain	No.	Indicator	Purpose of indicator
Investment	1.1	Total health expenditure (% of GDP)	Investment in eye health prevention, detection and management
	1.2	Proportion of total health expenditure spent on eye care, disaggregated by preventative vs management/treatment of condition	Investment in eye health prevention, detection and management
	1.3	Total number of eye care workers disaggregated by three main professions: a) Ophthalmologists; b) Optometrists; and c) Allied Ophthalmic	Eye care workforce density and distribution
	1.4	Total number of eye care workers disaggregated by geography (e.g., urban vs non-urban) and sector (public vs. private)	Eye care workforce density and distribution
	1.5	Inclusion of eye care in national health strategy health plan (inc. legislation, policies, regulation, services coordination, and financing)	Systems
	1.6	Existence of a national health information system database which collects eye care service utilisation data	Systems
Output	2.1	Availability and implementation of routine eye screening services across the country, targeting the detection of eye diseases for the general population	Availability of eye health services
	2.2	Availability and implementation of a pre-school eye care programme across the national territory, targeting comprehensive eye examination for children aged 3–5 years	Availability of eye health services
	2.3	Availability and implementation of national diabetes eye check programme which provides eye checks for people who are at risk of or have diabetes	Availability of eye health services
	2.4	Average eye-care related expenditure as a per cent of total median household income	Affordability of eye health services
	2.5	Average waiting time and range (in days) to receive cataract surgery, from the day the individual is first registered for surgery to the surgery itself.	Wait times for services
	2.6	Rate of cataract surgery	Wait times for services
	2.7	Anti-VEGF drug usage as a proxy for intravitreal injection procedures	Availability of eye health services
Outcome	3.1	Percentage of people undertaking a comprehensive eye examination at the recommended interval (as defined in nationally adopted guidelines)	Service utilisation
	3.2	Cataract surgical outcome (visual acuity, or VA): 3.2.1 Number of cataract operated eyes with a "good" outcome (PVA 6/12 or better) post cataract surgery 3.2.2 Number of cataract operated eyes with a "suboptimal" outcome (PVA worse than 6/12, and equal to or better than 6/60) post cataract surgery	Quality of services

Domain	No.	Indicator	Purpose of indicator
		3.2.3 Number of cataract operated eyes with a "poor" outcome (PVA worse than 6/60) post cataract surgery	
Impact	4.1	Estimated number of individuals (% of population) with: 4.1.1 Mild vision impairment: distance PVA worse than 6/12, but equal to or better than 6/18. 4.1.2 Moderate vision impairment: distance PVA worse than 6/18, but equal to or better than 6/60. 4.1.3 Severe vision impairment: distance PVA worse than 6/60 but equal to or better than 3/60. 4.1.4 Blindness: distance PVA worse than 3/60	Prevalence of vision impairment and blindness
	4.2	Estimated number of individuals (% of population) with: 4.2.1 Uncorrected refraction error 4.2.2 Cataract 4.2.3 Glaucoma 4.2.4 Age-related macular degeneration 4.2.5 Diabetic retinopathy	Prevalence of specific eye disease

Source: Deloitte.

A.1.2. Initial list of countries explored

An initial data scan using the analytical framework was undertaken for 17 countries which were deemed to be countries of interest due to their healthcare system, eye health system and approach to eye care service delivery. These 17 countries span all regions of the world, including:

- Regions of the Americas: Brazil, Canada, US
- European Region: Italy, Poland, Sweden, UK
- Eastern Mediterranean Region: Saudi Arabia, UAE
- South-East Asia Region: India, Nepal, Thailand
- Western Pacific Region: Australia, Cambodia, Japan, Singapore
- African Region: Rwanda, South Africa.

A.1.3. Literature search strategy

Table A.2 provides the search terms used in the literature search strategy. The set search terms were used to ensure consistency in the literature search across each country. For countries where English is not the primary language, Google Translate was used to find the equivalent term used in that native language.

Table A.2: Search strategy

Domain	No.	Indicator	Search terms
Investment	1.1	Total health expenditure (% of GDP)	• Health / healthcare / health system) (expenditure / spending / costs • Gross Domestic Product / GDP
	1.2	Proportion of total health expenditure spent on eye care, disaggregated by preventative vs management/treatment of condition	• Eye care / eye health / vision expenditure • Management / treatment
	1.3	Total number of eye care workers disaggregated by three main professions: a) Ophthalmologists; b) Optometrists; and c) Allied Ophthalmic per 1,000 residents and trends over time	• Eye care / eye health / vision • Expenditure / spending • In-patient / out-patient / optometry / ophthalmology / opticians / eyewear / pharmaceuticals

Domain	No.	Indicator	Search terms
	1.4	Total number of eye care workers disaggregated by geographic (e.g., urban vs non-urban) and sector (public vs. private)	• Eye care / eye health/vision • Workforce / labor force / employees / workers
	1.5	Inclusion of eye care in national health strategy health plan (inc. legislation, policies, regulation, services coordination, and financing)	• Ophthalmologist, Optometrists, Allied Ophthalmic • Workforce / labor force / employees / workers
	1.6	Number of eye health clinics, eye hospitals, specialist clinics (noting the definition varies based on health system)	• Eye care / eye health / vision • Workforce / labor force / employees / workers • Urban, regional, remote, provincial, local, public, private
	1.7	Presence of a national eye hospital/facility	• Eye care / eye health / vision • National strategy, plan, legislation, policy, regulation, service coordination, financing, priority
	1.8	Proportion of total research funding allocated to eye research	• National research funding / grant / financing
Output	2.1	Availability and implementation of routine eye screening services across the country, targeting the detection of eye diseases for the general population	• Routine, regular • Eye screening, vision screening, detection
	2.2	Availability and implementation of a pre-school eye care programme across the national territory, targeting comprehensive eye examination for children aged 3–5 years	• Pre-school, early years, child, children, 3-4 years) • Vision screening, detection
	2.3	Availability and implementation of national diabetes eye check programme which provides eye checks for people who are at risk of or have diabetes	• Diabetes, diabetic • Eye screening, vision screening, detection
	2.4	Average eye-care related expenditure as a per cent of total median household income	• Eye care / eye health / vision • Expenditure / spending / costs • Per person • Median household income
	2.5	Average waiting time and range (in days) to receive cataract surgery, from the day the individual is first registered for surgery to the surgery itself.	• Health / healthcare / health system • Expenditure / spending / cost • Private sector, public sector, private health insurers, out-of-pocket
	2.6	Rate of cataract surgery	• Wait time, delay, days • Cataract surgery
	2.7	Anti-VEGF drug usage as a proxy for intravitreal injection procedures	• Anti-VEGF • Anti–vascular endothelial growth factor therapy / treatment • Intravitreal treatment • Aflibercept, ranibizumab, brolucizumab, faricimab
Outcome	3.1	Percentage of people undertaking a comprehensive eye examination at the interval recommended and defined in nationally adopted guidelines	• Recommended, comprehensive • Eye examination at recommended • Interval, regularity

Domain	No.	Indicator	Search terms
	3.2	Cataract surgical outcome (VA): 3.2.1 Number of cataract operated eyes with a '"good" outcome (PVA 6/12 or better) post cataract surgery 3.2.2 Number of cataract operated eyes with a "suboptimal" outcome (PVA worse than 6/12, and equal to or better than 6/60) post cataract surgery 3.2.3 Number of cataract operated eyes with a "poor" outcome (PVA worse than 6/60) post cataract surgery	• Cataract surgical outcome • good, PVA more than 6/12 • suboptimal, PVA less than 6/12 • poor, PVA worse than 6/60
Impact	4.1	Estimated number of individuals (% of population) with: 4.1.1 Mild vision impairment: distance PVA worse than 6/12, but equal to or better than 6/18. 4.1.2 Moderate vision impairment: distance PVA worse than 6/18, but equal to or better than 6/60. 4.1.3 Severe vision impairment: distance PVA worse than 6/60 but equal to or better than 3/60. 4.1.4 Blindness: distance PVA worse than 3/60	• Prevalence, population, share, proportion, epidemiology • Mild vision impairment, distance PVA worse than 6/12, but equal to or better than 6/18 • Moderate vision impairment, distance PVA worse than 6/18, but equal to or better than 6/60 • Severe vision impairment, distance PVA worse than 6/60 but equal to or better than 3/60 • Blindness, distance PVA worse than 3/60
	4.2	Estimated number of individuals (% of population) with: 4.2.1 Uncorrected refraction error 4.2.2 Cataract 4.2.3 Glaucoma 4.2.4 Age-related macular degeneration 4.2.5 Diabetic retinopathy	• Prevalence, population, share, proportion, epidemiology • Causes / Impact / Association • Uncorrected refraction error • Cataract • Age-related macular degeneration/ AMD / wet-AMD / dry- AMD • Diabetic retinopathy • Other causes (inc. trachoma, ocular trauma, cerebral vision impairment and other/unknown)

Source: Deloitte.

A.1.4. In-depth review

Additional indicators were included in the analytical framework for the in-depth review. The updated indicators are highlighted in Table A.3.

Table A.3: Analytical framework used in the in-depth review

Domain	No.	Indicator	Purpose of indicator
Investment	1.1	Total health expenditure (% of GDP)	Investment in eye health prevention, detection and management
	1.2	Proportion of total health expenditure spent on eye care, disaggregated by preventative vs management/treatment of condition	Investment in eye health prevention, detection and management
	1.3	Total number of eye care workers disaggregated by three main professions: a) Ophthalmologists; b) Optometrists; and c) Allied Ophthalmic per 1,000 residents and trends over time	Informal proxy for eye health expenditure
	1.4	Total number of eye care workers disaggregated by geographic (e.g., urban vs non-urban) and sector (public vs. private)	Eye care workforce density and distribution
	1.5	Inclusion of eye care in national health strategy health plan (inc. legislation, policies, regulation, services coordination, and financing)	Systems

Domain	No.	Indicator	Purpose of indicator
	1.6	Number of eye health clinics, eye hospitals, specialist clinics (noting the definition varies based on health system)	Informal proxy for eye health expenditure
	1.7	Presence of a national eye hospital/facility	Investment in eye health prevention, detection and management
	1.8	Proportion of total research funding allocated to eye research	Informal proxy for eye health expenditure
Output	2.1	Availability and implementation of routine eye screening services across the country, targeting the detection of eye diseases for the general population	Availability of eye health services
	2.2	Availability and implementation of a pre-school eye care programme across the national territory, targeting comprehensive eye examination for children aged 3–5 years	Availability of eye health services
	2.3	Availability and implementation of national diabetes eye check programme which provides eye checks for people who are at risk of or have diabetes	Availability of eye health services
	2.4	Average eye-care related expenditure as a per cent of total median household income	Affordability of eye health services
	2.5	Average waiting time and range (in days) to receive cataract surgery, from the day the individual is first registered for surgery to the surgery itself.	Wait time for services
	2.6	Rate of cataract surgery	Informal proxy for eye health expenditure
	2.7	Anti-VEGF drug usage as a proxy for intravitreal injection procedures	Informal proxy for eye health expenditure
Outcome	3.1	Percentage of people undertaking a comprehensive eye examination at the interval recommended and defined in nationally adopted guidelines	Service utilisation
	3.2	Cataract surgical outcome (VA): 3.2.1 Number of cataract operated eyes with a "'good" outcome (PVA 6/12 or better) post cataract surgery 3.2.2 Number of cataract operated eyes with a "suboptimal" outcome (PVA worse than 6/12, and equal to or better than 6/60) post cataract surgery 3.2.3 Number of cataract operated eyes with a "poor" outcome (PVA worse than 6/60) post cataract surgery	Quality of services
Impact	4.1	Estimate number of individuals (% of population) with: 4.1.1 Mild vision impairment: distance PVA worse than 6/12, but equal to or better than 6/18. 4.1.2 Moderate vision impairment: distance PVA worse than 6/18, but equal to or better than 6/60. 4.1.3 Severe vision impairment: distance PVA worse than 6/60 but equal to or better than 3/60. 4.1.4 Blindness: distance PVA worse than 3/60	Prevalence of vision impairment and blindness
	4.2	Estimate number of individuals (% of population) with: 4.2.1 Uncorrected refraction error 4.2.2 Cataract 4.2.3 Glaucoma 4.2.4 Age-related macular degeneration 4.2.5 Diabetic retinopathy	Prevalence of specific eye disease

Source: Deloitte.

A.2. Data scan heat maps

The heat map for initial findings on data scan is represented in Table A.4.

Table A.4: Heat map for initial findings on data scan, 30 June 2022

Country	Investment metrics			Output metrics				Outcome metrics		
	Investment in eye health	Workforce	Systems	Availability of services	Affordability of services	Wait times	Service utilisation	Quality of services	Prevalence of sight loss	Prevalence of specific eye diseases
Canada	Some data	Some data	Full data	Some data	Some data	Full data	Some data	Some data	Full data	Some data
US	Likely no data	Full data	Full data	Full data	Likely no data	Likely no data	Some data	Likely no data	Full data	Full data
Italy	Likely no data	Some data	Full data	Some data	Likely no data	Full data	Likely no data	Likely no data	Full data	Likely no data
Sweden	Some data	Some data	Likely no data	Full data	Likely no data	Full data	Likely no data	Likely no data	Full data	Some data
UK	Likely no data	Some data	Full data	Full data	Some data	Full data	Likely no data	Likely no data	Full data	Some data
India	Likely no data	Some data	Full data	Some data	Likely no data	Likely no data	Likely no data	Full data	Full data	Some data
Australia	Full data	Full data	Full data	Full data	Some data	Full data	Some data	Full data	Full data	Full data
Japan	Some data	Some data	Likely no data	Some data	Likely no data	Likely no data	Likely no data	Likely no data	Full data	Some data
Singapore	Likely no data	Some data	Some data	Full data	Likely no data	Likely no data	Likely no data	Some data	Full data	Some data
Nepal	Some data	Likely no data	Full data	Likely no data	Likely no data	Likely no data	Likely no data	Some data	Full data	Likely no data

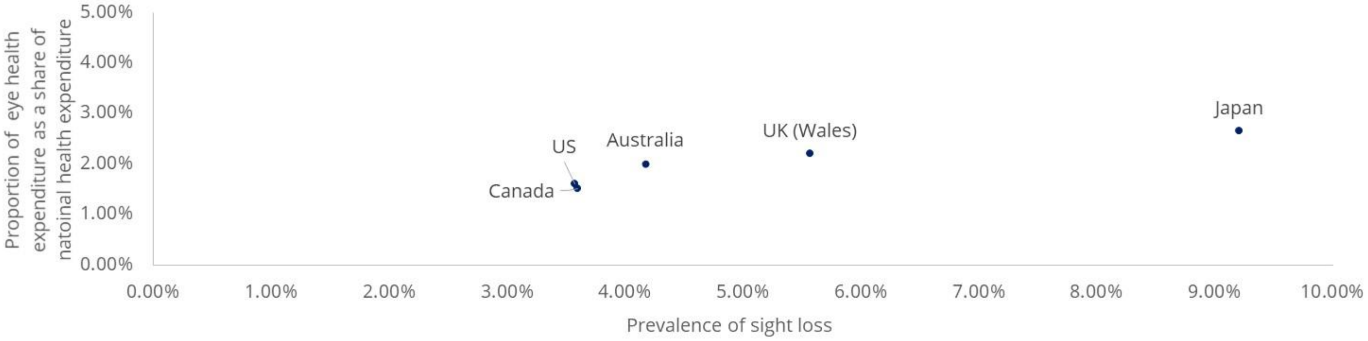
KEY: Full data Some data Likely no data

Source: Deloitte.

Appendix B: Prevalence estimates

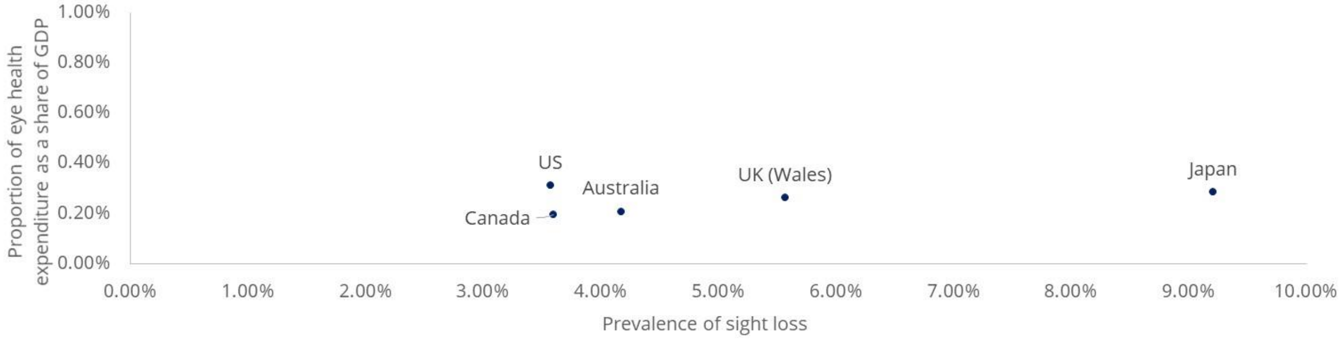
The relationship between eye health expenditure and vision outcomes is complex, and has many influencing factors. As can be seen in Chart B.1, **as prevalence of sight loss (which includes MSVI and blindness) increases, so does the share of health expenditure allocated to eye health**. When prevalence is compared to eye health expenditure as a share of GDP (as shown in Chart B.2), the relationship follows a similar trend. However, the US is revealed as an outlier. This may be driven driven by its comparatively higher health expenditure as a proportion of GDP. The difference in these two measures is that the first expresses the size of the eye health system relative to other elements of the broader health system, and the second expresses the size of the eye health system without the context of the size of the broader health system.

Chart B.1: Eye health expenditure as a share of total health expenditure and prevalence of sight loss (moderate to severe vision impairment and blindness)



Source: Deloitte using various country-specific qualitative sources. Note: crude prevalence rate. Vision loss includes both MSVI and blindness. This chart includes the prevalence of MSVI and blindness (MSVI: VA <6/18 but >3/60; Blindness VA<3/60)

Chart B.2: Eye health expenditure as a share of GDP and prevalence of sight loss (moderate to severe vision impairment and blindness)[55]



Source: Deloitte using various country-specific qualitative sources. Note: crude prevalence rate.

Country-specific data reports

Appendix C: Country data report: Australia

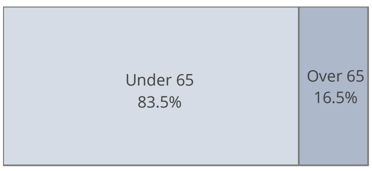
Australia – Country Fast Facts

Data availability: **Excellent**

Data quality: **Excellent**

National profile

Population age profile



Prevalence of vision loss

3% of the Australian population have vision loss or blindness

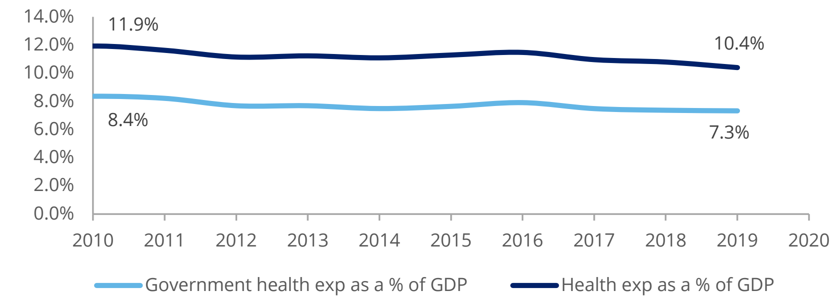
The total number in persons:

849k

Source: GBD (2020)

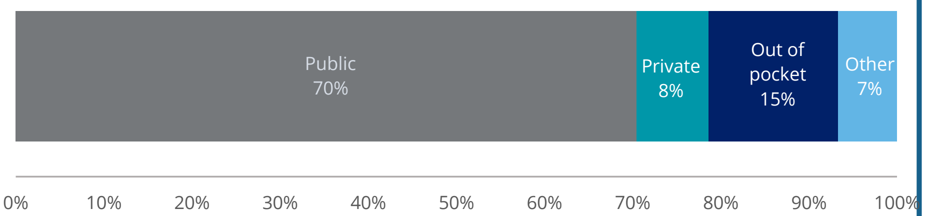
Health system at a glance

- Australia has a universal public health insurance system (Medicare), with free public hospital care among other services. This is financed through general tax revenue and a government levy.
- Total health expenditure as a percent of GDP was 10.4% in 2019-20. This is a decrease from 11.9% in 2010.



Source: World Bank Data

- In Australia in 2019-20, 70% of health expenditure was government funded. Private health insurance and out of pocket payments accounted for 23% of health spending.



Source: Australian Institute of Health and Welfare (2021). Note, other includes other non-government sources.

It is estimated there are approximately 8.5 million people over the age of 50 years at risk of macular disease and over 1.7 million Australians have some evidence of macular disease. Australia is a world leader in fighting macular disease.

Source: Australian Institute of Health and Welfare (2021)

KEY FINDINGS

For Australia

1	Over the past five years, total eye health expenditure has increased in Australia from 2.4% in 2016 to **2.5% of total health expenditure in 2019.** This driven by a broader prioritisation of diseases relating to the **ageing population**. There has been particular focus on **AMD** by the Australian government. Expenditure on AMD has doubled over this period.
2	There is a **high-quality and mature eye health system** in Australia. Most prominently, fully subsidised eye screening is available for all Australian residents. However, the **pre-school screening system is not national**, and is not present in two of Australia's eight states and territories.
3	Australia has a **shortage of ophthalmologists** and a **geographic maldistribution of the eye health workforce** more generally. This leads to gaps in eye care, particularly in **regional and remote areas**, and may contribute to the length of cataract surgical wait times and timely access to care.
4	Rates of **intraocular injections** in the population aged 65+ have grown by 40% from 2014-15 to 2018-19. The number of a subset of intraocular injections - **anti-VEGF injections -** has more than doubled, with 180% growth over the past decade.
5	Overall age-standardised prevalence rates across vision impairment and blindness have decreased **by 0.04% since 2010**. However, non-age-standardised rates of eye disease have remained stable or increased slightly, likely because of the ageing of the population.

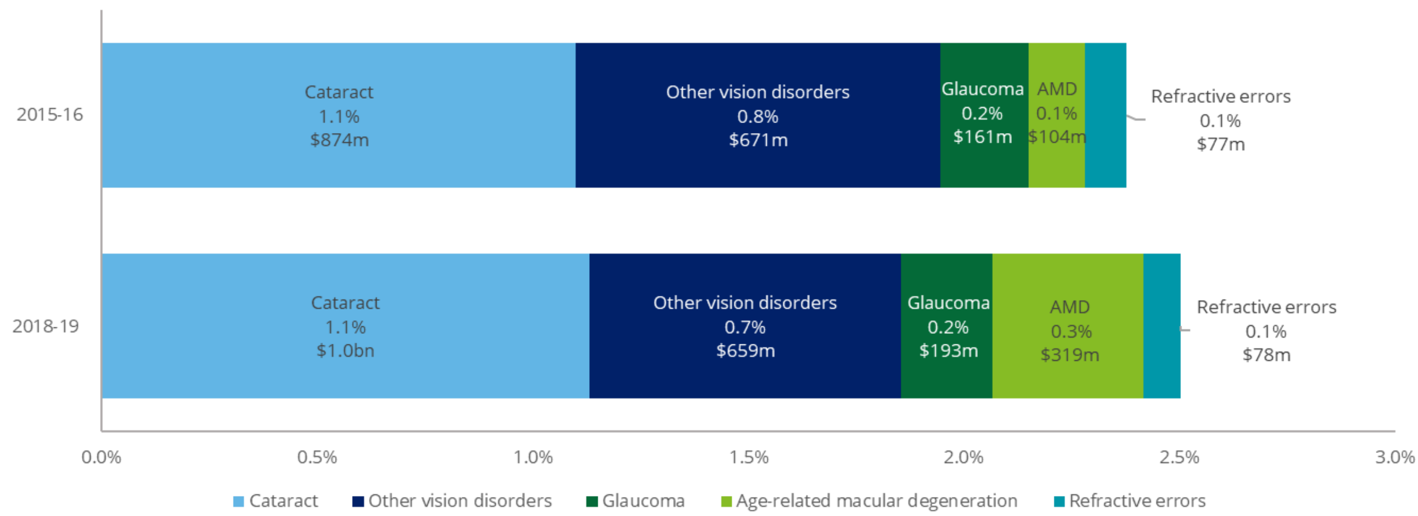
C.1. Eye health investment findings

Australia - Eye health investment key findings	
Number	**Key findings**
KF1	Since 2015, **Australian eye health expenditure has increased,** both as a share of total health expenditure and in level terms. Eye health accounted for 2.5% of total health expenditure, or US$2.28bn. This expenditure is concentrated in older populations, with 85.6% eye health expenditure directed towards those aged above 50. The increase in expenditure is largely driven by a **tripling of expenditure on age-related macular degeneration (AMD)**, as well as higher spending on glaucoma and cataract. This reflects the needs of Australia's ageing population.[31]
KF2	Australia has an identified **shortage of ophthalmologists, with just 3.8 per 100,000 persons.** The broader eye health workforce is **poorly distributed**, which has led to gaps in care for those in **regional and remote areas.**
KF3	Eye care is the focus of investment in Australia because it is **associated with the ageing population.** However, it is not among the most highly prioritised disease groups. Within the eye health space, there is a particular **priority placed on AMD, which is an age-dependent eye condition.**

C.1.1. Eye health expenditure

- **Australian eye health expenditure has increased**, both as a share of total health expenditure and in level terms. In 2019, it accounted for 2.5% of total health expenditure, US$2.28bn, or 0.148% of Australia's GDP. The vast majority (85.6%) of eye health expenditure is on the population over the age of 50, and the increase in expenditure is largely driven by a **tripling of expenditure on AMD**, as well as increases in spending on glaucoma and cataract. This reflects the needs of Australia's ageing population (Chart C.1).[31]
- Eye health expenditure as a share of total health expenditure has slightly increased from 2.4% in 2016 to 2.5% in 2019. In level terms, this is equivalent to an increase in eye health expenditure from US$1.89bn in 2015-16 to US$2.28bn in 2018-19.[31]
- This represents 20.5% growth in the value of eye health expenditure. When disaggregated by major eye health disease, this has been driven by a tripling of expenditure on AMD, an almost 20% increase in spending on glaucoma, and approximately 18% higher expenditure on cataract (see Table C.1).[31]

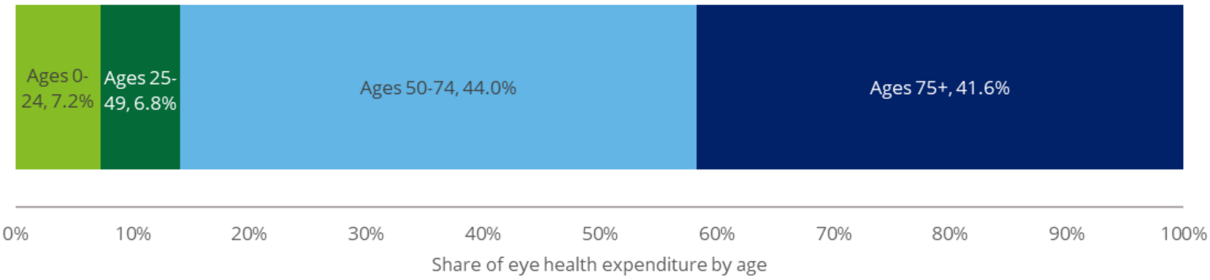
Chart C.1: Change in eye health expenditure as a % of total health expenditure and value (US$), disaggregated by expenditure by condition



Source: Australian Institute of Health and Welfare (2021).

- The overrepresentation of older Australians in eye health expenditure can be seen in Chart C.2, where 85.6% of total eye health expenditure is directed towards those aged 50 and above, despite this group representing just 34.6% of the total Australian population.[31]

Chart C.2: Share of total eye health expenditure by age group.



Source: Australian Institute of Health and Welfare (2021).

C.1.2. Affordability of eye health services

- In Australia, there are both private and public hospital systems. All Australians under the Medicare system have access to free treatment at public hospitals. Those with private health insurance can make a choice between private and public hospital systems.[55]
- In Australia, 60% of eye health expenditure occurs outside of public settings. This means that the key payers are consumers (out-of-pocket payments) and private health insurance. However, given that only 53% of Australians have private health insurance,[56] it is likely that the cost of eye health expenditure in private systems is split between health insurance and OOP payers. This stands in contrast to the broader Australian health system, where 70% of expenditure occurs in public settings. This could indicate issues around affordability of eye health services in Australia.
- In Australia, 39.4% of eye health care expenditure occurs in purely public systems (such as public hospitals), with the remaining 60.6% of expenditure occurring in systems which draw on a mix of private health insurance, OOP expenditure and some public payments. The largest single area of expenditure on eye health (39.8% of total eye health expenditure) is in the private hospital system, which largely draws on private health insurance and out-of-pocket payments.[31]
- Eye screening in Australia is publicly subsidised nationally, making it an affordable element of the eye health care system for many Australians. The Medicare system subsidises eye tests provided by optometrists for all Australian citizens and permanent residents. The nature of eye tests depends on the needs of the individual but can include measures of their ability to see details up close and at a distance, testing of peripheral and colour vision and testing of muscles around the eyes.[57]

Table C.1: Summary of preventative and treatment services covered by public funding

	Australia
Eye screening services	Fully subsidised programs for eye screening.[57]
Corrective lenses (glasses and lenses)	Eyeglasses are publicly subsidised for certain underserved populations.[58]
Medication (including eye drops)	Partially subsidised through the Pharmaceutical Benefits Scheme.[59]
Intravitreal injections (e.g., Anti-VEGFs treatments)	Anti-VEGF injections are partially subsidised, with a co-payment until the safety net is reached.[60]
Eye surgeries	Fully subsidised at public hospitals. However, public hospitals generally handle less common diagnoses. Private hospital treatments also account for around 70% of eye health hospitalisations.[61]

KEY: Not publicly funded | Partially funded or publicly funded for eligible persons | Publicly funded for the whole population

Source: As listed in the table. Note: Private services are available for people who chose to use these services. These services are covered by the consumer.

C.1.3. Eye health workforce

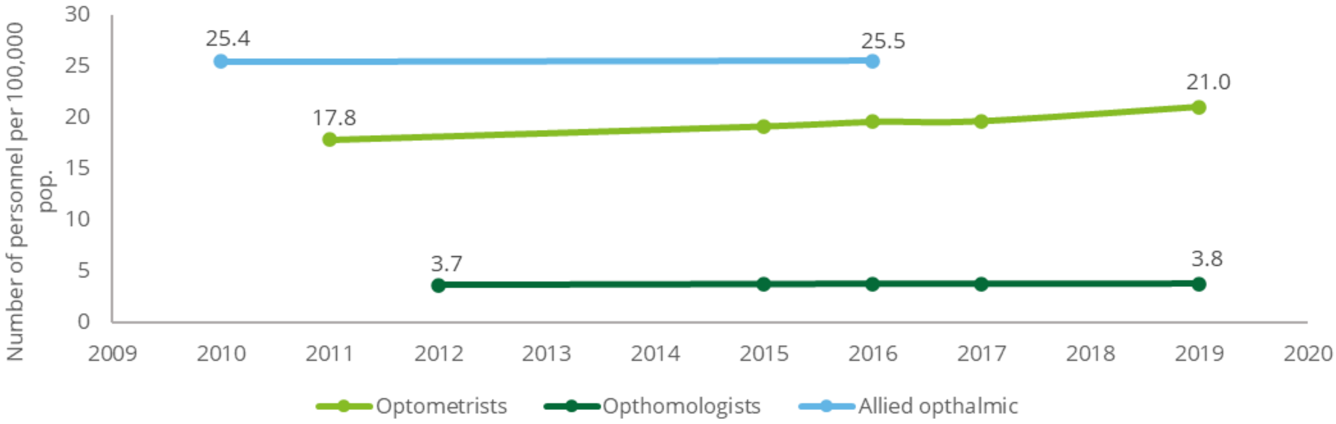
- The eye care workforce in Australia is made up of a multidisciplinary team of health professionals, including technicians, nurses, orthoptists, optometrists and ophthalmologists (Table C.2). The majority of the eye health workforce is made up of optometrists and ophthalmologists. In Australia, optometrists prescribe and fit glasses, while ophthalmologists handle the medical aspects of eye care, such as treatment, surgery and prescription of medicines.[61]
- Australia has an identified **shortage of ophthalmologists, with just 3.8 per 100,000 persons.** The broader eye health workforce is **poorly distributed**, leading to gaps in care for those in **regional and remote areas**.
- In 2018, the Department of Health identified a shortage in the eye care workforce, with projections indicating an undersupply from 2018-2030.[62] The number of ophthalmologists recorded a marginal grown in the past decade (from 3.7 per 100,000 Australians in 2012 to 3.8 in 2019).[61]
- However, the workforce size of other eye health professionals (optometrists and allied ophthalmic professionals) has recorded larger increases (Chart C.3). Between 2011-2019, the workforce density of optometrists has increased from 17.8 optometrists per 100,000 persons in 2011 to 21.0 per 100,000 persons in 2019.[61] Similarly, the number of allied ophthalmic personnel (i.e. specialist nurses, orthoptists, assistants etc) (per 100,000 persons) has also increased from 25.4 per 100,000 population in 2010 to 25.5 by 2016.[63]
- There are significant maldistribution issues with the eye health workforce. Despite 32% of Australia's population living outside of capital cities,[64] only 21% of optometrists, 15% of ophthalmologists and 23% of the allied ophthalmic workforce work outside of metropolitan areas.[61] This can lead to gaps in eye care in regional and remote areas.

Table C.2: Eye health workforce estimates in Australia

Category	Estimate	Estimate density (per 100,000)	Source
Optometrists	5324	21.0	Australian Institute of Health and Welfare (2021)[61]
Ophthalmologists	964	3.8	Australian Institute of Health and Welfare (2021)[61]

Source: As indicated in the table.

Chart C.3: Eye care personnel (per 100,000 persons), Australia, 2009-20



Source: Australian Institute of Health and Welfare (2021).

C.1.4. Eye care strategy, policy and infrastructure

- Australia's current national health strategy (*Australia's National Preventive Health Strategy 2021–2030*) outlines the long-term approach to prevention in Australia over the next decade. It describes priorities around tobacco, diet, physical activity, cancer screening, immunisation coverage, alcohol and other drug harm and mental health. Vision health is not specifically mentioned in this strategy document.[65]
- There is no current national government eye health plan or strategy which covers all eye health services for the general population. Previously, there was the 2005 National Framework for Action to Promote Eye Health and Prevent Avoidable Blindness and Vision Loss which covered a range of eye health conditions. However, this framework is no longer active.[42]
- As of 2019, Australia's National Department of Health and Aged Care has a *National Strategic Action Plan for Macular Disease*. The plan's focus on AMD reflects its status as the leading cause of severe sight loss in Australia. This identification and focus on a specific disease to drive action is seen as key to unite actors and stakeholders in the AMD space and execute the key actions.
- The plan was developed with the Macular Disease Expert Advisory Group (this group was formed by the peak body for macular disease in Australia). The advisory group consisted of peak bodies in the AMD and vision spaces, the college of ophthalmologists, the peak body for optometry and prominent clinicians and researchers in the AMD space.
- It aims to provide a framework for collaborative efforts by governments and other parts of the community, including people living with macular disease, health care professionals, non-government organisations, researchers, families, carers, communities and industry, to reduce the incidence and impact of macular disease. The plan focuses on four pillars:

  - prevention and early detection,
  - treatment,
  - support, and
  - data & research.[42]

- The plan has led to tangible investment into AMD, with the government committing AU$3 million towards improving awareness of risk factors and awareness among health professionals at the plan's release in 2019.[43]
- Australia's National Aboriginal and Torres Strait Islander Health Plan 2021-2031 highlights the importance of eye health among First Nations communities. It suggests place-based early intervention to prevent avoidable blindness through the diagnosis and management of eye conditions such as trachoma.[66]
- Australia also invests in eye health research. Australia allocates 1.67% of medical research funding to balance, eye and hearing diseases.[67]

C.2. Eye health output findings

Australia - Eye health output key findings	
Number	**Key finding**
KF4	A unique strength of Australia's eye care service delivery system is the provision of **comprehensive eye screening programs** for the general population and target populations such as those with diabetes. Despite the availability of fully subsidised eye screening, just over a third of Australians report not engaging in regular eye screening tests.
KF5	The rate for some procedures and investigations, such as **intraocular injections for those aged 65 and older, and children's vision assessments for those 3-14 years**, have seen **significant growth over the last four years**, indicating increased demand among these populations (Chart C.4).
KF6	Median wait times for cataract surgery have doubled between 2016-17 and 2020-21 to **172 days.** This is likely driven by the cancellation of elective surgeries and redeployment of medical personnel in response to the COVID-19 pandemic. The share of people waiting more than a year for cataract surgery has increased from 1.4% in 2016-17 to 14.5% in 2020-21.

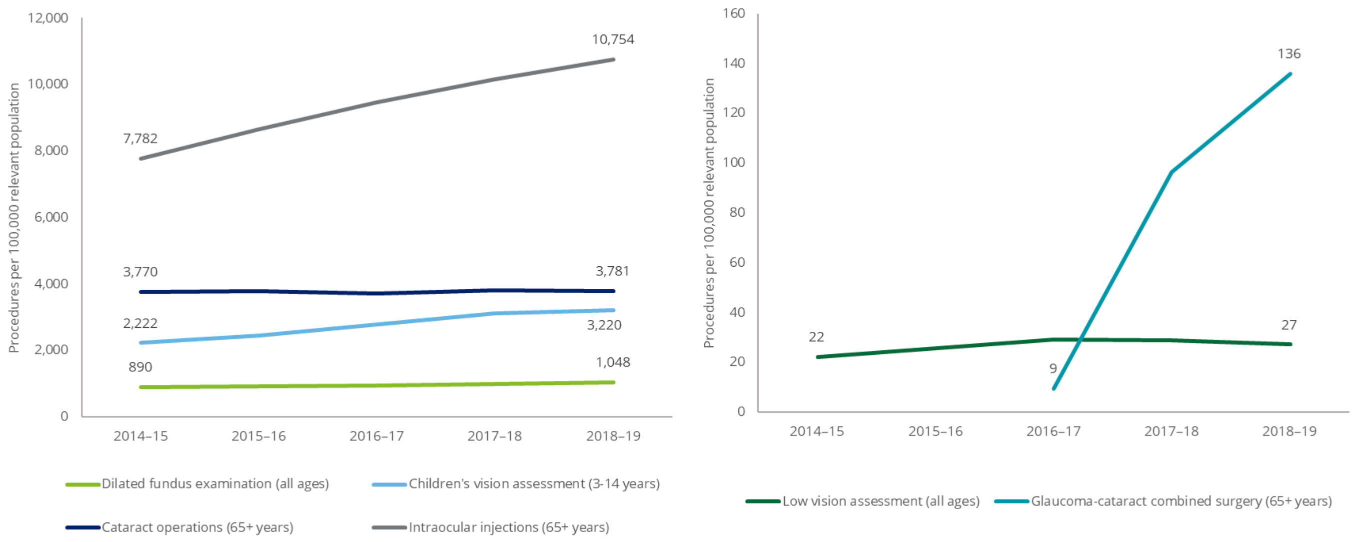
C.2.1. Availability and utilisation of eye screening services

- The Australian universal healthcare system subsidises general eye screening tests for all Medicare holders (this includes citizens, permanent residents and others).[57] Most Australian State and Territory governments have also established pre-school eye care programmes, which provide complimentary eye screening services for children who are aged between 3–5 years old (with the exception of the Northern Territory and Queensland).[68]
- A national diabetes eye check programme operates nationally and is fully subsidised. This program focuses on awareness and alerts those registered with the National Diabetes Services Scheme of the need for eye screening.[69]

C.2.2. Availability and utilisation of eye treatment services

- Data around utilisation of eye health services was not available from government sources. Grey literature indicated 35% of Australians self-reported as not having undergone regular eye examinations.[70] The recommended frequency of eye tests is around two years, however there are no specific guidelines.[71]
- Screening in Australia has seen growth over the 5 years from 2014-15 to 2018-19 - low vision assessments have grown by 23%, while vision assessments for children have increased by around 45%. While the rates of treatments such as cataract surgeries have remained relatively stable, the rate of intraocular injections has increased by 40% from 2014-15 to 2018-19 (see Chart C.4). [61]

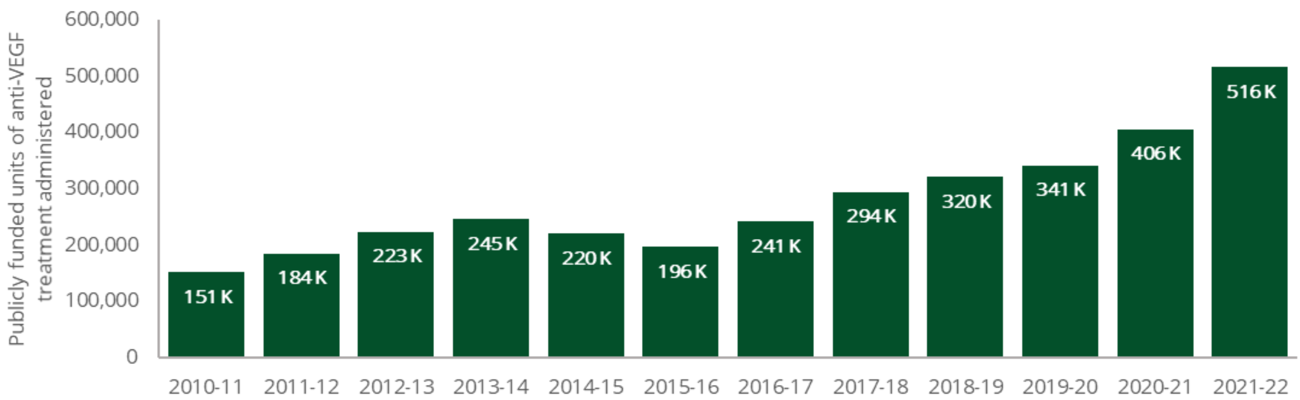
Chart C.4: Eye procedure rates for higher frequency (left hand side) and lower frequency (right hand side) procedures per hundred thousand of the relevant population



Source: Australian Institute of Health and Welfare (2021).

- There are three anti-VEGF treatments subsidised by the Pharmaceutical Benefits Scheme in Australia, Beovu® (brolucizumab), Lucentis® (ranibizumab) and EYLEA® (aflibercept).[72]
- In 2021-22, Australia publicly funded 516,751 units of anti-VEGF treatment. As seen in Chart C.5, the number of anti-VEGF treatments administered has more than doubled (180% increase) in the past decade.[50]

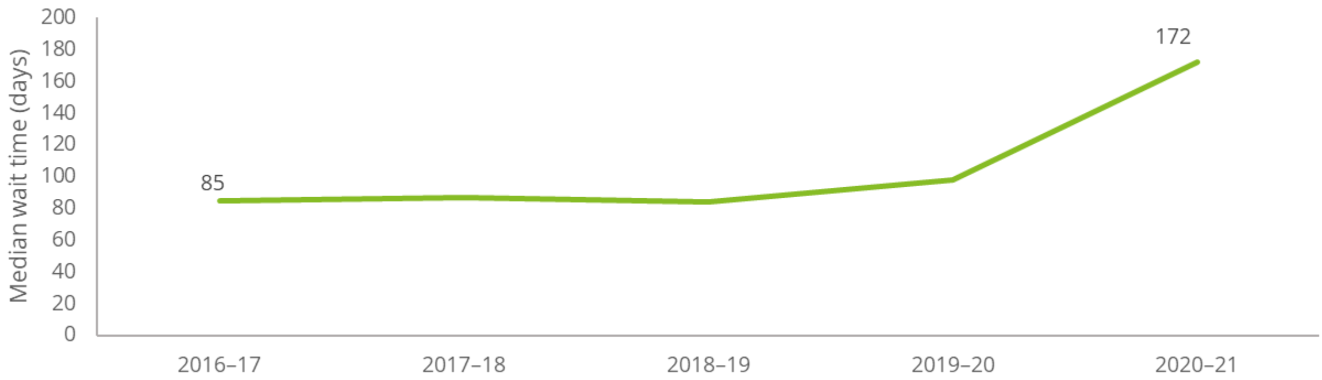
Chart C.5: Units of anti-VEGF treatment administered, Australia, 2010-11 to 2021-22



Source: Medicare Statistics (2022).

- In 2020-21, the median wait time for cataract surgery was 172 days, which is over a two-fold increase in the cataract wait time from 2016-17 (85 days), as seen in Chart C.6. This is likely driven by cancellation of elective surgeries and redeployment of medical personnel as a response to the COVID-19 pandemic. The share of people waiting more than a year for cataract surgery has increased from 1.4% in 2016-17, to 2.1% in 2018-19, before reaching 14.5% in 2020-21. Eye care surgeries more generally have followed a similar path, increasing from a median wait time of 73 days in 2016-17 to 118 days in 2020-21.[73]

Chart C.6: Median wait time for cataract surgery, Australia, 2016-17 to 2020-21



Source: Australian Institute of Health and Welfare (2021).

- Eye care aimed specifically at Australia's indigenous population represents an important area of the eye health system. Eye disease and vision impairment is the third most common long term health condition among Aboriginal and Torres Strait Islander Australians, impacting over a third of the population.[74] Programs in this area include visits by optometrists to remote areas, support for eye surgeries, the provision of equipment and specialist research.[75]

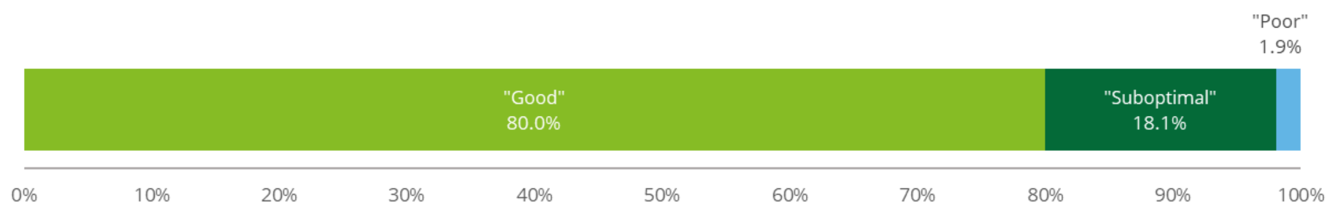
C.3. Eye health outcome findings

Australia - Eye health outcome key findings	
Number	**Key finding**
KF7	Australian cataract surgical outcomes are **"good" 80% of the time, with 20% of surgeries having "suboptimal" or "poor" outcomes.**
KF8	The prevalence of **mild and MSVI, and of blindness**, in Australia have **decreased by 0.04%** between 2010 and 2020. Further, the **prevalence of particular eye diseases has declined** since 2015. This may be due to increased health system expenditure and investment around eye health.
KF9	In 2020, **1.15%** (358,293 people) of the population had mild vision impairment, **2.02%** (630,783 people) had moderate vision impairment and **0.14%** (57,115 people) had severe vision impairment.

C.3.1. Quality of eye health services

- In 2016, results for cataract surgical outcomes (Chart C.7) indicate:
  - 80.0% of cataract surgeries were "good" (presenting VA (PVA) 6/12 or better). *Note that this is the minimum requirement to hold a driver's license in Australia.*[76]
  - 18.1% of cataract surgeries were "suboptimal" (PVA worse than 6/12, and equal to or better than 6/60)
  - 1.9% of cataract surgeries were "poor" (PVA worse than 6/60)

Chart C.7: Cataract Surgical Outcomes



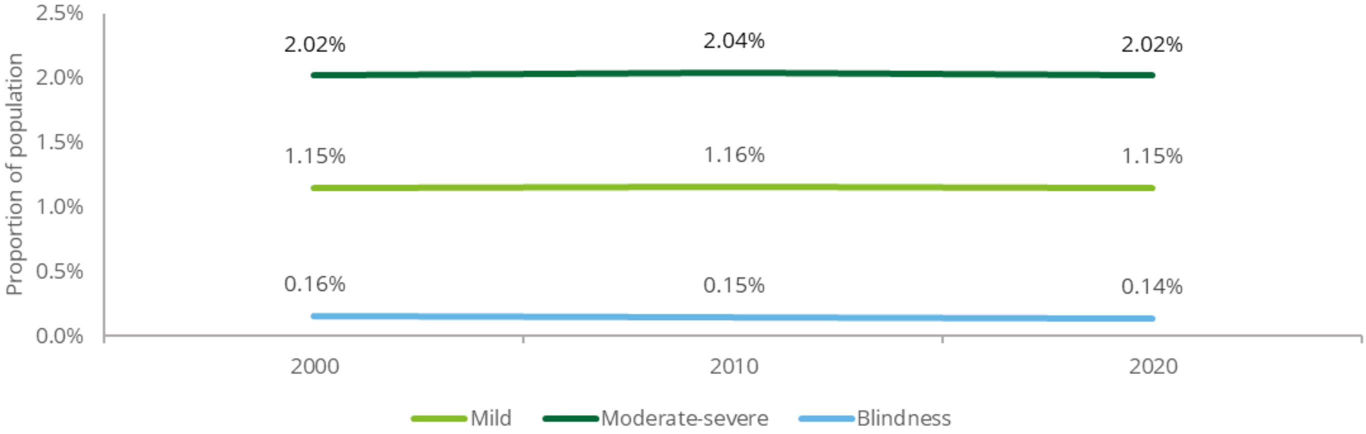
Source: Keel et al (2018).

- A 2011 Western Australian study showed a cataract surgical complication rate of less than 1.6%. This represents a decrease of almost 70% over the study period of 1980-2001. This indicates improvements in the quality of cataract surgeries performed in Australia.[77]

C.3.2. Prevalence of vision impairment and blindness

- In 2020, 1.15% (358,293 people) of the population had mild vision impairment, 2.02% (630,783 people) had moderate vision impairment and 0.14% (57,115 people) had severe vision impairment. This represents a decrease in total vision impairment since 2010 and a smaller decrease since 2000.[20] This is presented in Chart C.8.

Chart C.8: Prevalence of mild and MSVI, and blindness prevalence

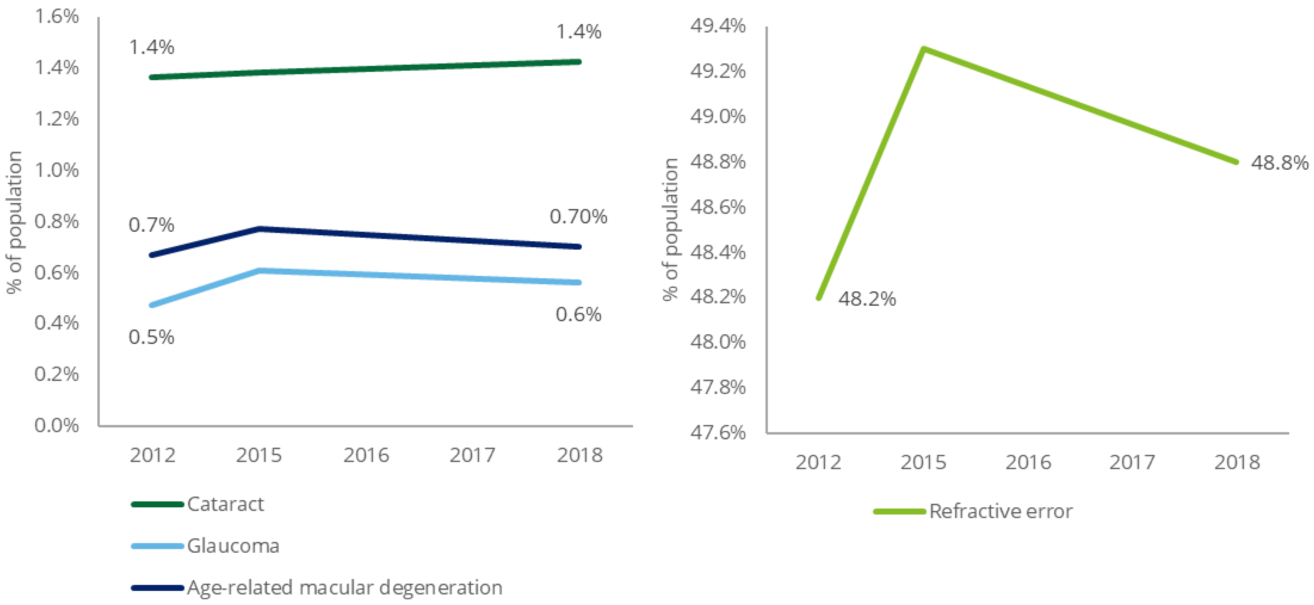


Source: Global Burden of Disease (2020).

C.3.3. Prevalence of specific eye diseases

- As shown in Chart C.9, the prevalence rates for cataract (1.4%) and AMD (0.7%) have remained relatively stable since 2012. However, the prevalence rates of refractive error (48.8%) and glaucoma (0.6%) have increased over this period.[61]

Chart C.9: Prevalence of selected eye diseases



Source: Australian Institute of Health and Welfare (2021).

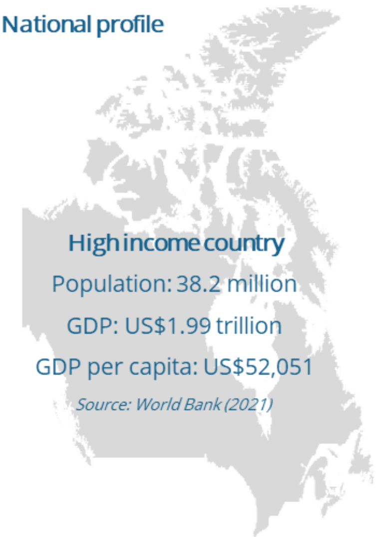
Appendix D: Country data report: Canada

Canada – Country Fast Facts

Data availability: **Good**

Data quality: **Good**

National profile



High income country

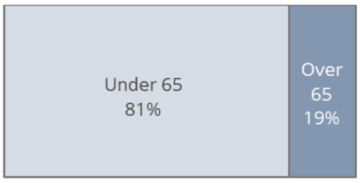
Population: 38.2 million

GDP: US$1.99 trillion

GDP per capita: US$52,051

Source: World Bank (2021)

Population age profile



Prevalence of vision loss

3% of the Canadian population have vision loss or blindness

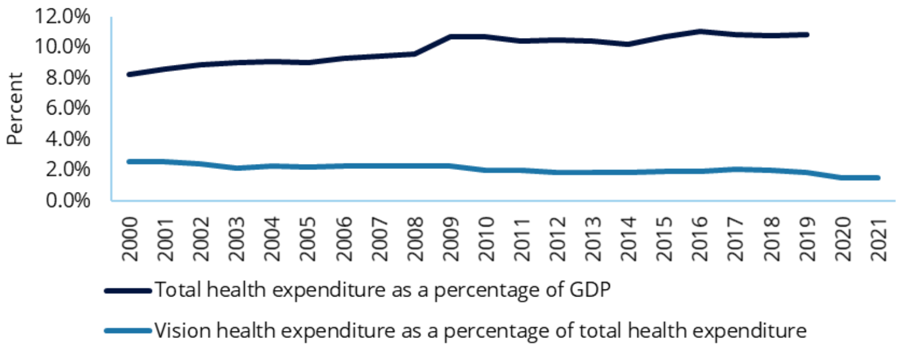
The total number in persons:

1.2m

Source: Deloitte Access Economics (2022)

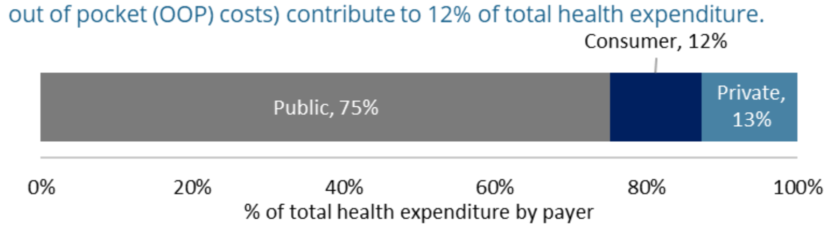
Health system at a glace

- Canada has universal health care (i.e., Medicare), however, it is delivered through 13 different provincial and territorial health care insurance plans, with disparities on eye care coverage observed.
- Canada's health expenditure as a percentage of GDP has increased over time to 12.9% in 2019. Eye health expenditure as a % of GDP has remained constant around 0.21% (not shown), resulting in a decreasing eye health expenditure as a share of total health expenditure from 2.6% in 2000 to 1.5% in 2021.



Source: Canadian Institute for Health Information (2021), World Bank (2020)

- Health expenditure in Canada is largely funded through public sources (75%) with provincial and territorial governments making up 66%. Consumers (e.g., out of pocket (OOP) costs) contribute to 12% of total health expenditure.



Source: Canadian Institute for Health Information (2022). Note: Public spending is split into provincial government (65.6%) and other governments (9.1%), private spending is split into private health insurance (10.6%) and others (2.6%)

- Treatments such as cataract surgery and anti-VEGF injections are commonly covered under Medicare for people who meet specific eligibility for these services (e.g., aged 65 and over).
- Basic eye care services such as eye examination and refractive correction are not covered by Medicare plans in most provinces, resulting in OOP expenses.

In Canada, age-related eye diseases such as cataract, age-related macular degeneration, and glaucoma are on the rise due to the ageing population. While refractive errors are common, treatment is highly accessible for Canadians.

Source: Deloitte Access Economics (2022)

KEY FINDINGS

For Canada

1	The prevalence of vision impairment and blindness in Canada has remained stable in the past three decades (1990-2020). **In 2020, approximately 3.0% of the Canadian population (3 million people) had some form of vision impairment.** The four most common eye diseases which caused **sight loss in Canada** include cataract, AMD, diabetic retinopathy, and glaucoma. All of these diseases are age-related, suggesting that the increase in prevalence is likely driven by Canada's ageing population. In particular, the prevalence of cataract has tripled in the past decade (between 2010 and 2020, the number of people living with cataract increased from 0.93 million to 3.5 million).
2	Canada spent an estimated **1.5% of total health expenditure on eye care in 2021**. Expenditure in level terms has increased C$3.9 billion (or US$2.9 billion) (2010) to C$4.8 billion (or US$3.6 billion) (2021). However, as a proportion of total health expenditure, the share of eye care experienced a decrease from 2.0% in 2010. The funding responsibilities for Canada's universal healthcare system (Medicare) are shared between federal and provincial governments. Provincial governments are responsible for the management, organisation, and delivery of health services for their residents, while the federal government is responsible for funding.
3	**Medicare is delivered through 13 provincial health insurance plans. The breadth of coverage varies across provinces.** Under Medicare, medical payments for eye injury and various eye diseases such as cataract, glaucoma and diabetic retinopathy are generally covered for residents. However, the cost of basic eye services such as eye examinations, contact lenses, and glasses is generally covered by optional or supplemental vision insurance. Of the 60% of Canadians who are covered by private health insurance through their place of employment, only 10% have health plans that include unlimited vision benefits. People who do not have private health insurance bear the full cost of basic eye services. This has resulted in a **high OOP share of eye care services**.
4	**Accessibility of eye care services in Canada varies by regions based on the distribution of the eye health workforce**. Ophthalmologists are largely concentrated in urban settings in specialist eye clinics and hospitals, however optometrists are better distributed between rural and urban areas. In remote areas, primary eye care is largely provided by GPs and nurse practitioners.
5	**There is low uptake and utilisation of certain eye care services in Canada (i.e., routine eye screening and eye health specialist visits), in large part due to the low prioritisation or awareness or education on vision health.** For example, vision screening is not included in the guidance of diabetic management, and therefore is not a step along the continuum of care. This is a concern primarily for population groups at high risk of sight loss, given that some conditions require timely access to treatment before vision is permanently lost. Evidence showed that the rate of service utilisation is low in routine eye screening (35-47% among adolescents in 2008), and the proportion of at-risk individuals accessing eye health service (14% of people living with glaucoma, 37% of people with diabetes, and 41% of people aged above 65 years in 2005). However, **the use of eye health services has increased rapidly in more recent years**. Between 2014 and 2018, the volume of ophthalmic interventions has grown by 30% (from 830,000 to 1,080,000). **The uptake of treatment for refractive error in Canada is fairly high,** resulting in low prevalence of uncorrected refractive at around 2.7% for distance visual impairment and 2.2% for near visual impairment.

D.1. Eye health investment findings

Canada - Eye health investment key findings	
Number	**Key finding**
KF1	Canada spent an estimated **1.5% of total health expenditure on eye care** in 2021. **Expenditure in level terms has increased** from C$3.9 billion (or US$2.9 billion) (2010) to C$4.8 billion (or US$3.6 billion) (2021). As a proportion of total health expenditure, the **share of eye care has decreased** from 2.0% in 2010 to 1.5% in 2021. This decrease partly reflects the nation's greater focus on other competing health areas such as opioid overdose, tobacco use, and diabetes.[78]
KF2	Canada's national healthcare plan, Medicare, is composed of **13 interlocking provincial health insurance plans** which cover a varying breadth of services across each province. In general, medical payments for **eye injury and various eye diseases** (such as cataract, glaucoma and diabetic retinopathy) are covered under Medicare. However, the cost of other **basic eye services** (such as eye examinations, contact lenses, and glasses) is only covered by optional or supplemental vision insurance.
KF3	**Eye care services have a high consumer out-of-pocket (OOP) share** compared to other health services (e.g., dental) in Canada. This is due to **gaps in provincial health plans and low reimbursement rates for eye care services** by private health insurances. Although 60% of Canadians have private health insurance (mostly as employment benefits), only 10% of private health insurance holders have plans that include unlimited eye care benefits, with 13% of plans not covering eye care services at all.
KF4	**Eye health services in Canada are delivered by optometrists (17.7 per 100,000 persons), ophthalmologists (3.35 per 100,000 persons), opticians (18.8 per 100,000 persons), General Practitioners (GPs) and nurse practitioners** (no workforce data available). Ophthalmologists are largely located in urban settings, while optometrists are more geographically dispersed. In remote areas, primary eye care is largely provided by GPs and nurse practitioners. The **poor geographical distribution of the eye health workforce** is a barrier to equitable access to eye care in remote and rural regions in Canada.
KF5	The Canadian Association of Optometrists (CAO) advocates for the **recognition of primary eye care** as a core component of health care. The Canadian Government's existing list of national health strategies and initiatives does not include a specific focus on eye care.

D.1.1. Eye health expenditure

- In 2021, Canada's **total health expenditure is approximately 12.7% of GDP**. This is an increase from 8.3% of GDP in 2000[79]. The increase was due to the increasing needs of an ageing population, and greater investment and progress in technological innovations for eye care.[80,81]
- The **Canadian Government bears approximately 75% of total health expenditure** (65.6% from the provincial and territorial governments and 9.1% from other parts of the public sector). **Consumer spending constitutes 12.1%** of total health expenditure, followed by **private health insurance (10.6%)** and non-consumption (e.g., capital, research) (2.6%). Since 2000, consumer OOP share has decreased (16.6%).[82]
- Based on the Canadian official government data, Canada spent an estimated **1.5% of total health expenditure on eye care** in 2021.[83] **Expenditure in level terms has increased** from C$3.9 billion (or US$2.9 billion) (2010) to C$4.8 billion (or US$3.6 billion) (2021). However, as a proportion of total health expenditure, eye health expenditure has progressively declined from 2.6% to 2.0% in 2000 and 2010 respectively, partly due to competing health priorities such as opioid overdose, tobacco use, and diabetes.[78]
- Of Canada's total private sector spending (C$76 billion in 2018), eye care is estimated to account for **5.9% of all private healthcare expenditure**. The per capita cost of eye care services remains relatively constant at about **C$115 per capita** (in 2018 dollars).[84] Private insurance for vision care has not kept pace with the reimbursement of other private health benefits for other services such as dental. This has led to **higher OOP costs for eye health** (this is described in further detail in Section D.1.2).

D.1.2. Affordability of eye care services

- Canada has a national healthcare system composed of **13 interlocking provincial health insurance plans**, ensuring all residents have access to hospital and physician services. The funding responsibilities for Canada's health systems are shared between federal and provincial governments. Provincial governments are responsible for the management, organisation, and delivery of health services for their residents, while the federal government is responsible for funding. Canada's national health insurance program, **Medicare, is funded publicly (i.e., general taxation) with provincial differences in its administration.**[85]
- Eye care services in Canada are funded through one of three ways: (1) Medicare / public health insurance, (2) private health insurance (often as employee benefits), and (3) consumer OOP cost. However, the differences in eye care coverage across both public / private health insurance has meant that a proportion of Canadians bear the full cost of eye care services (Table D.1).
- Under Medicare, **medical payments for eye injury and various eye diseases** such as cataract, glaucoma and diabetic retinopathy are **generally covered** for residents across Canadian provinces. However, the **cost of basic eye services** such as eye examinations, contact lenses, and glasses is generally **covered by optional or supplemental vision insurance.**[84]
- The **breadth of eye care service coverage of the public health insurance varies across provinces**. The Nova Scotia's Medicare plan uniquely covers the cost of visual analysis by optometrists (called "Optometric Benefit"). This plan applies to residents under 10 years and over 65 years of age, where one routine vision analysis is covered every 2 years. Some provinces, such as Ontario, also cover services like prescription drugs, eye exams and eyeglasses for low-income families.[86]

Table D.1: Summary of preventative and treatment services covered by public funding in Canada

	Canada
Eye screening services	Publicly funded through some government initiatives and/or Medicare health insurance plans for children, youth and people with diabetes, with provincial variations.
Corrective lenses (glasses and lenses)	Consumer OOP expenses.
Medication (including eye drops)	Publicly funded through Medicare health insurance plans (i.e., provincial drug benefit) with provincial variations on conditions. E.g., in Ontario, glaucoma medications are publicly funded for people aged above 65 only. Otherwise, it is an OOP expense.
Intravitreal injections (e.g., Anti-VEGFs treatments)	Publicly funded through Medicare health insurance plans (i.e., provincial drug benefit) with provincial variations on specific inclusion criteria (e.g., age > 65 years in Ontario for on-label therapy, maximum lifetime treatments of 15 doses in Manitoba and Newfoundland). Otherwise, it is an OOP expense.
Eye surgeries	Publicly funded through Medicare health insurance plans in all provinces and territories.

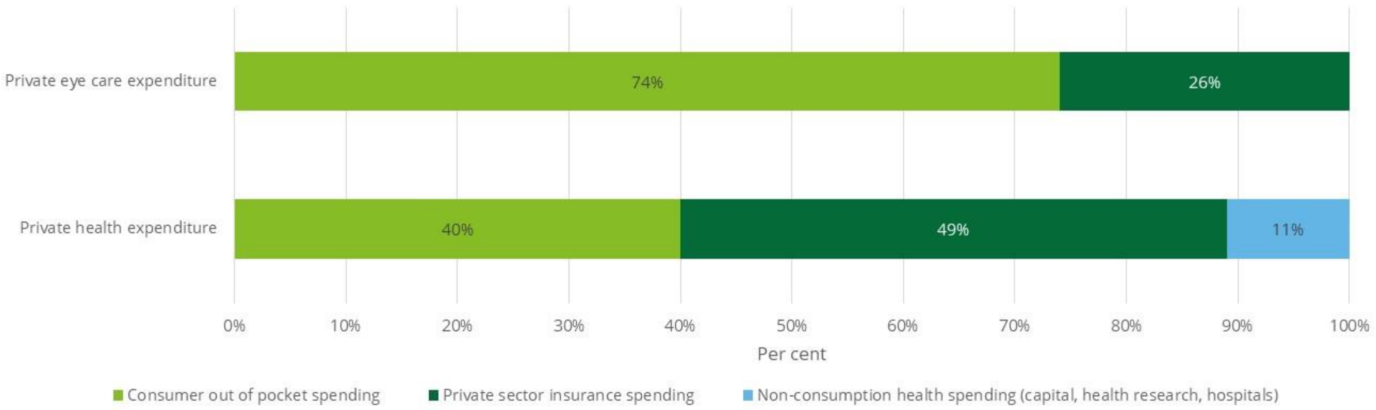
KEY: Not publicly funded; Publicly funded for eligible persons; Publicly funded for the whole population

Source: As listed in the table. Note: Private services are available for people who chose to use these services. These services are covered by the consumer.

- There is evidence that a high proportion of private health insurance holders do not benefit from vision care coverage. As of 2014, a review into private health insurance reported that of 60% of Canadians are covered by private health insurance through their place of employment,[87] **only 10% have health plans that include unlimited vision benefits, and 13% have plans which do not cover any vision care services.** For people who do not have private health insurance, they bear the full cost of basic eye services (Table D.1).
- The variations in the **level of eye care coverage impact the affordability of eye care services in Canada**. A study conducted by the Canadian Association of Optometrists (CAO) in 2018 found that **eye care services had the largest OOP share** in terms of healthcare expense for most Canadians, with 74% of all private spending on eye care expenses being out-of-pocket (Chart D.1).[84] This is compared to 37% for prescription drugs and 44% for dental.

- **The gaps in provincial health plans and low reimbursement rates for eye care services** are identified as barriers to optimal eye care in Canada.[85] This limits the ability for people to receive timely access to eye services across Canada.

Chart D.1: Private health expenditure in Canada by source of funds



Source: Deloitte based on Canadian Association of Optometrists (CAO;2019).[84]

D.1.3. Eye health workforce

- **Eye health services in Canada are delivered primarily by optometrists, ophthalmologists, and opticians**:[88]
  - **Optometrists are the primary healthcare provider of eye care**. They provide an optometric eye exam to examine, assess, measure, and diagnose eye disorders and diseases, fit and dispense eyewear, and prescribe medications (in most provinces). In 2020, there were **6,707 optometrists** in 2020 (17.7 per 100,000 persons).[89]
  - **Ophthalmologists are surgeons and specialists in eye disease**. They are secondary-level healthcare providers and people with eye diseases usually require a referral from their optometrists to obtain an appointment for medical or surgical treatment such as cataract surgery. In 2018, there were **1,249 ophthalmologists** (3.35 per 100,000 persons).[90]
  - **Opticians are trained through a college program to fabricate and fit vision aids**, such as glasses, based on the prescription of an optometrist. Opticians are licensed to provide spectacles. They may also dispense contact lenses and other optical aids. In 2017, there were **6,900 opticians** (18.8 per 100,000 persons).[90]
- The estimated number of optometrists, opthalmologists and opticians in Canada across three time periods (2010, 2015 and 2020) is presented in Table D.2.
- **Between 2010 and 2020, the growth of the optometrist workforce has been three times higher than that of the ophthalmologist workforce in Canada.** The overall number of optometrists has slightly increased from 14.2 per 100,000 in 2010 to 17.7 optometrists per 100,000 persons in 2020. This contrasts with the number of ophthalmologists, where the ratio has been relatively constant at 3.3-3.4 per 100,000 in the past decade. This indicates a shortage of ophthalmologists compared to optometrists.[91] The majority (74%) of eye care services is provided through private clinic settings.[91]

Table D.2: Eye health workforce in Canada (2010, 2015 and 2020)

Profession	2010	2015	2020
Optometrist (n per 100,000)	4,841 (14.2)	5,860 (16.4)	6,707 (17.7)
Ophthalmologist (n per 100,000)	1,137 (3.3)	1,221 (3.4)[92]	-
Optician (n per 100,000)	-	6,900 (2017; 18.8)	-

Source: Canadian Association of Optometrists (2020)[91] and Canadian Institute for Health Information (CIHI; 2020).[89]

- In Canada, the **geographic availability of eye care services varies by province/territory**.[93] In general, ophthalmologists are largely located in urban settings, while optometrists are more geographically dispersed. **In remote areas where a larger proportion of Indigenous population resides, primary eye care is largely provided by GPs and nurse practitioners.**[91] Those who are based in regional and rural areas are likely required to travel to access secondary care from an ophthalmologist.[94]
- The geographical maldistribution of optometrists is a barrier to equitable access to eye care in remote and rural regions in Canada.[91] Research has found that Canadian residents who live in provinces/territories with either **a low optometrist ratio relative to eye care needs**, or **a high proportion of specific sociodemographic characteristics** (e.g., older age, low income) are more likely to experience gaps in access to eye care services.[93] This results in a significant gap in equity in access to diagnosis and care that disproportionately affects certain communities exacerbated by various geographical and socioeconomic factors.

D.1.4. Eye care strategy, policy and infrastructure

- In 2021, the Canadian Government participated in the United Nations (UN) General Assembly with the purpose of adopting a UN agreement on tackling preventable sight loss and enshrining eye health as part of the UN's Sustainable Goals. Within this resolution, **the establishment of a National Vision Health Plan was endorsed by Canada**, although there is no indication that a plan has been developed at this stage.[95]
- Peak bodies in the eye health sector in Canada, such as the CAO, Canadian Ophthalmological Society and Fighting Blindness Canada, have advocated for the Canadian Government to develop a **national strategy or plan on vision and eye care in Canada**. They have also strongly recommended for **primary eye care to be recognised as a core health component,** as Canada's existing list of national health strategies and initiatives does not include a specific focus on eye care.[96]

D.2. Eye health output findings

Canada - Eye health output key findings	
Number	**Key finding**
KF6	**Routine eye screening services are available** across Canada. However, the costs and financing arrangement **vary across provinces/territories**. For example, more than half (7/13) of Canadian provinces/territories have public health-funded vision screening programs for children and youths, while others have voluntary (non-universal) screening. A 2008 study on adolescents found that eye screening rate is higher in provinces with insured routine eye examinations (47%) compared to that in provinces without insured eye examinations (35%).[91]
KF7	**Some Canadians who are at high risk of sight loss do not access eye health services**. This includes 14% of people living with glaucoma, 37% of people with diabetes, and 41% of people aged 65 years, suggesting those who require eye care do not have their needs met.[91,97]
KF8	In 2021, the **median wait time of cataract surgery is 72 days. 66% of people** were treated within the **recommended benchmark** of 112 days compared to 70% of people prior to the COVID-19 pandemic.[38] There is significant difference in provincial median wait times - median wait times ranged between 37 to 148 days in 2006.
KF9	Barriers to access eye care services in Canada include **incomplete provincial government coverage**, **lack of perceived benefits** of eye care services, **limited collaboration** and coordinated services between eye care providers, **delayed referral** and shortage of specialists.

D.2.1. Availability and utilisation of eye screening services

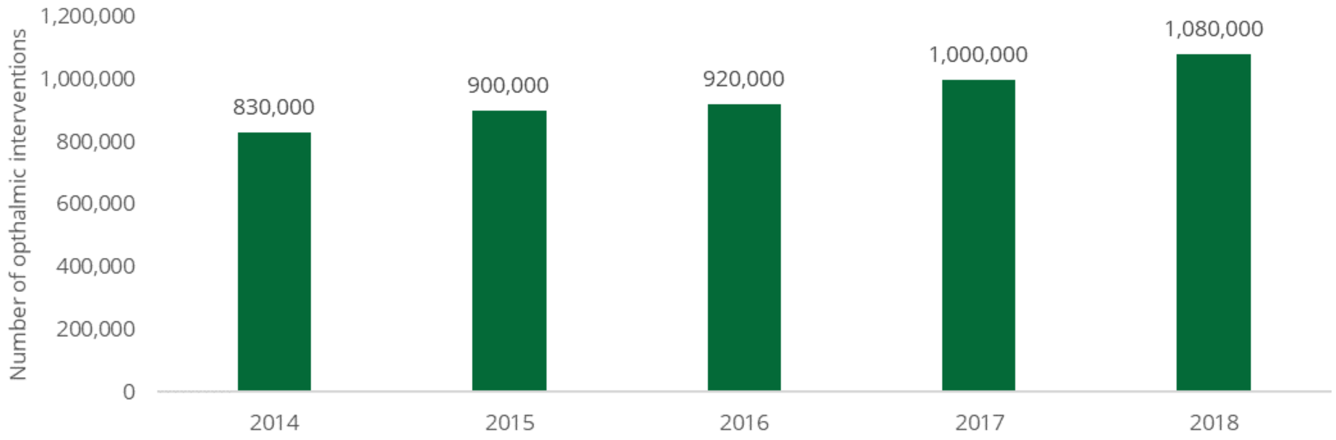
- **Eye screening programs are available across Canada for children and youth.** The **costs and financing arrangements vary across provinces/territories** due to provincial differences in the breadth of public insurance coverage and government initiatives:[98]

  - **7 of 13 Canadian provinces/territories have public health-funded vision screening programs for children and youth,** including Newfoundland & Labrador, Prince Edward Island, Nova Scotia, New Brunswick, British Columbia, the Northwest Territories and the Yukon.[99] **Québec, Ontario and Nunavut have voluntary (non-universal) screening** either during routine primary care visits or by public health/primary care nurses in more remote locations.[99]
  - Manitoba, Saskatchewan, Alberta, British Columbia and Ontario have launched the Eye-See-Eye-Learn, an early childhood vision screening initiative targeting kindergarten-aged children.[99]
  - Other provinces provide **optometric coverage for comprehensive eye exams, complete or partial assessment, diagnostic and treatment services for children and youths up to 17 years of age**. However, the types of coverage and frequency of services vary.[100,99]
- **Canadians living with diabetes are recommended to receive an eye exam by an ophthalmologist or optometrist every 1-2 years.** While province-specific screening programs exist (e.g., Diabetes Eye Screening Program in Ontario), there is currently no national diabetic eye screening program.
- The utilisation of regular eye screening among general public and those with specific eye health diseases is estimated to be low at between 24%-40%:
  - A 2020 study of 1.3 million people with diabetes found that **34% (n=455,027) had not been screened for diabetic retinopathy** since 2016, with the mean duration being 10.67 years. This is a slight increase compared to findings in 2011-15.[101,102]
  - Findings from the 2007–08 Canadian Community Health Survey (CCHS) found that the **rate of adolescent eye screening was highest (46.4%) in provinces with insured routine eye examinations**. Further, adolescents living in provinces with uninsured routine eye examinations and in the three remote territories had a lower rate of screening at 35% and 28% respectively.[91]

D.2.2. Availability and utilisation of eye treatment services

- With regards to the availability of services, it appears that a suite of treatments are readily available in most parts of the country, including cataract surgery, anti-VEGF injections, and glaucoma surgery delivered in both private and public settings. Key barriers which impact access to these eye care services include workforce shortages and limited infrastructure in rural and remote areas (as discussed above in section D.1.3).
- In terms of utilisation, those who are older are more likely to have utilised eye care services. According to the self-reported Canadian Health Measure Survey (CHMS) data in 2016-19 involving around 5,700 respondents, the proportion of people that had **visited an eye care professional in the past year were found to include:**[103]
  - **58.2%** of children and youth aged 6 to 19 years
  - **50.4%** of adults aged 40 to 64
  - **71.6%** of seniors aged 65 to 79.
- **Some Canadians who are at high risk of sight loss do not access eye health services**. A 2005 study showed that up to two-fifth of people in certain high-risk groups lack eye care access, including people living with glaucoma (14%), people with diabetes (37%), and people aged 65 years or older (41%).[97] The key reasons include incomplete government coverage, asymptomatic ocular diseases, and lack of perceived benefits of eye care services.
- When disaggregated by eye care service type, the volume of ophthalmic interventions (i.e., medical procedures conducted by ophthalmologists) has increased by considerably, driven by the increase in anti-VEGF injections. **Between 2014 and 2018, the volume of ophthalmic interventions grew by 30% (from 860,000 to 1.1 million)**. This is equivalent to an annual rate of 7.5%(Chart D.2).[90] This increase is driven by three main factors – (1) the ageing of the population, (2) innovation in treatment options, and (3) improvements in wait times for cataract surgeries.[90]
- In 2018, the total volume of ophthalmic interventions in Canada was 1.1 million (Chart D.2). Of this, 415,923 (38%) were cataract surgeries and 631,129 (75%) were for anti-VEGF injections for AMD (Table D.3).[90] The age-standardised rate of cataract surgery increased slightly from 2014 to 2019 within the range of 1,190-1,230 per 100,000 population.[104] The total cost of anti-VEGF therapy was estimated to be $810 million (in 2018).[105]

Chart D.2: Ophthalmic interventions in Canada (2014-18)



Sources: Canadian Institute for Health Information; IQVIA; The Conference Board of Canada.[90]

Table D.3: Volume of ophthalmic interventions in Canada (2018)

	Number of interventions (2018)
Anti-VEGF injections for AMD	631,129
Cataract surgery	415,923
Glaucoma surgery	18,438
Eye muscle surgery for strabismus	10,429
Vitrectomy surgery for diabetic retinopathy	4,056
Corneal transplantations	3,413

Sources: Canadian Institute for Health Information; IQVIA; The Conference Board of Canada.[90]

- **The waiting time for eye care services (as proxied through cataract surgery) was stable between 2017 and 2019** – The median waiting time for cataract surgery ranged between 65-67 days between 2017 and 2019. However, the COVID-19 pandemic contributed to marked increases in wait times – the median wait time for cataract surgery increased to 310 days in 2020.
- In 2021, 66% of people requiring cataract surgery across Canada were treated within the recommended benchmark (112 days between referral date and procedure date), compared with 70% in the pre-pandemic period (Table D.4Table D.4).[38] **There also exists variations in the wait time across provinces/territories** - in 2016, the provincial median wait times ranged from 37 to 148 days.

Table D.4: Cataract surgery wait times in Canada (2017-2021)

	2017	2018	2019	2020	2021
% meeting benchmark of 112 days	71%	70%	70%	45%	66%
50th percentile (days)	66	65	67	133	72
90th percentile (days)	211	218	219	310	255

Source: CIHI (2021).[38]

- Reviews on Canada's eye care policy and services identified several **barriers to eye care access**: [85, 97, 106]
  - a **growing need** for low vision service due to ageing population,
  - **gaps in coverage** for routine eye care preventive screenings, and
  - **a lack of perceived benefits** of eye care services within the general population,
  - **limited collaboration** and coordinated services between eye care providers, and
  - **delayed referrals** and shortage of specialists.

D.3. Eye health outcome findings

Canada - Eye health output key findings	
Number	**Key finding**
KF10	**Data on the quality of eye health services in is not publicly available.** Proxy studies have reported fairly good outcomes - a 2015 study of 229 corneal transplants that reported a 90-94% success rate, and a 2000 study of 1,329 cataract surgeries reported improved outcomes in 92.4% of the cases.
KF11	**The prevalence of vision impairment and blindness in Canada is 3%** (3 million people), with the prevalence **increasing steadily from 1990 to 2020.** The four most common eye diseases which cause **sight loss in Canada** are cataract (n=442,705; 1.2%), AMD (n=179,123; 0.5%), diabetic retinopathy (n=116,198; 0.3%), and glaucoma (n=129,101; 0.4%), all of which are age related.
KF12	**The prevalence rates of cataract are on the rise** in Canada due to the rising prevalence of diabetes and better disease detection rates. The number of Canadians with cataract increased by 370% from 0.93 million to 3.5 million between 2010 and 2020. This corresponds to an age- and sex-standardised prevalence of 10.2% in 2009 (compared to 8.9% in 2001).
KF13	Although refractive errors are prevalent in half of the adult population,[107] wide access to refractive error treatments (i.e., prescription glasses, contact lens or other procedures) means the **prevalence of uncorrected refractive errors is low at around 2.7% for distance visual impairment and 2.2% for near visual impairment.**[108]

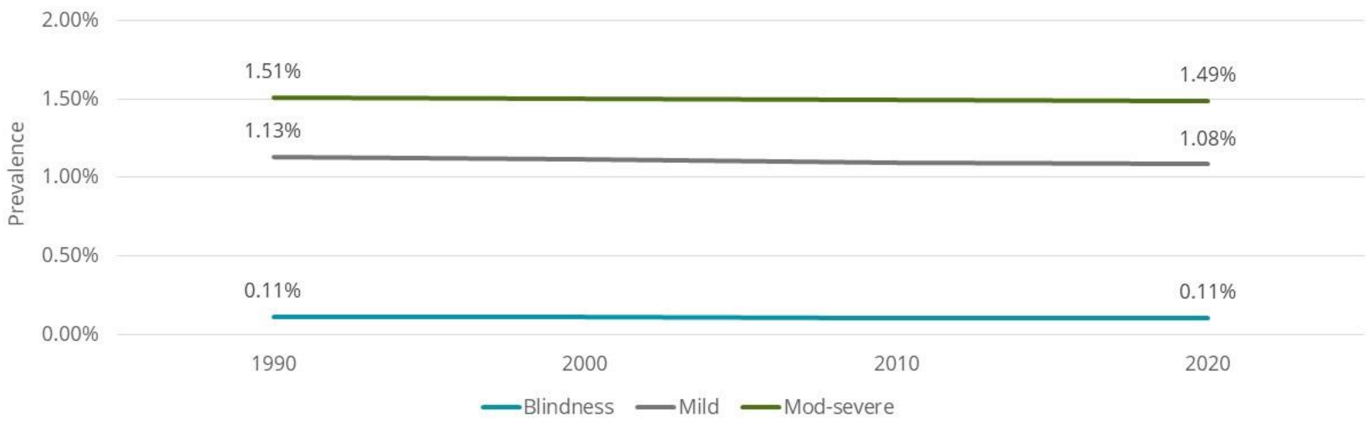
D.3.1. Quality of eye health services

- In Canada, CIHI gathers and analyses health care data including health outcomes as defined by changes in health that result from measures or specific health care investments or interventions. They include improvements in a person's quality of life following surgery for a specific health issue (e.g. eyesight following cataract surgery).[109] This data is available upon requests by researchers, decision-makers and health managers in line with CIHI guidelines.
- **However, a few publicly available datasets are available on the clinical outcomes of eye care.**[90] The only publicly accessible research papers on the quality of eye care outcomes were smaller-scale studies:
  - a 2015 study on corneal graft surgery reported 90-94% graft survival rates among 229 corneal transplants,[110]
  - a 2000 study on cataract surgery found that among 1,329 surgeries, the best-corrected VA had improved in 786 eyes (92.4%), remained the same in 42 (4.9%) and had worsened in 23 (2.7%).[111] This indicates that the majority of cataract surgeries achieve good postoperative outcomes.

D.3.2. Prevalence of vision impairment and blindness

- Based on estimates derived from the Global Burden of Disease study, in 2020, the age-standardised total prevalence of **mild vision impairment was 1.08%** (approximately 539,000 persons), **moderate to severe vision impairment** was **1.49%** (760,000 persons), and **blindness was 0.11%** (68,400 persons).[112] The **rate of vision impairment has remained relatively consistent** from 1990 to 2020 (from 2.68% to 2.75%)[112] (Chart D.3). No prevalence estimates from primary sources were available.

Chart D.3: Rate of vision impairment in Canada (1990-2020)



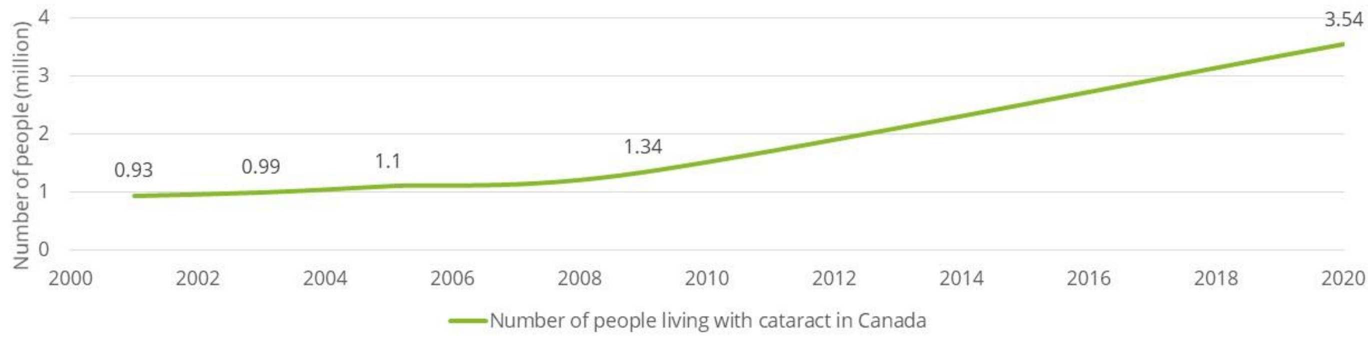
Source: IAPB (2020).[112]

- Approximately 1 out of 6 people (more than 5.5 million Canadians), are diagnosed with common eye diseases and are at serious risk of losing their vision.[91] The 4 most common eye diseases which cause sight loss in Canada (in 2018) are cataract (n=442,705; 1.2%), AMD (n=179,123; 0.5%), diabetic retinopathy (n=116,198; 0.3%), and glaucoma (n=129,101; 0.4%).[91]

D.3.3. Prevalence of specific eye diseases

- The most prevalent eye disease in Canada is cataract at 9.2%, affecting 3.5 million people. This is followed by AMD (8.7%), diabetic retinopathy (3.5%) and glaucoma (2.5%).
- The prevalence and incidence rates of cataract has increased in the past decade. The number of Canadians with cataract increased by 370% from 0.93 million to 3.5 million between 2010 and 2020.[113] This corresponds to an age- and sex-standardised prevalence of 8.9% in 2001 and 10.2% in 2009 (Chart D.4).[114] The increase in the prevalence of cataract has been linked to the ageing population, rising prevalence of diabetes, better detection of cataract, and a lower threshold in cataract diagnosis since the shift in practice between 2000 and 2008.[114]

Chart D.4: Number of people with cataract in Canada (2000-20)



Source: Yang et al (2021).[114]

- Around 728,000 Canadians are affected by glaucoma, with most having chronic open-angle glaucoma (the most common form of the disease). In 2002–03, an estimated 409,000 Canadians had glaucoma. Overall, the prevalence of self-reported glaucoma increased from 1.1% in 1994–95 to 1.8% in 2002–03,[113] and to 2.5% in 2019.
- AMD affects around 2.5 million Canadians people, with a prevalence of 8.7% in 2019. It is the leading cause of sight loss in people over the age of 50.[115]

- The prevalence of diabetic retinopathy in 2020 is approximately 3.5% among Canada's generation population and 25.1% among people with diabetes.[116] The rate of diabetic retinopathy is likely to increase over the next few decades amid the rising prevalence of diabetes
- Although refractive error is a condition that affects half of adult Canadians,[107] wide access to refractive error treatment (through prescription glasses, contact lens or other procedures) results in low prevalence of **uncorrected refractive errors** at around 2.7% for distance visual impairment and 2.2% for near visual impairment.[108] In general, myopia prevalence increased from 6% at ages 6–8 to 29% at ages 11–13.[117]
- One in five Canadian youth and children **require refractive corrective glasses**. The prevalence increases with age - around **half of Canadian adults requires refractive correction** (Table D.5).

Table D.5: Proportion of Canadians using glasses or contact lenses (2020)

	Children and youth (age 6-19)	Adults (aged 40-79)
Proportion of the sub-population with VA score better than 20/40 **without** glasses or contact lenses	72.4%	43.8%
Proportion of the sub-population **who require glasses or contact lenses** to achieve VA score better than 20/40	21.9%	51.1%
Proportion of the sub-population with vision impairment that cannot be improved even when using corrective lenses	5.7%	5.1%

Source: StatCan (2020)[107]

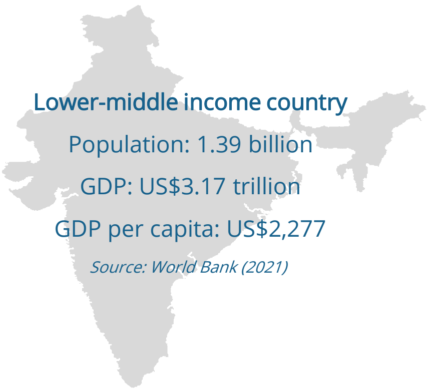
Appendix E: Country data report: India

India – Country Fast Facts

Data availability: **Adequate**

Data quality: **Poor**

National profile



Lower-middle income country

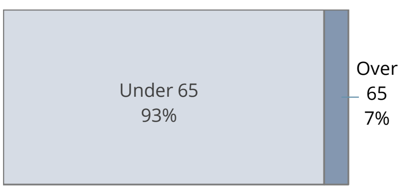
Population: 1.39 billion

GDP: US$3.17 trillion

GDP per capita: US$2,277

Source: World Bank (2021)

Population age profile



Prevalence of vision loss

21% of the Indian population have vision loss or blindness

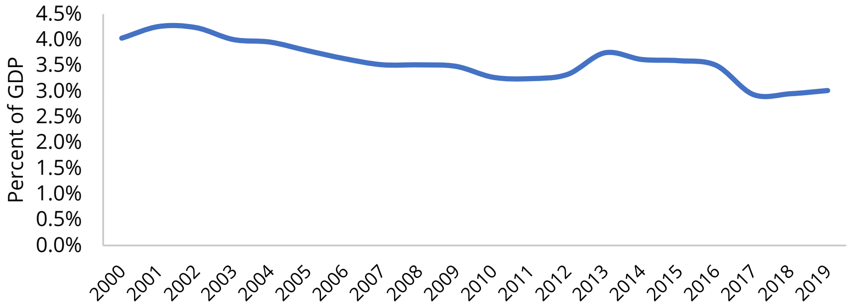
The total number in persons:

274m

Source: IAPB (2020)

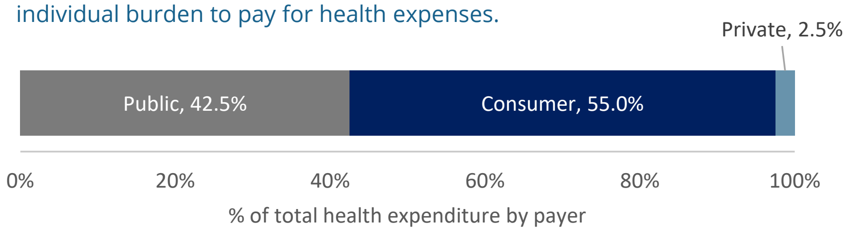
Health system at a glance

- Total health expenditure as a percentage of GDP in India has decreased consistently from 4.0% in 2000 to 3.3% in 2019. However, in level terms, total health expenditure increased by more than five-fold during the same period (USD 19 billion to USD 105 billion; data shown in main text).



Source: World Bank (2019)

- The health care system in India is primarily administered by its 28 states, where state government expenditure makes up 83% of total government spending. Each state generally spends between 1.5-4.5% of their total budget on health, leading to disparities in the availability and quality of health services.
- Consumer out-of-pocket (OOP) spending as a share of total health expenditure decreased from 72% (2000) to 55% (2019) due to increased government spending. However, the high share of OOP expenditure indicates significant individual burden to pay for health expenses.



Source: Ministry of Health and Family Welfare (2018) & World Bank (2019). Private includes employers' contribution and foreign financial transfers.

- The not-for-profit sector (mainly non-government organisations, NGO) plays a major role in eye service provision in India. NGOs have pioneered a cross-subsidisation model and worked in close partnership with the government to set up primary community eye health centres across the country.

India has a high rate of vision impairment (20%) and blindness (0.6%) compared to global average. Eye care has been a focus among governments and NGOs, leading to innovative practices that improved eye outcomes.

Source: Saldinger (2018)

KEY FINDINGS

For India

1	The age-standardised prevalence of blindness in India has reduced from 1.75% in 1990 to 0.86% in 2020. This represents an improvement in vision outcomes for over 200 million people. However, **India remains home to the world's largest blind population at 9 million (0.6%), and vision impairment at 260 million (20%)**. **The leading cause of vision impairment is cataract** (71%), followed by refractive error (19.7%), and glaucoma (5.8%).
2	Central and state governments in India have developed discrete programs to improve access to eye care services. The central government has delivered the **National Programme for Control of Blindness and Visual Impairment** since 1976, which comprise free cataract surgery at specified hospitals and the distribution of free spectacles to school children and elderly population cohorts. **Several state governments have also launched universal eye screening programs**, including Telangana which screened over 15 million people (43% of its population).
3	**NGOs in India have also contributed to enhancements in India's eye health detection and treatment system**. A number of NGOs, such as L V Prasad Eye Institute (LVPEI) and Aravind Eye Hospitals, have a large coverage across India including rural areas. NGOs have also initiated the **cross-subsidisation model for eye care**, where tiered pricing is implemented based on income levels. Under this model, a portion of poorer households receive complimentary eye care services. The Aravind Eye Hospitals, which has hospitals in 14 out of 36 states/union territories, are also known to deliver some of the **highest quality eye services**, with a cataract surgery success rate of 97% compared to the national average of 73%.
4	India **faces a significant workforce and infrastructure shortage in eye health**, with an estimated 45,000 optometrists compared to the estimated national need for over 125,000 optometrists (which represents a 64% workforce shortfall). The uneven geographic distribution of workforce and infrastructure further exacerbates issues in rural regions – even though 65% of India residents live in rural areas, 80% of health workers (not eye-specific) reside in urban areas. The governments have recently introduced the training of allied ophthalmic personnel and certification of more ophthalmologists to address gaps in workforce supply.
5	As the responsibilities of eye care service delivery are spread across different organisations, **the availability and quality of these services are often not consistent**. This is illustrated through the coverage and quality of cataract surgeries. In India, the average national coverage of cataract surgeries is ~75%. However, the proportion of coverage has wide regional disparities (from 47.1% to 93.2% across different regions). In terms of quality, the proportion of success cataract surgeries currently stands at 73.4%; but this too differs between urban and rural populations (77.6% vs 70.6%).

E.1. Eye health investment findings

India - Eye health investment key findings	
Number	**Key finding**
KF1	**There is no official government data on eye health expenditure. An NGO estimated that in 2012, India spent less than 2.5% of total health expenditure on eye care** in 2016.[45] **However, India's total health expenditure has increased nearly five-folds in the last two decades in level terms.**[118] Health expenditure as a percentage of GDP has decreased consistently by a quarter (from 4.03% to 3.27%) during the same period, partly due to the significant growth in India's GDP. When disaggregated by payer, consumer OOP expenditure accounts for more than half (55%) of total health expenditure.
KF2	**Based on broader health expenditure trends, eye health expenditure is likely to vary by region.** These regional variations are driven by differences in average household income levels. These differences have created disparities in the quality and availability of health services (including those that relate to eye health).
KF4	**Eye care in India has been a focus of many initiatives by public and private organisations** in light of the high blindness rate in the country. The Government has created an enabling environment for NGOs and private sector to jointly deliver eye health services. **Innovative measures from these initiatives**, such as **cross-subsidisation models** in NGO hospitals, **free universal eye screening** under the government's National Programme for Control of Blindness and Visual Impairment (NPCBVI), and the Vision 2020 global initiative have resulted in India providing highly cost-effective eye care to its population.[119]
KF5	**India faces a significant workforce shortage in eye health services (an estimated 64% gap)**, as well as a **maldistribution** of trained workforce which are highly concentrate in urban areas. Innovative changes to the eye health workforce and policy, such as the introduction and training of locally recruited and trained **allied ophthalmic personnel and the certification of more ophthalmologists,** have created positive impacts in terms of: (1) increasing the number of health workforce, and (2) supporting better utilisaLVPEtion of ophthalmologists (such as in surgeries instead of basic eye examinations).
KF6	**Despite investments by both the government and NGOs, India continues to face a shortage of eye health infrastructure such as community centres and tertiary eye hospitals.** This issue is particularly prominent in rural areas where the lack of primary care delivery has created barriers for people to access comprehensive eye care.

E.1.1. Eye health expenditure

- There is no official government data on eye health expenditure. However, based on data published by India Vision Institute (an NGO established in 2012 with the aim to improve primary eye care in India), it is estimated that India spent less than 2.5% of total health expenditure on eye care in 2016.
- **There is no information on eye health expenditure trends. Based on aggregate national trends, health expenditure has increased over time.** Between 2010 and 2019, India's total health expenditure has doubled from US$55 billion (2010) to US$105 billion (2019) per capita.[120] As a proportion of GDP, health expenditure has decreased from 3.3% (2010) to 3.0% (2019).[120] This is driven by the more significant growth in India's GDP relative to increases in total health expenditure.
- **When disaggregating total health expenditure by payer, more than half of the Indian population has to pay OOP to access healthcare services. While there have been recent increases in government investment in health, the proportion of OOP spending on health in India remains two times higher than global average**.
  - Consumer OOP spending accounted for 55% of total health expenditure in 2019, while government spending accounted for 42.5% of total health expenditure.
  - Government investment in health has contributed to decreases in the proportion of OOP as a share of total health expenditure from 72% (2000) to 55% (2019).[121] However, the proportion of OOP expenditure in India remains at least two times higher than the global average of 18.1%.[121]
  - This situation is exacerbated by low health insurance penetration – in 2010, about 37% of India's population had some form of health insurance.[122]
  - Government programs and private health insurance plans also do not typically cover medical tests, medications, and post-surgery costs, which creates greater affordability challenges for Indian residents.[123]

- **The significant geographic disparities in income levels have also meant that access to healthcare services may vary across regions.**
  - The health care system in India is primarily delivered by its 28 states. 83% of government spending on healthcare is through state government accounts. Healthcare expenditure by states vary which creates disparities in eye service availability throughout the country. For example, western states of India are generally wealthier than eastern regions. Investment in health infrastructure is also higher in wealthier regions (this is discussed in more detail in Section E.1.2).[124]
  - States across India generally spend between 1.5-4.5% of their total budget on health, with more populous states like Uttar Pradesh and Bihar spending a smaller percentage due to competing policy priorities such as sanitation, vaccination, and reproductive health.

Role of government in delivery of eye care services

- **Eye care services are delivered by three key parties – the central government, stage governments and NGOs.** The role and types of services provided by these agencies are summarised in the Table E.1.

Table E.1: Role of central government / state governments / NGOs in the design and / or delivery of eye care services

Key service provider	Role
Central government	The Central Government of India has established the **NPCBVI,**[21] with the mission to provide free eye care to the population. The NPCBVI delivers several programs under universal health coverage to reduce consumer OOP expenses, including:[21] • **Free cataract surgery** at district hospitals and selected NGO eye hospitals/private practitioners • **Eye screening and distribution of free spectacles** to school children and elderly • **Collection of donated eyes** through network of eye banks and eye donation centres • **Diagnosis and treatment of other eye diseases** (glaucoma, childhood blindness, squint etc.) at district hospitals and identified NGO eye hospitals • **The training of para medical ophthalmic assistants** (refer to Section E.1.2 for definition) posted at PHC/district hospitals.
State government	As a federal republic, the implementation of most health-related programs occur at the state level, although some programs may be funded by the central government. State governments are primarily responsible for the development of vision care facilities (within existing government health centres). These facilities deliver a wide range of eye care services – from detection and diagnoses of eye diseases to referrals and follow up care.[125]
NGOs	**NGOs** play an important role in driving the eye health delivery in India.[126] They have pioneered the **cross-subsidisation model** for eye care, where tiered pricing is implemented based on the individuals' income levels. This model enables wealthier people to effectively cross subsidise the treatment costs of lower income people. • For example, while LV Prasad Eye Institute (LVEPI) - an NGO delivering clinical services, education, and research - uses grants and donors to fund its research or as capital expenditure, its operating costs are covered by the fees, which account for more than three-quarters of its annual income • Other NGOs that provide eye care throughout India include Aravind Eye Hospitals, Dr Shroff Charity Eye Hospital, and Sadguru Netra Chikitsalaya. • Under the "Global Sight Initiative", an international network of hospitals and NGOs coordinated by Seva (a global eye care NGO) to tackle avoidable blindness,[127] NGOs (in collaboration with state governments) have established **more than 300 vision centres (VCs) across the country including remote rural areas to deliver primary eye care services.** VCs are staffed by locally trained technicians and typically offer refraction and dispensing of spectacles, diagnosis of common eye conditions, and referral of cases needing further intervention to a hospital.[128] • NGOs and eye care organisations in India, together with the government, also participate in the Vision 2020 global initiative of the WHO and the IAPB to coordinate and advocate for improved eye programs. They do so by sharing of knowledge and collaboratively developing solutions for eye care.

Source: Deloitte, based on various sources as indicated in table.

- Despite the presence of these eye initiatives, the significant magnitude of eye issues in India still results in a large proportion of people who are not able to access these subsidised programs or eye care services such as eye surgeries and corrective glasses.[129] Factors such as those for transport, treatment, surgery, drugs, glasses and optical devices, were found to act as **major deterrents for the access of eye care services for the low income population**.[130] Table E.2 outlines the types of preventative and treatment services that are covered by government funding.

Table E.2: Summary of preventative and treatment services covered by government funding

	India
Eye screening services	Eye screening is available free of charge for (1) school children and the elderly population through central government initiatives, (2) low-income population at some NGO facilities, (3) general population in certain states. Outside of these circumstances, eye examinations are an OOP expenditure for consumers.
Corrective lenses (glasses and lenses)	Free spectacles are provided for school children as part of the government NPCBVI initiative. Otherwise, it is considered an OOP expense.
Medication (including eye drops)	Eye medications (e.g., glaucoma medication) are offered free of charge at (1) specified hospitals/clinics as part of NPCBVI, or (2) NGO hospitals for low-income population. Otherwise, it is considered an OOP expense.
Intravitreal injections (i.e., Anti-VEGFs treatments)	Anti-VEGF treatments are offered free of charge at (1) specified hospitals/clinics as part of NPCBVI, or (2) NGO hospitals for low-income population. Otherwise, it is considered an OOP expense.
Eye surgeries	In-patient eye surgeries are offered free of charge at (1) specified hospitals/clinics as part of NPCBVI, or (2) NGO hospitals for low-income population. Otherwise, it is considered an OOP expense.

KEY: Not publicly funded; Publicly funded for eligible persons; Publicly funded for the whole population

Source: As listed in the table. Note: Private services are available for people who chose to use these services. These services are covered by the consumer.

E.1.2. Eye health workforce

- **India has a significant workforce shortage in eye health services**. This situation is exacerbated by the geographic **maldistribution** of these trained workforce as they mostly work in urban areas. In 2010, 70% of ophthalmologists are located in urban areas where only 23% of population resides. In contrast, nearly 66% of eye surgeries took place at the urban facilities inhabited by 31% of the population.[131]
- India currently has an estimated 22,000 ophthalmologists (1.6 per 100,000 persons) and 54,000 optometrists (4 per 100,000 persons), representing a significant shortage of trained eye workforce compared to the estimated national need for over 125,000 optometrists (which represents a 57% shortfall of workers).[132,133]
  - This has been largely attributed to a **shortage of education providers which focus on optometry in India**, with a Diploma in Optometry offered by 72 institutions (7%) out of more than 990 higher education providers, and Bachelor in Optometry offered by 101 institutions (10% of institutions) across India.[45]
- The shortage of eye care medical professionals has impacted the availability of both eye screening and treatment services. The shortage of optometrists has also contributed to a more suboptimal use of the ophthalmologist workforce as ophthalmologists are occupied in primary care procedures instead of conducting surgeries.[133]
- In order to address the lack of eye health workforce, NGO and governments have made innovative policy and structural changes including:
  - NGO initiatives such as **Mission Saksham provide training for "allied ophthalmic personnel"**, including nurses, technicians, and assistants, to supporting doctors in conducting initial evaluations, thereby enabling hospitals to focus on more complex surgeries.[134]

  - In some areas, NGOs also recruit **local residents as volunteering healthcare assistants** who carry out communication-oriented services. These volunteers make door to door visits to raise awareness of eye health and encourage residents to seek eye health services.
  - The government also **modified regulations in recent years to allow more ophthalmologists to be certified** each year.[126]

E.1.3. Eye care strategy, policy and infrastructure

- Eye care in India has been a focus of many public and private organisations' initiatives, in light of the high blindness rate in the country. The **impact of avoidable causes of blindness to the Indian economy (in terms of lost potential productivity)** is estimated to be INR187,000 crores (unit of measure equivalent to 10m rupees) or **US$34 billion per annum** (2008), with Indian rupee (INR) 126,500 crores or US$23 billion alone due to uncorrected refractive error.[135]
- **Government support for eye health has created an enabling environment for eye care delivery in India**. This includes funding allocation, favourable policies for importing equipment, promotion of local eye care industry, and human workforce development.[136] There is also an increasing trend of private and corporate philanthropy and private and NGO investment into the eye care sector. As a result of these initiatives (refer to Table E.1), India has one of the most cost-effective eye care procedures in the world.[119]
- In terms of **eye health infrastructure**, eye services are delivered and triaged through four levels of healthcare settings (health and wellness clinic, primary healthcare centres, community health care centres, and district care/hospitals), representing general, primary, secondary and tertiary eye care respectively:
  - India has approximately 1,280 eye hospitals (compared to a 37,700 general hospitals). Most of the major hospitals are located at urban areas. The hospitals are either set up as part of a chain, as individual private clinic or as sub-specialty in a multispecialty hospital.[137]
  - Although secondary and tertiary eye care facilities are available in several cities, there is a vacuum existing due to the lack of organised primary eye care sector in rural India.[137]
  - Optical retail chain outlets that dispense prescription spectacles and contact lenses are most located in the main cities, with smaller optical outlets spread across all the urban and rural parts of the country.[45]
- Overall, **there is a significant shortage of eye health infrastructure** in India. The issue is particularly prominent in rural areas where the lack of primary care delivery creates barriers for further comprehensive care due to the lack of referrals.[137]

E.2. Eye health output findings

India - Eye health output key findings	
Number	**Key finding**
KF7	**Eye screening and the early detection of eye diseases are promoted through India's Central Government's School Eye Screening Program** and several state governments' (Telangana, Odisha and Andhra Pradesh) state-wide screening programs. Millions of people receive treatment or are referred to tertiary care for conditions including refractive errors and cataract.
KF8	**The uptake of screening for diabetic retinopathy can be improved**, as only 10.7% people living with diabetes surveyed in a 2020 study were aware of the condition and only 8% had undergone diabetic retinopathy eye screening test.
KF9	Annually, 6 million cataract surgeries are conducted in India. **Cataract surgical coverage in India is high (~75%)** as a result of NGO and government initiatives to improve affordability and access. Wait time of cataract surgery is also satisfactory with early-stage cataract having an average waiting time of 3-4 months from diagnosis, while immature and mature stage cataract have a waiting time of 15 days to 1 months from diagnosis.
KF10	Beyond cataract, **other eye diseases such as glaucoma and refractive errors are significantly undertreated in India,** however, the volume of treatment of other eye diseases (e.g., glaucoma) is increasing at a rate of roughly 30% from 2014 to 2017. The utilisation of these eye care services can be addressed, for the large part, at the primary level of care to increase coverage at the early intervention stage.

E.2.1. Availability and utilisation of eye screening services

- The central government, state governments and NGOs have delivered various initiatives that promote screening for school children and for general population as the causes of 80% of cases of blindness in India, i.e., refractive error and cataracts, are easily treatable once they are diagnosed.[137]
- The Central Government of India, as part of the NPCBVI, delivers the **School Eye Screening Program** to detect refractive errors and provide free spectacles in school children. As of 2017-18, **over 30 million children have been screened annually** (roughly 20% of children age 7-12 in India), resulting in approximately **1 million people detected with refractive errors** (roughly 0.7% of children in India), and ~**800,000 provided with free spectacles each year** (Table E.3; note the decrease in 2020-21 has been attributed to COVID-19 pandemic related disruptions).[138] However, eye screenings are largely delivered by school teachers trained either under the NPCBVI or by the outreach teams of not-for-profit eye hospitals. It is acknowledged through a review into strategies and challenges of vision screening at school that a lack of trained eye health professional has impacted the quality of eye screening programs.[139]

Table E.3: NPCBVI School Eye Screening Program results (2014-17)

Year	No. of Children Screened for Refractive Error (% of children aged 7-12 in India)	No. of Children found with Refractive Errors (% of children screened)	No. of free spectacles provided to school children suffering from refractive errors (Target 900,000) (% of children found with refractive error)
2014-15	29,985,309 (22%)	1,153,639 (3.8%)	736,572 (64%)
2015-16	34,450,657 (25%)	1,345,390 (3.9%)	830,620 (62%)
2016-17	32,779,542 (24%)	1,148,033 (3.5%)	757,906 (66%)
2018-19	-	-	881,929
2019-20	-	-	856,768
2020-21	-	-	180,723
2021-22*	-	-	252,600

Note: Data on no. of children screened for refractive error and no. of children found with refractive errors for years 2018 to 2022 is unavailable. 2021-22 data is provisional only.

Source: Ministry of Health and Family Welfare (2017; 2022).[138,140]

- Several states in India, such as **Telangana, Odisha and Andhra Pradesh**, have also initiated **state-wide screening programs**, using the strategy of "Expand the Ward" to **test-track-treat** in one go, leading to millions of people being treated/referred for treatment for eye conditions such as refractive errors and cataract.
  - As the biggest ever vision screening programme in India, **the state government of Telangana has screened over 15 million people** (43% of its population), resulting in **over 4 million people provided with spectacles**, and **close to a million referred to higher centres for treatment** such as cataract surgery.
- The LVPEI runs a network of 82 eye screening centres, serving at least 1 million people every year, of which over half of the people receive free treatment.[137]
- While there is currently a lack of national diabetic retinopathy screening program, the India Ophthalmological Society Diabetic Retinopathy Taskforce and Vitreoretinal Society of India have recently released screening guidelines and announced their **plan on ramping up diabetic retinopathy screening programs** in 2020.[141]
- In addition to addressing the availability of eye screening services, uptake of screening can also be improved by **increasing education and awareness of eye healthcare**. A 2020 study found that 10.7% of 178 people with diabetes mellitus were aware of diabetic retinopathy and only 8% had undergone diabetic retinopathy screening,[141] while a 2021 study found that only 16.5% of people aged >40 underwent glaucoma screening[142].

E.2.2. Availability and utilisation of eye treatment services

- **The number of eye treatment services provided to India – particularly for non-cataract eye diseases - has increased between 2014-15 to 2019-20** (note the decrease in 2020-21 due to the COVID-19 pandemic).
  - The central government collects data on selected eye treatments, such as cataract surgeries and treatment of diseases including diabetic retinopathy and glaucoma, to assess the progress of the NPCBVI. Table E.4 shows that **more than 6 million cataract surgeries are conducted annually**, with the treatment of eye diseases increasing at a rate of roughly 30% from 2014 to 2019.
  - The number of cataract operations performed during this period of time (between 6.3 to 6.4 million) is close to its target of (6.6 million)
  - The number of treatment and management of other eye diseases have ranged between ~242,000 and 837,000, which is between 3 to 12 times higher than its target of 72,000.

Table E.4: NPCBVI Cataract operation and treatment/management of other eye diseases results (2014-17)

	Cataract operations		Treatment/management of other eye diseases (Diabetic retinopathy, glaucoma, childhood blindness, keratoplasty etc.)
Year	No. of Cataract operations performed (Target 6,600,000)	% surgery with intraocular lens	Achievement (Target 72,000)
2014-15	6,419,933	95	242,830
2015-16	6,304,177	95	312,925
2016-17	6,481,435	95	404,677
2018-19	6,690,830	-	614,433
2019-20	6,433,140	-	837,151
2020-21	3,550,765	-	299,852
2021-22*	3,956,934	-	305,298

Note: Data on % surgery with intraocular lens for years 2018 to 2022 is unavailable. 2021-22 data is provisional only.

Source: Ministry of Health and Family Welfare (2017; 2022).[138, 140]

- Cataract surgical rate (calculated by the number of operations per million people, per year) has increased 8.5-fold within three decades (from over 700 in 1981 to 6,000 in 2012), and is currently close to the estimated rate of 8,000–8,700 needed to eliminate cataract-induced blindness in India[143] . This reflects the successful outcome of various NGO and government initiatives (as described above). **While national cataract surgical coverage is approximately 75%,**[129 ,144] **wide disparities exist among states**: for example,in UP's Kannauj, the cataract surgery coverage is 47.1%, while in Gujarat's Kheda, the rate is 93.2%.
- **Common barriers to cataract surgeries** are untreated systemic comorbidities (especially among the elderly and rural population), financial constraints, low awareness for the need of eye health services, and fear of surgery,[129] reflecting the challenges in affordability, service accessibility, and awareness.
- **Wait time for cataract surgery is shorter in India compared to other countries in South Asia.** Early-stage cataract has an average waiting time of 3-4 months from diagnosis, while immature and mature stage cataract has a waiting time of 15 days to 1 month from diagnosis.[145]
- Beyond cataract, **other eye diseases such as glaucoma and refractive errors remain significantly undertreated** in India:
  - For glaucoma, there remains no consensus on a public health approach to address the prevalence of the condition. Glaucoma remains largely in the realm of tertiary care where infrastructure availability and costs are prohibitive (Section E.1.3), which makes it inaccessible and unaffordable to a large proportion of people in India.

- According to a WHO study (2013), an estimated 550 million people in India (roughly 44% of total population) need eyeglasses, representing a big challenge for India to tackle uncorrected refractive error.[24]
- India has no large public database or registry on anti-VEGF treatment use,[146] however, anecdotal reports indicated that costs were prohibitive and has led to high dropout rates.[147]

- The availability and utilisation of these eye care services can be addressed, for the large part, at the primary level of care, resulting in greater coverage at the early intervention stage. While school screening and community programmes have become more available in recent decades, better quality screening will equip India to tackle uncorrected refractive errors earlier.

E.3. Eye health outcome findings

India - eye health output key findings	
Number	Key finding
KF11	**The quality of eye health services (as proxied by cataract surgery outcome) is highly varied in India across states, between urban/rural regions, and across eye institutions.** In 2019, the average success rate of cataract surgery across India was 73.4% (as per BCVA definition of "good"). Outcomes for cataract surgeries in urban areas (77.6%) are better than those in rural areas (70.6%) in the state of Andhra Pradesh. In addition, Aravind Eye Hospitals (NGO) are known to deliver high quality services, with a success rate of 97% across 1.83 million eyes operated from 2012 to 2018.
KF12	**In 2020, there were an estimated 270 million people, equivalent to approximately 20% of the population, with sight loss. Of these, 9.2 million people were blind (0.65%).** The proportion of the Indian population with mild vision impairment was 3.45% (47 million people), and those having moderate to severe vision impairment was 5.55% (77 million people). **The rate of blindness has reduced from 0.83% in 1990 to 0.64% in 2020**, representing a significant sight-saving of over 200 million people in India.[112] In contrast, the rate of MSVI has increased from 4.75% in 1990 to 5.55% in 2020.[112]
KF13	**India has a higher prevalence of several eye diseases** compared to global average, including **cataract (25%-32%), uncorrected refractive errors (10.2%) and glaucoma (3.2%).** The rate of age-related macular degeneration (1.8-4.7%), and diabetic retinopathy (1.5%) is similar to Western countries.

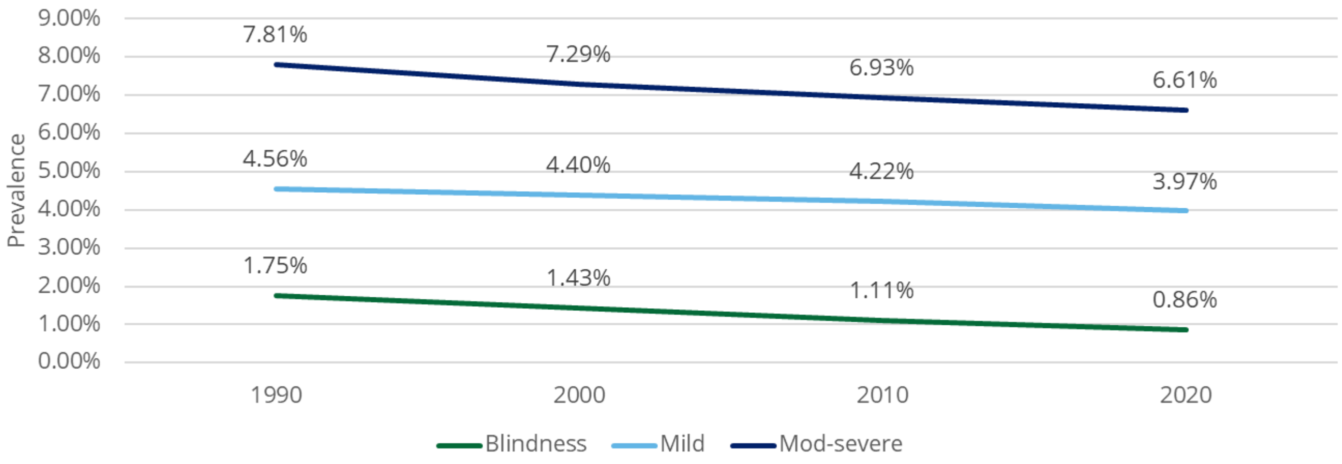
E.3.1. Quality of eye health services

- The quality of eye health services, as proxied by **cataract surgery outcome**, is highly varied across states, between urban/rural regions, and across eye institutions. The majority of cataract surgeries report a good post-operative outcome as defined by PVA 6/12 or better (70.6%-97%),[138,148,149] with the Aravind Eye Hospitals (an NGO) recording the best results. It was also found that a higher proportion of subjects in urban area recorded good outcomes (77.6%) as compared to those in the rural area (70.6%).[148]
- In an effort to improve the standard and quality of cataract surgeries, the governments in India in recent years banned cataract surgeries at temporary surgical facilities and mandated for surgeries to take place in hospital settings only.[126,150]

E.3.2. Prevalence of vision impairment and blindness

- Based on estimates derived from the Global Burden of Disease study, in 2020 in India, there were an estimated 270 million people with sight loss. Of these, 9.2 million people were blind.[112] This is presented in Figure 5.1.
  - The age-standardised prevalence of mild vision impairment was 3.97% (around 48 million people), in line with global average of 3.27%.[112]
  - The proportion of India's population with moderate to severe vision impairment was 6.61% (equivalent to around 77 million people), significantly higher than global average of 3.74%.
  - The proportion of Indian population who were blind totalled 0.86% (equivalent to around 9 million people), slightly higher than the global average of 0.55%.
- The rate of blindness has reduced from 1.75% in 1990 to 0.86% in 2020, representing a significant sight-saving of over 200 million people in India.[112]
- The rate of mild and MSVI have also both decreased from 1990 to 2020.[112]

Figure 5.1: Vision impairment prevalence in India (1990-2020)



Source: Global Burden of Disease (2020).[112]

- A 2022 population-based survey of people above 50 years found that the overall weighted, age-gender standardised, prevalence of blindness was 1.99% (95% CI 1.94%, 2.13%) and of visual impairment (VI) (presenting visual acuity <6/12 in better eye) was 26.68%.[151]
- The prevalence of vision impairment is higher in rural areas compared to national average in India. A study of 4,711 subjects aged >30 found that 22% of population in rural central India live with visual impairment (PVA<20/60 and ≥20/400) and 0.7% has blindness (PVA <20/400 and of ≤20/200) according to WHO standards.[152]
- Due to the lack of available and accessible eye screening services, it is estimated that approximately 11 million children living with visual impairment or blindness are undiagnosed.[137]
- Cataract remains the most common cause of blindness (66.2%) and visual impairment (71.3%) among the population aged ≥50 years.[129,151] Other leading causes of blindness include refractive error (19.7%), glaucoma (5.5%), posterior segment disorder (5.9%), surgical complication (7.2%), and posterior capsular opacification (0.9%), and corneal blindness (0.90%).[138] The proportion of blindness and visual impairment that is due to avoidable causes include 92.9% and 97.4% respectively.[151]

E.3.3. Prevalence of specific eye diseases

- India's most common eye diseases are cataract and uncorrected refractive errors. The prevalence of these conditions, along with glaucoma, age-related macular degeneration, and diabetic retinopathy are higher than global average (Table E.5).

Table E.5: Prevalence of specific eye conditions in India

Condition	Prevalence
Cataract	25-32%
Uncorrected refractive errors	10.2%
Glaucoma	3.2%
Age-related macular degeneration	1.8-4.7%
Diabetic retinopathy	1.5%

Source: Deloitte, summarised based on various data sources described below.

- In 2019, the prevalence of refractive error in India is 53.1%, of which myopia and hyperopia was 27.7% and 22.9% respectively. In terms of uncorrected refractive errors, the prevalence of uncorrected myopia and hyperopia is 10.2%, while the prevalence of uncorrected presbyopia was 33%,[153] both of which are significantly higher than OECD countries.
- Monotype subtype cataracts (i.e., having only one of three types of cataracts - nuclear sclerotic cataracts, cortical cataracts or posterior subcapsular cataracts) were identified in 32% and 25% in rural and urban population, and mixed cataracts (i.e., having more than one type of cataracts) in 12.68% and 18.6% in the rural and urban groups respectively.[154]
- It was estimated that there are approximately 11.2 million people aged 40 years and older (~0.9% of total population) with glaucoma in India in 2010. Primary open angle glaucoma is estimated to affect 6.48 million people. The estimated number with primary angle-closure glaucoma is 2.54 million. Those with any form of primary angle-closure disease could comprise 27.6 million persons.[155]
- The prevalence rates of AMD in India ranged from 1.8% to 4.7% based on a study in 2009.[156] For population aged>60 in 2010, the prevalence of late AMD is 1.2%, grade 1 early AMD is 39.3%, grade 2 early AMD is 6.7%, and grade 3 early AMD is 0.2% [157]
- The prevalence of diabetic retinopathy among people aged>50 with diabetes is 16.9% in 2019.[158]

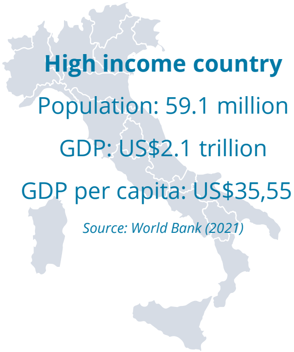
Appendix F: Country data report: Italy

Italy – Country Fast Facts

Data availability: **Good**

Data quality: **Excellent**

National profile



High income country

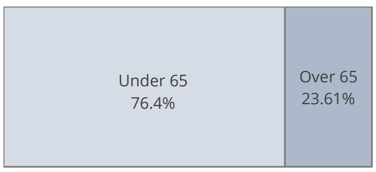
Population: 59.1 million

GDP: US$2.1 trillion

GDP per capita: US$35,551

Source: World Bank (2021)

Population age profile



Prevalence of vision loss

6% of the Italian population have vision loss or blindness

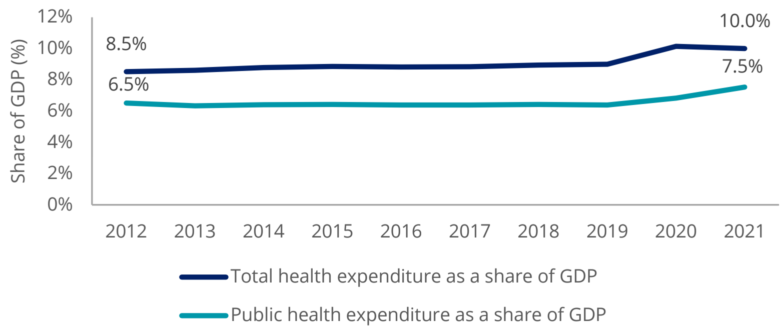
The total number in persons:

5.6m

Source: GBD (2020). Note: age-standardised prevalence.

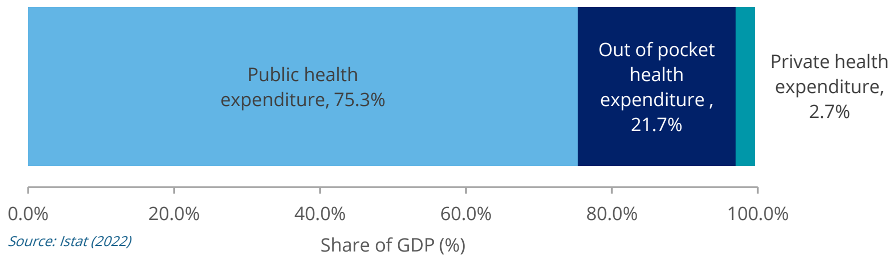
Health system at a glance

- Italy has a universal public health service, with mostly free primary care, inpatient care, and health screenings. This is financed through corporate and value-added tax revenues.
- As seen below, total health expenditure as a percent of GDP was 10.0% in 2021, an increase from 8.5% in 2012. Public health expenditure as a share of GDP has seen similar increases from 6.5% in 2012 to 7.5% in 2021.



Source: Istat (2022)

- In 2021, 75.3% of health expenditure was government funded. Voluntary funding schemes and out of pocket payments account for 24.3% of health spending.



Source: Istat (2022)

> There are many reasons the number of people with low vision [in Italy] is increasing... There is the progressive increase in life expectancy... [and] scientific advances in ophthalmology which reduce blindness which increases partial vision impairment.

Source: Italian Ministry of Health (2018)

KEY FINDINGS

For Italy

1	Italy invests in eye health through a number of key channels, including eye health **policy and strategy, subsidisation** of eye care products and services and a **regional eye care system**. However, there are **challenges** with these systems, including workforce shortages and the heterogeneity of services nationwide.
2	Italy has a **shortage of eye health workers** across regional eye care services. The number of ophthalmologists per 100,000 population has decreased from 7.9 in 2012 to 7.3 in 2021. This has reportedly led to **gaps in services and access to timely care.**
3	There is a **lack of homogeneity in eye care across the country, both in the availability and range of services available.** This is due in part to the decentralisation of the Italian health system. For example, the rollout of vision rehabilitation services has not been consistent across regions, with some variation in the availability of eye health rehabilitation services due to a lack of resources.
4	There appears to be inconsistent eye screening coverage across different age groups. The **eye screening system mainly focuses on infants and children**, although there are programs available for other segments of the adult population in some regions. This includes programs dedicated to those over the age of 40, given the association between ageing and eye disease. However, for those who are not exempt from fees based on income, eye screening will be an out-of-pocket cost.
5	**More people in Italy have moderate sight loss in 2019 when compared to 2015.** This appears to be **driven by the ageing of the population**, given that the age-standardised prevalence has decreased over the last three decades.

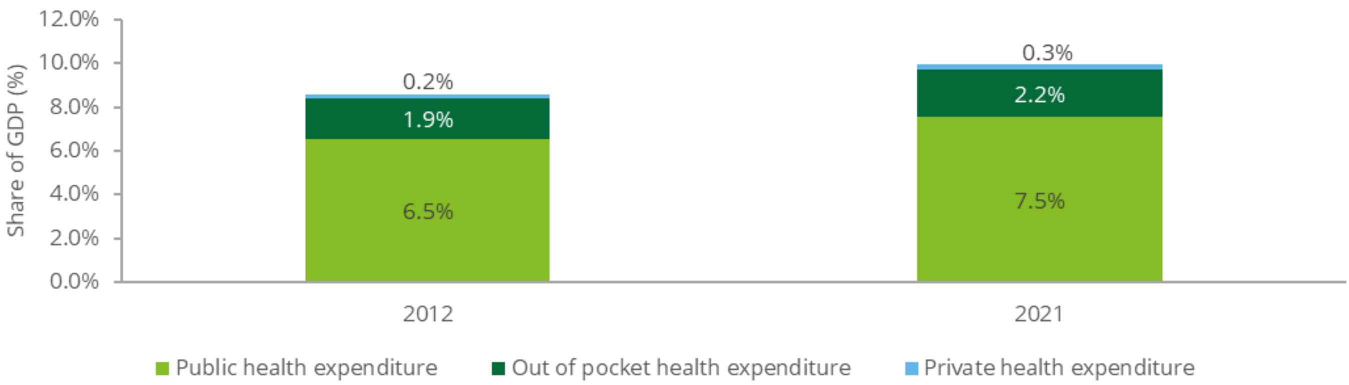
F.1. Eye health investment findings

Italy - Eye health investment key findings	
Number	**Key finding**
KF1	There is no available data on eye health expenditure in Italy. Based on aggregate trends, **total health expenditure (as a proportion of GDP) has increased between 2012 and 2021**. The increase is driven by higher public health expenditure.
KF2	Given Italy's universal public health care system, most eye care is fully or partially subsidised except for corrective lenses. As a share of OOP health expenditure, **expenditure on glasses and contact lenses represents more than 10%,** likely because many other health costs are covered by Italy's public health system. OOP expenditure on glasses and contact lenses has **decreased as a share of median income**, from 0.36% in 2014 to 0.27% in 2019, likely indicating an improvement in affordability.
KF3	Italy has a **shortage of eye health workers** across regional eye care services. The number of ophthalmologists per 100,000 persons has decreased from 7.9 in 2012 to 7.3 in 2021.

F.1.1. Eye health expenditure

- There is no available data on eye health expenditure in Italy. Total health expenditure in In Italy accounts for 10.0% of GDP in 2021, or US$257 million (presented in Chart F.1) This represents an increase from 8.5% of GDP in 2012. Most of this growth is driven by rising public health expenditure, which grew from 6.5% of GDP in 2012 to 7.5% in 2021. However, OOP expenditure has also grown, from 1.9% of GDP in 2012 to 2.2% in 2021.[159]

Chart F.1: Italian health expenditure by payer



Source: Istat (2022).[159]

- Despite the lack of data on eye health expenditure, the size of the eye health system can be approximated through several sources:
    1. The total funding allocated to Italian regions for provision of eye health rehabilitation services was approximately US$982,000, or around 0.001% of total health expenditure in 2018. However, this reflects a reduction in funds over time, from funds committed at US$2.8m in 2012. The reason for this reduction is not clear. After reaching a low of US$281,321 in 2017, the Ministry of Health in collaboration with IAPB Italy were able to secure a funding increase of US$733,978 to use for eye health and a further US$366,989 at a national level for 2018.[160]
    2. In 2021, the total OOP expenditure on eyeglasses and contact lenses in Italy was US$6.5bn, or around 11.6% of total OOP health expenditure. This represents a decrease since 2014, when it accounted for 16.3% of OOP health expenditure (totalling US$7.2bn).[161]
    3. The Italian government has allocated €15m (US$23m) to a program which provides glasses subsidies for low-income populations. However, the program has not been made available yet despite the anticipated start in 2021.[162]

F.1.2. Affordability of eye health services

- Italy has a universal public health service, with mostly free primary care, inpatient care, and health screenings.
- Eye care medications, intravitreal injections and eye surgeries are publicly funded services. This includes anti-VEGF treatments. Corrective lenses are not subsidised currently. However, legislation has been passed to introduce an eyeglasses subsidy (this is listed in Table F.1). Free eye screening is available for some parts of the population, and partially subsidised for others. for further detail.[163]

Table F.1: Italian eye health services by level of subsidisation

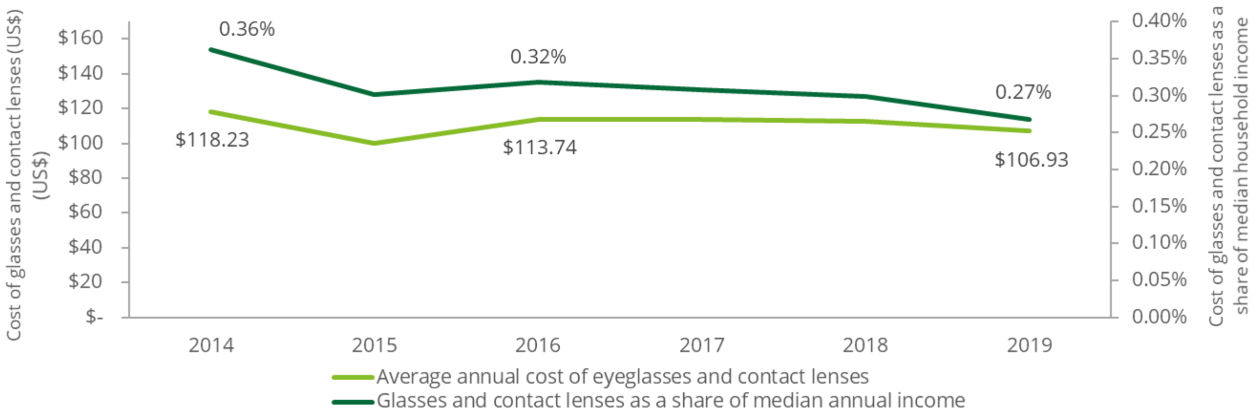
	Italy
Eye screening services	Eye screening is partially subsidised in Italy for those over a low-income threshold.[164] A special fully subsidised program is available for those aged 40 or older across 40 Italian cities through mobile eye screening vans. [165]
Corrective lenses (glasses and lenses)	A glasses subsidy was recently passed in Italy for the low income population, but is not yet available.
Medication (including eye drops)	Prescription medications for chronic conditions are fully subsidised.[163]
Intravitreal injections (e.g., Anti-VEGFs treatments)	Anti-VEGF treatments are fully subsidised by the National Health Service.[166]
Eye surgeries	Outpatient, primary and inpatient care is generally full subsidised.

KEY: Not publicly funded | Partially funded or publicly funded for eligible persons | Publicly funded for the whole population

Source: As indicated in the table.

- Given corrective lenses are not subsidised, these tend to represent out-of-pocket costs. The average cost of eyeglasses and contact lenses to the consumer in Italy was around US$107 per year, or 0.27% of median income in 2019. The cost to the consumer and its share of median annual income have both declined over the five years to 2019, indicating improving affordability.[161] This is presented in Chart F.2.
- Eyeglasses and contact lenses represented 11.61% as a share of OOP health expenditure in 2021.[161]

Chart F.2: Italian health expenditure by payer



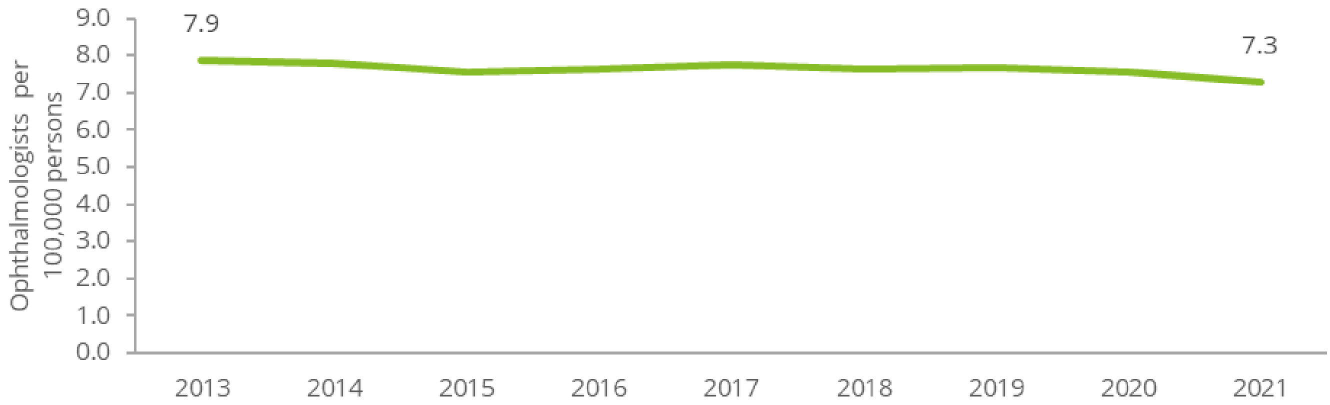
Source: Istat (2022).

- The Italian government has recently announced a €50 (US$76) subsidy for the purchase of corrective glasses and contact lenses for low-income populations from 2021-23, however the program is not yet operational.[162]

A1. Eye health workforce

- There are two main types of eye health workforce in Italy:
    1. Ophthalmologists - who prescribing corrective lenses, make diagnoses, and treat eye diseases.
    2. Optician-optometrists - who conduct vision tests, measures any issues and can prescribe corrective lenses. However, these optician-optometrists cannot make diagnoses, prescribe pharmaceuticals or conduct treatments.[167]
- As of 2021, there were 7.3 ophthalmologists per 100,000 persons in Italy (Chart F.3 and Table F.2), a decrease from 7.9 per 100,000 in 2013.[168]
- There is reported to be a shortage of eye health workers across Italian regions, leading to gaps in services. However, it is not clear which type of eyecare personnel are most subject to shortages.
- There is no data to indicate the number of optometrists or allied ophthalmic personnel.

Chart F.3: Ophthalmologists per 100,000 persons 2013-21



Source: Italian Ophthalmological Society (2022).

Table F.2: Eye health workforce estimates in Italy

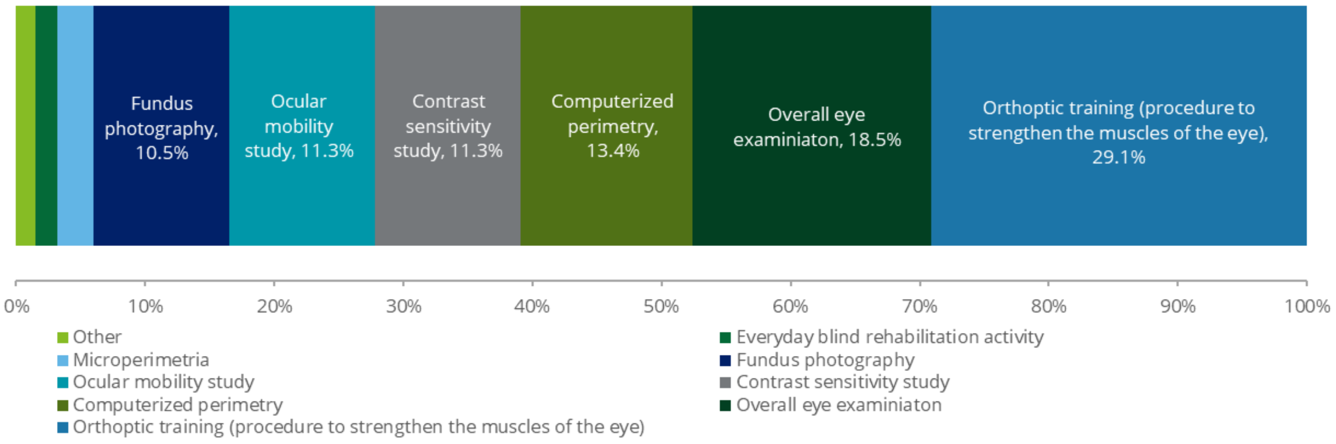
Category	Estimate	Estimate density (per 100,000)	Source
Ophthalmologists	4,300	7.3	Italian Ophthalmological Society (2021 estimate)

Source: As indicated in the table.

F.1.3. Eye care strategy, policy and infrastructure

- Italy's eye health strategy is composed of two components: the **National Prevention Plan (NPP)** which outlines the approach to central planning of preventative health and health promotion activities and the **National Technical Committee for the Prevention of Blindness** who is responsible for promoting information campaigns on eye diseases and developing eye health guidelines**.** The two components to Italy's eye health strategy are detailed in more detail below:
  - The second macro-objective of the **NPP** focuses on *preventing the consequences of sensorineural disorders, low vision area and blindness*. The key action to address this objective has been a program of screening at birth and the age of three by paediatrician and ophthalmologist.[160]
  - The **National Technical Committee for the Prevention of Blindness** performs the following actions within groups:
    1. collect data on visual impairment,
    2. develop guidelines for prevention of visual impairment,
    3. monitor activities of organisations active in prevention of vision impairment in Italy to optimise resources,
    4. monitor international cooperation initiatives,
    5. implement the National Prevention Plan
    6. promote information projects and programs in accordance with the WHO global action plan 2014-19.[160]
- A key element of Italy's eye health infrastructure is their regional and national centres for visual rehabilitation. Italy has a strong focus on visual rehabilitation centres for those diagnosed with vision impairment or blindness. There are 8 centres for vision rehabilitation in Italy per 100,000 persons. Italy also has a National Centre for Visual Rehabilitation which conducts a number of procedures to assist those with sight loss such as procedures to strengthen the muscles in the eye and vision testing. The most common service provided was orthoptic training (where the muscles of the eyes are strengthened), followed by overall eye examination.[160] This is represented in Chart F.4.

Chart F.4: Number and type of eye health services provided by the National Centre (adults)



Source: Ministry of Health (2021).

F.2. Eye health output findings

Italy - Eye health output key findings	
Number	**Key finding**
KF4	Eye care programs are determined by the local governments of Italian regions. There is therefore **variation across the country, both in terms of the availability and range of services available.**
KF5	While **eye screening programs focus on infants and children**, there is a mobile eye screening service for those aged 40+ across 40 Italian cities.

F.2.1. Availability and utilisation of eye screening services

- Eye screening in Italy is mostly delivered at a regional level, and generally focuses on preventative childhood screening. Vision screening is funded by national health insurance. The delivery of vision screening programs is decided upon by public health organisations and local government.[169]
- For children, eye screening begins at birth (by an ophthalmologist and paediatrician), with further screening at the age of three by a paediatrician, ophthalmologist or orthoptist.[160] Between the ages of 3-7 years, children are screened twice by a paediatrician, orthoptist, or ophthalmologist in a hospital or school. [169]
- For adults aged 40+, the Vista in Salute Project is a mobile eye screening service conducted in the squares of 40 Italian cities. The project offers free ophthalmological checks for the prevention of glaucoma, diabetic retinopathy and maculopathy.[160] Some regions also offer free eye screening programs for those with diabetes.[170]

F.2.2. Availability and utilisation of eye treatment services

- Generally, there is reported to be a lack of national homogeneity of eye health services in Italy, given that each Italian region have their own directive. This is something reported to be a challenge more broadly than within just the eye health system. The provision of health services is reported to vary significantly based on the way individual regions choose to design them. This leads to variation in the availability, experience and outcomes of eye health services across regions.[171]
- There is limited data to support assessments on the availability of eye treatment services as most publicly available data points were point in time and only on specific eye services. For example:
  - As of 2019, Italy's cataract surgical rate was 1,088 per 100,000 persons.[172] No time series data is available to compare this rate over time. In 2019, the median wait time for cataract surgeries was 25 days.[173]
  - In the year to October 2019, the total number of naïve patients (first treatment with intravitreal VEGF inhibitors) was 159,709. Since 2016, the usage of aflibercept has remained stable. It is the most common anti-VEGF treamtent with 1,200 eyes started per month. The usage of ranibizumab has also been relatively constant at around 1,000 eyes per month.[174]

- There is evidence of unaddressed eye health needs in the country. In Italy in 2018, around 30,000 cases of vision impairment were diagnosed with vision impairment or blindness but did not receive rehabilitation services for the visual impairment or blindness. This was reportedly driven by staffing shortages, increased demand for evaluations, and a lack of spaces for rehabilitation.[160]

F.3. Eye health outcome findings

Italy - Eye health outcome key findings	
Number	Key finding
KF7	More people in Italy have moderate vision impairment in 2019 when compared to 2015, however this appears to be driven by the ageing of the population, with age-standardised prevalence decreasing in all categories over the last three decades.

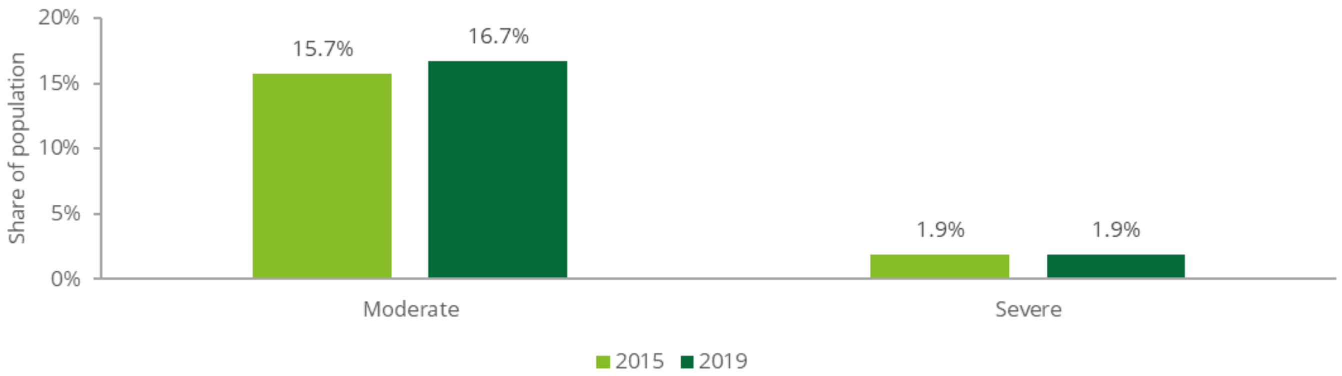
F.3.1. Quality of eye health services

- No data was available on the quality of eye health services in Italy.

F.3.2. Prevalence of vision impairment and blindness

- The prevalence of AMD, glaucoma, cataract, retinal vascular diseases have been driven by longer life expectancies and ageing populatio.[175,160]
- Based on Italian government data, the prevalence of blindness in Italy was 0.18% of the population in 2021, or 108,856 people (Chart F.5).[176] The crude prevalence of moderate vision impairment was 16.7% in 2019, an increase from 15.7% in 2015. This is likely driven by the ageing of the population, with older people more likely to experience vision impairment, and this data not being age standardised. The prevalence of severe vision impairment, however, has remained constant at 1.9%.[177] It should be noted that although the definitions of these categories are not specified, they would likely vary when compared to measured used in other countries.

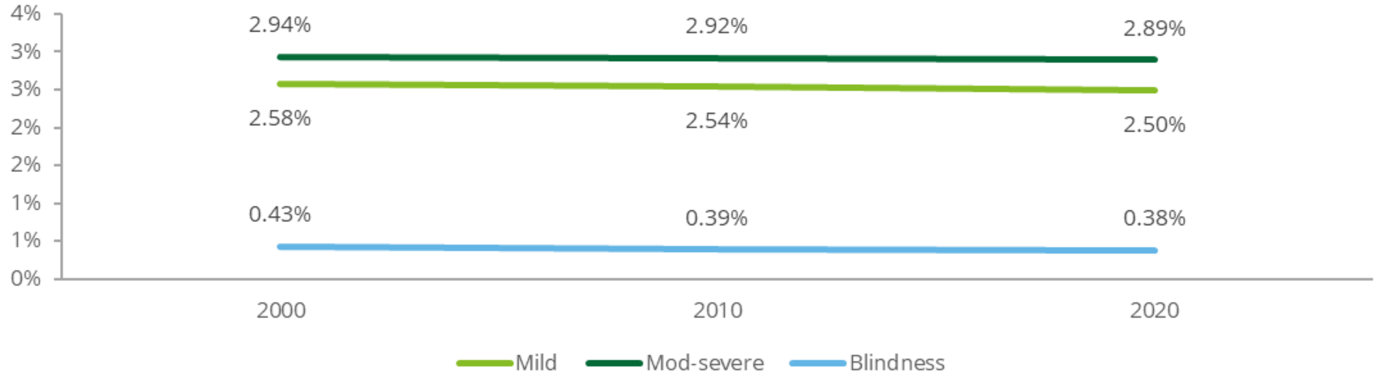
Chart F.5: Prevalence of vision impairment as reported by Istat



Source: Istat (2022).[159]

- Based on estimates derived from the Global Burden of Disease study, the age-standardised prevalence of total sight loss in 2020 was 5.77% in 2020. This represents a decrease in all categories from 2000 and 2010 (Chart F.6). This demonstrates that when the ageing of the population is removed as a factor, the prevalence of vision impairment in Italy is decreasing over time.[112]

Chart F.6: Prevalence of vision impairment as reported by GBD



Source: GBD (2020).[20]

Appendix G: Country data report: Japan

Japan – Country Fast Facts

Data availability: **Good**

Data quality: **Good**

National profile

High income country

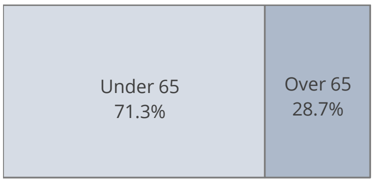
Population: 125.7 million

GDP: US$4.94 trillion

GDP per capita: US$39,285

Source: World Bank Data (2022)

Population age profile



Prevalence of vision loss

5% of the Japanese population have vision loss or blindness

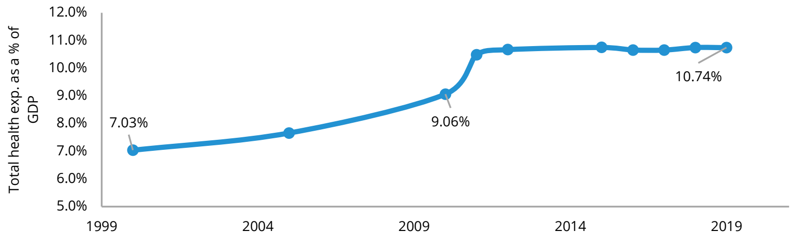
The total number in persons:

6.6m

Source: GBD (2020)

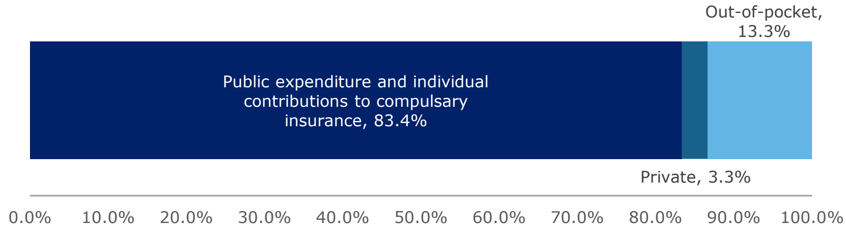
Health system at a glance

- Japan has a universal compulsory health insurance system funded by tax revenue and individual contributions. Health insurance plans are employment- or residence-based.
- Total health expenditure as a percent of GDP was 10.74% in 2019. This is an increase from 7.03% and 9.06% in 2000 and 2010, respectively.



Source: World Bank Data (2022)

- In Japan, approximately 83% of health expenditure is publicly funded. Other sources of funding include consumers (13.3% of total health expenditure) and private sources (3.3%).



Source: Commonwealth Fund and OECD (2022)

> The projected increases in the prevalence of visual impairment over time reflect the demographic changes of a declining and aging Japanese population... The burden of disease due to visual impairment and imposed on society is likely to increase.

Source: Yamada (2009)

KEY FINDINGS

For Japan

1	**Japan spends approximately 2.65% of total health expenditure on eye health.** This expenditure is largely in response to the demand for eye care of Japan's **ageing population**, with 67% of expenditure directed to this age group. While the value of eye health expenditure has increased over time, it has diminished as a share of total health expenditure.
2	Japan is among the world's most aged populations, with 28.7% aged over 65. People in this age group tend to experience higher prevalence of many eye diseases, such as cataract and age-related macular degeneration. As such, the eye health focus in Japan is closely linked to the broader focus on the health issues associated with an **ageing population**.
3	Japan **does not have comprehensive eye screening programs across the population**, meaning that people may miss out on preventative care without early detection of eye diseases. As such, for many Japanese residents, the main interactions with eye health systems are in **childhood (offered through annual health checks) and old age**.
4	The **prevalence of Japan's visual impairment has stayed relatively consistent over time.** The age-standardised prevalence of vision impairment in Japan is 5.2%. Of the total population, 3.4% have mild vision impairment, 1.7% have moderate to severe vision impairment, and 0.1% experience blindness.
5	Despite Japan's level of expenditure on eye health, the lack of general screening may mean that over a person's lifetime, they may have very little awareness or interaction with the eye health system. This can lead to **gaps in preventative care.**

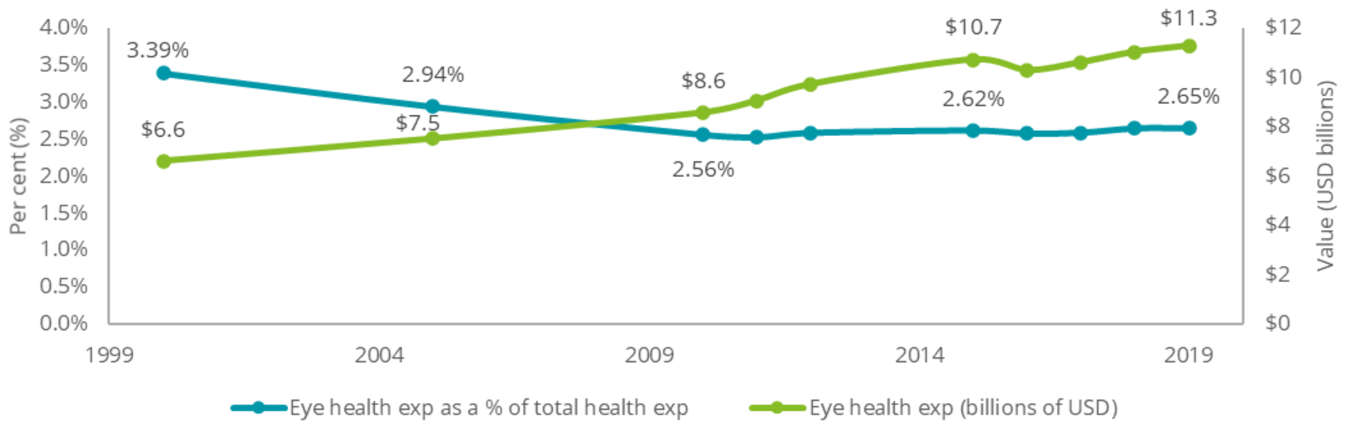
G.1. Eye health investment findings

Japan - Eye health investment key findings	
Number	**Key finding**
KF1	Japan spends approximately 2.7% of its total health expenditure on eye health. This expenditure is largely in response to the demand for eye care of Japan's **ageing population**, with 67% of expenditure directed to those aged 65 and over. While the value of eye health expenditure has increased over time, it has diminished as a share of total health expenditure because of larger increases in expenditure across **other disease areas**.
KF2	Japan has a **large eye care and optician workforce**, with 12.5 ophthalmologists and 5.4 opticians per hundred thousand population. All eye care is **partially publicly subsidised**, either for a portion of the population or for a proportion of the cost, which eliminates barriers to eye care services.
KF3	Japan is among the world's most aged population - 28.7% of its residents are aged over 65. People in this age group tend to experience higher prevalence of many eye diseases, such as cataract and age-related macular degeneration. As such, the eye health focus in Japan is closely linked to the broader focus on the health issues associated with an **ageing population**.

G.1.1. Eye health expenditure

- Japan's total health expenditure represented 10.74% of GDP in 2019, an increase since 2010 (9.06%) and 2000 (7.03%).[178]
- Of this total health expenditure, expenditure on eye health care in Japan represents 2.65% of total healthcare spending as of 2019.[35] The primary driver of this high level of expenditure is the demand for eyecare services among the ageing Japanese population, given the higher prevalence of eye conditions and vision impairment among this group.[179]
- As can be seen in Chart G.1, despite the value of eye health expenditure increasing from 2000-19, it has declined as a share of total health expenditure due to increases in expenditure on other disease areas.[35]

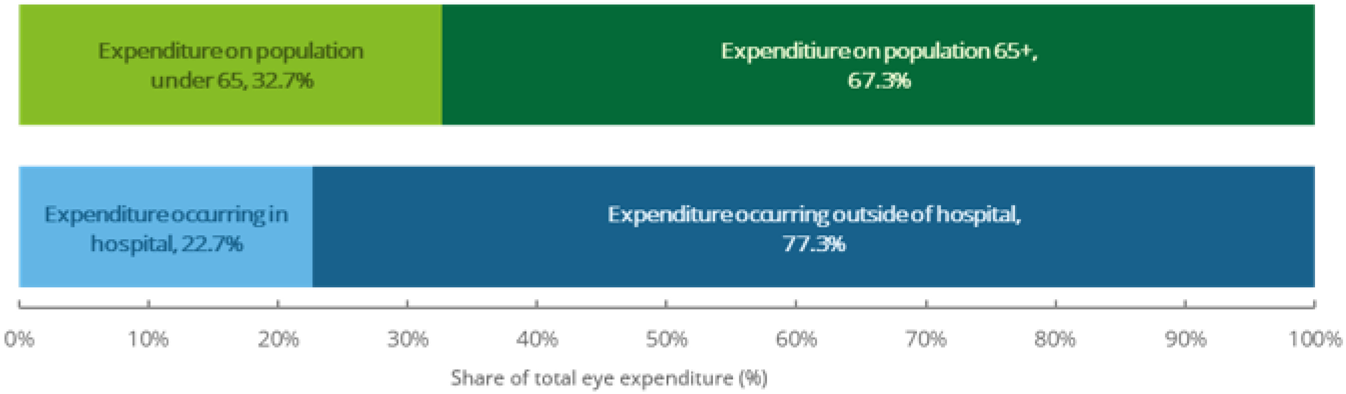
Chart G.1: Eye health expenditure in US$ million and as a share of total health expenditure



Source: Ministry of Health, Labour and Welfare (2019).[35]

Chart G.2 disaggregates eye health expenditure by age of recipient and location. The chart shows that more than two-thirds (67.3%) of eye health expenditure is directed to those aged above 65 years old. People in this 65 and older age group tend to experience higher prevalence of many eye diseases, such as cataract and age-related macular degeneration.[180] This shows that Japan's eye health expenditure mainly focuses on addressing the needs the ageing population.[35] Further, this chart shows that 77.3% of the total eye health expenditure also occurs outside of the hospital system (i.e., in eye clinics), and the remaining 22.7% occurs in the hospital system such as inpatient and outpatient settings.[35]

Chart G.2: Eye health expenditure by age of recipient and location (2019)



Source: Ministry of Health, Labour and Welfare (2019).[35]

G.1.2. Affordability of eye health services

- In general, affordability around eye care is not reported to be an issue in Japan, except for advanced eye conditions requiring more complex procedures such as laser assisted in situ keratomileusis (LASIK).[179]
- As seen in Table G.1, eye screening services, corrective lenses, medicines, intravitreal injections and eye surgeries are partially subsidised in Japan, either for a proportion of the population or of the cost. Most eye health care, such as medicines and surgeries, are subsidised to the same partial level as other Japanese health services. The exception is eye screening and corrective lenses, which are subsidised only for children. Anti-VEGF injections are also subject to the High-Cost Care Support System, where extra funding is provided to reduce the burden of the high-cost treatments.

Table G.1: Summary of preventative and treatment services covered by public funding

	Japan
Eye screening services	Subsidised for school-aged children, but not for the general population.[179]
Corrective lenses (glasses and lenses)	Eyeglasses for treatment (not vision correction) publicly subsidised for children only.[181]
Medication (including eye drops)	Publicly subsidised at 70% of cost.[182]
Intravitreal injections (e.g., Anti-VEGFs treatments)	Anti-VEGF injections are subsidised at 70% of cost as are other treatments, however the High-Cost Care Support System may apply.[183]
Eye surgeries	Publicly subsidised at 70% of cost.[182]

KEY: Not publicly funded; Publicly funded for eligible persons; Publicly funded for the whole population

Source: As listed in the table. Note: Private services are available for people who chose to use these services. These services are covered by the consumer.

G.1.3. Eye health workforce

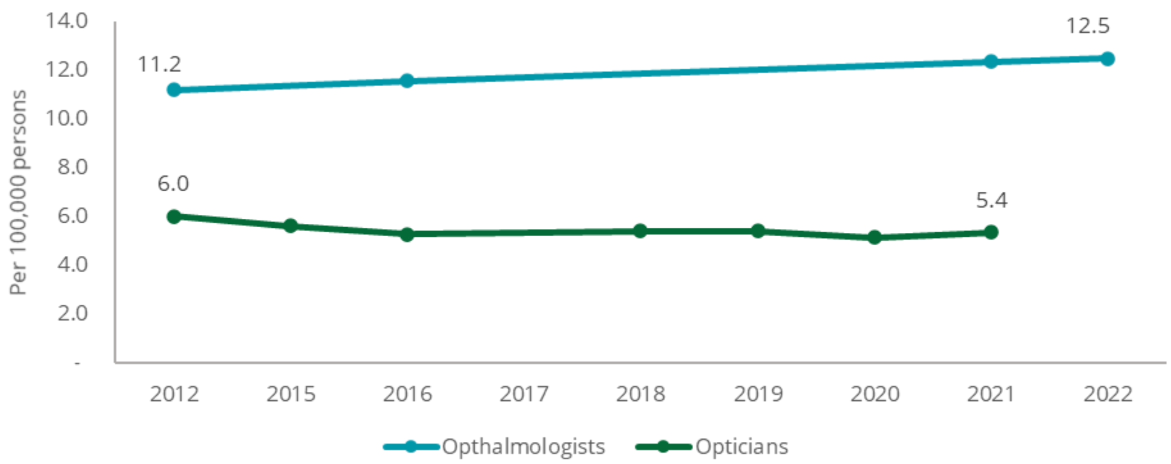
- The number of ophthalmologists in Japan totalled 12.5 per 100,000 as of 2022 (see Table G.2 and Chart G.3). A unique characteristic of Japan's eye workforce is that ophthalmologists deliver services which are more often undertaken by optometrists in other countries, such as performing eye screening tests. As such, this requires a larger eye care workforce.

Table G.2: Eye health workforce estimates in Japan

Category	Estimate	Estimate density (per 100,000)	Source
Opticians	6,731 (2021) [184]	5.4	Japan Optical Technicians Association (2021 and archived versions)
Ophthalmologists	15,681 (2022) [185]	12.5	Japanese Ophthalmological Society (2022 and archived versions)
Orthoptists	15,633 (2020)[186]	12.4	Ministry of Health, Labour and Welfare (2020)

Source: As indicated in the table.

Chart G.3: Eye health workforce per hundred thousand population



Source: Japan Optical Technicians Association (2021)[184] and Japanese Ophthalmological Society (2022 and archived versions).[185]

- As can be seen in Chart G.3 the Japanese eye care workforce has been steadily increasing since 2012. This is likely in response to increased demand for eye care amid an ageing population.
- Japan also has an optician workforce of 5.4 opticians per 100,000 population in 2021.[184] Opticians are also known as eyeglass production technicians and dispense eyeglasses to customers. As can be seen Chart G.3, the number of opticians has declined since 2012 (6.0 per 100,000 persons).

G.1.4. Eye care strategy, policy and infrastructure

- Eye health is not mentioned in the Japanese health strategy. However, it is the object of increased investment in the health space as it is linked to other age-related diseases.[179] A number of priority conditions in Japan are associated with vision impairment, such as cardiovascular disease, dementia and diabetes. This means that eye care has become a key element of the healthcare system in providing for an ageing population.[187]

G.2. Eye health output findings

Japan - Eye health output key findings	
Number	Key finding
KF4	Japan **does not have comprehensive eye screening programs** across the population, meaning that people may miss out on preventative care or early detection of eye diseases. As such, for many Japanese people the main interactions with eye health services are in **childhood and old age**.
KF5	Japan's **cataract surgical rate** is 990 surgeries per 100,000 population. This has increased by 17% in the last five years, likely due to the ageing population.

G.2.1. Availability and utilisation of eye screening services

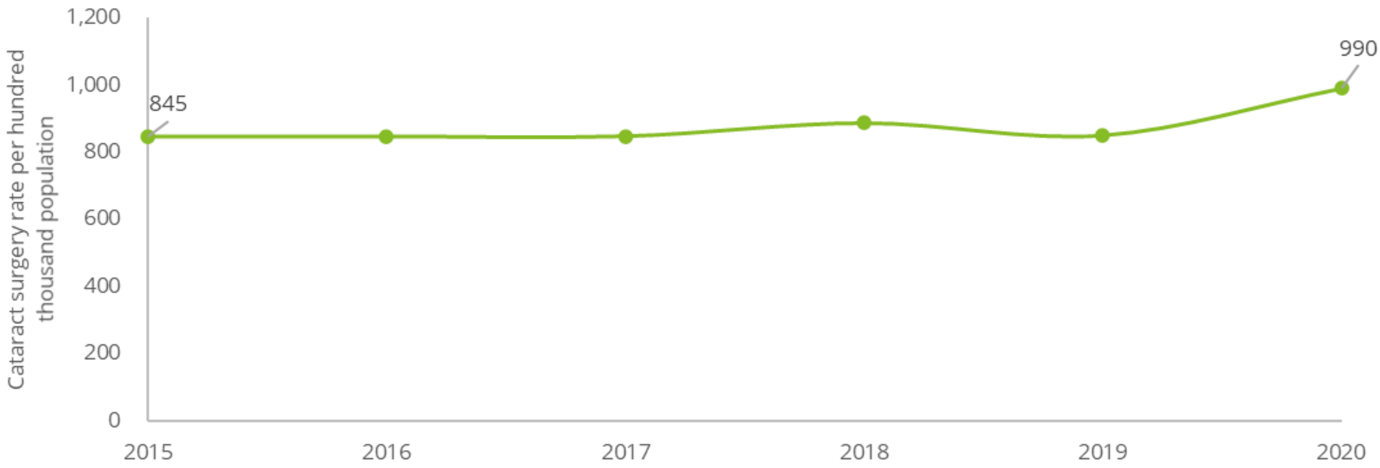
- People may only be aware of their eye health in school, and in old age when eye disease becomes an issue. As such, the window for preventative care may be missed.
- Japan has no nationwide eye screening program. However, literature suggests that a small number of programs exist under local governments, although the number and nature of these was not specified. There is no nationwide approach to vision screening in these clinics, and so their approaches differ across regions. Details around the nature of this variation was not available. For instance, the uptake of the target population can be low, and detailed examinations may not be carried out. [188] There is however anecdotal evidence that the take up of eye screening services is relatively low. The main channel through which people aged 40-74 would receive testing is through a specific health check-up. However, data shows that just 13.4% of those receiving specific health check-ups receive ophthalmic check-ups.[189]

- In every grade, Japanese school students undergo screenings for a range of issues including eyesight, but also height, weight, hearing and dental.[190]
- Literature suggests that diabetic eye examination rates in Japan are low, given the lack of comprehensive screening programs. This is attributed to referral pathways between primary care doctors and ophthalmologists being weak at a community level.[191]

G.2.2. Availability and utilisation of eye treatment services

- Japan's cataract surgical rate is 990 surgeries per 100,000 population. This is an increase of 17% from 845 per 100,000 persons in 2015 (Chart G.4).[192] This is likely due to demographics shifting towards an older population, among which cataracts are more common.

Chart G.4: Cataract surgery rate per 100,000 population



Source: Ministry of Health, Labour and Welfare (2020).[36]

- While no contemporary data is available, wait times for elective surgeries were reported to be low in 2013, although no specific figure was available.[193]

G.3. Eye health outcome findings

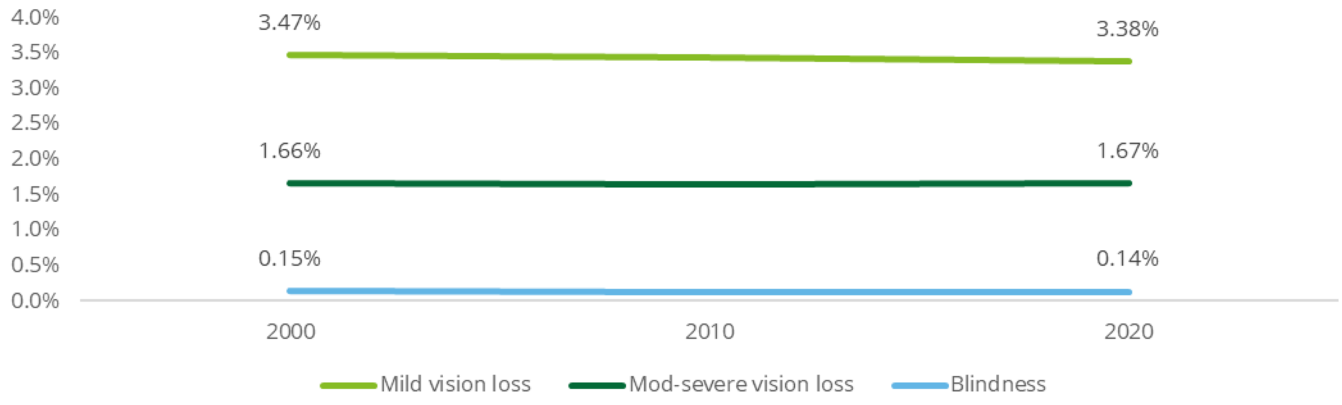
Japan - Eye health outcome key findings	
Number	Key finding
KF6	Japan's prevalence of visual impairment has stayed **relatively consistent over time**, with a slight decrease since 2000.
KF7	The age-standardised **prevalence of sight loss in Japan is 5.2%**. Of the total population, 3.4% have mild vision impairment, 1.7% have moderate to severe vision impairment, and 0.1% experience blindness.

G.3.1. Prevalence of vision impairment and blindness

- Based on estimates derived from the Global Burden of Disease study, the age-standardised total prevalence of vision impairment and blindness in the Japanese population was 5.2% (Chart G.5). Of this total, 3.4% of the Japanese population (7.5 million people) had mild vision impairment, 1.7% (3.8 million people) had moderate to severe vision impairment, and 0.1% were blind (398 thousand people). This represents a slight decrease from 2000, however very little change in prevalence has been observed over the past twenty years.[112]
- The stable prevalence rates may reflect the gap in preventative interactions with the eye health system. As a country expert reported, the lack of general population eye screening in Japan can contribute to a general lack of awareness around eye disease. As such, the general population can find themselves only interacting with eye health care once the

disease has progressed. This gap in screening in middle age when eye disease often emerges is also explored in research by Yamada et al, who suggest it could lead to progression of disease.[188]

Chart G.5: Prevalence of visual impairment by severity



Source: GBD (2020).[20]

G.3.2. Prevalence of specific eye diseases

- The leading causes of visual impairment in 2010 were glaucoma (24.3%), diabetic retinopathy (20.6%), degenerative myopia (12.2%), age-related macular degeneration (10.9%), and cataract (7.2%). These diseases collectively accounted for three-quarters of all visual impairment.[194]
- As of 2020, aggregated diseases of the eye and adnexal represented 7.13% of the total patients across hospitals and general clinics.[36]

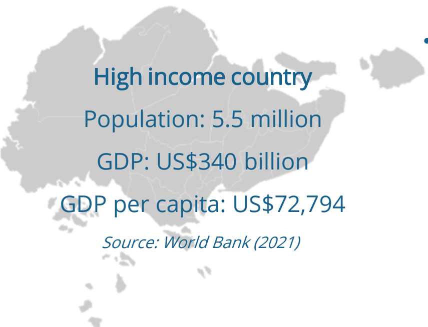
Appendix H: Country data report: Singapore

Singapore – Country Fast Facts

Data availability: **Good**

Data quality: **Adequate**

National profile



High income country

Population: 5.5 million

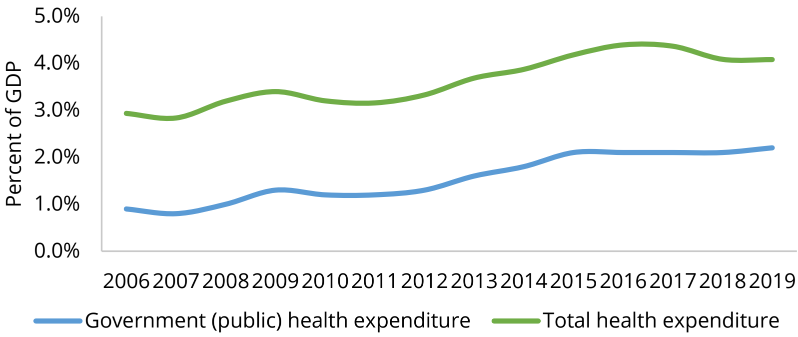
GDP: US$340 billion

GDP per capita: US$72,794

Source: World Bank (2021)

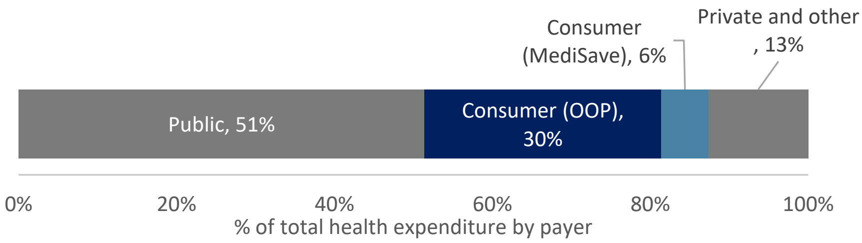
Health system at a glance

- Singapore has universal public health insurance and government mandated savings schemes (MediShield Life and MediSave), with subsidised public hospital care including eye health services at the Singapore National Eye Centre (SNEC).
- In Singapore, total health expenditure as a percent of GDP was 4.1% in 2019, an increase from 3.2% in 2010.



Source: Singapore Ministry of Health (2021), World Bank (2019)

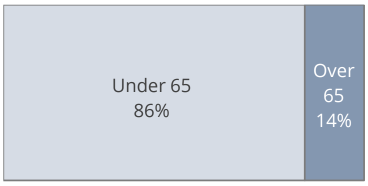
- In Singapore, around half of health expenditure is funded by the government, consumers (36%), and employer health benefits (13%).



Source: Ministry of Health (2020) & World Bank (2021). Note: The split between private and other is unavailable.

- In-patient eye health procedures (e.g., cataract surgery, glaucoma surgery) are usually fully or partially covered through public subsidies and consumers' own savings (through government-mandated MediSave).
- Out-patient eye care services (e.g., eye screening, prescription glasses) are largely paid by consumers (out of pocket expenditure).

Population age profile



Prevalence of vision loss

3% of the Singaporean population have vision loss or blindness

The total number in persons:

0.42m

Source: IAPB (2020)

Singapore has one of the highest prevalence of myopia. Based on 2019 data, 1 in 5 Singapore children are myopic by the time they turn 7 years old; 70% of Singapore students suffered from myopia by the age of 20.

Source: Ministry of Health (2019)

KEY FINDINGS

For Singapore

1	**Annual eye screening in Singapore is publicly funded for students and high-risk population cohorts** through various initiatives (i.e., population aged 60 and above, children and adolescents, and people living with diabetes). For adults without risk factors, there are **no guidelines which encourage annual or regular eye screening.** Apart from publicly funded initiatives, access to screening services are partially subsidised at public hospitals. Consumers who undergo eye screening at private clinics bear the full cost of these services.
2	**Based on estimates derived from the Global Burden of Disease study, the rate of vision impairment decreased steadily from 1990 to 2020, especially for mild conditions**. As of 2020, the age-standardised prevalence of Singaporeans with mild vision impairment was 3.27%, moderate or severe vision impairment was 2.47% and blindness was 0.18%.
3	**Singapore has a dedicated publicly funded eye hospital and an associated eye research institute – the Singapore Eye Research Initiative (SERI).** SNEC and SERI have driven significant eye health initiatives and innovative applications in Singapore, such as the establishment of the SNEC's Myopia Centre.
4	**There is no available eye health expenditure in Singapore. Total health expenditure as a percent of GDP was lower than other OECD economies at 4.1% in 2019.** The Singaporean health structure provides government subsidies in public hospitals. Singapore's three health funding schemes aim to uphold personal responsibilities and create safety nets for those in need of care. Across the three schemes, eye care services are covered only for in-patient services such as surgeries and for low-income populations on a case-by-case basis.
5	**Given the high prevalence of myopia (~80%) in Singapore, the government has deemed it to be a priority health area.** To combat this, initiatives have been implemented which ensure annual vision screening in schools (National Myopia Prevention Programme), awareness campaigns (NurtureSG), and a dedicated centre for care, detection, education, and research of myopia (SNEC Myopia Centre).

H.1. Eye health investment findings

Singapore - Eye health investment key findings	
Number	**Key finding**
KF1	There is no disaggregated data on eye health expenditure for Singapore. Total health expenditure for the nation has, however, increased from 3.2% to 4.1% in the past decade (2010 to 2019).[195] Compared to other OECD countries, Singapore's healthcare system produces some of the best healthcare metrics globally,[196]. This is evidenced through its above average life expectancy (83.5 years[197]) and below average vision impairment rate (2.94%).[112, 198]
KF2	**Total health expenditure in Singapore as a percentage of GDP has increased in the past decade (2010-2019) from 3.2% to 4.1%**, due in part to its rapidly ageing population.[195] During this period, the government's (public) share of health expenditure also rose from 32% to 41% due to increased public subsidies.[199]
KF3	**The share of out-of-pocket consumer expenditure is high in Singapore at 30% (2019).**[195] All eye health services by private providers are paid out-of-pocket. In public hospitals, eye health services for Singaporeans are partly subsidised for by the government. Selected in-patient procedures (e.g., cataract surgery and glaucoma surgery) are claimable through the government mandated MediSave.
KF4	**In Singapore, there are 3 ophthalmologists per 100,000 persons** and **46 optometrists/opticians per 100,000 persons in 2019.** In view of projected increases in demand for eye health services (due to its ageing population), there are concerns that Singapore will face a shortage of ophthalmologists in the future. This has led to calls for better utilisation of optometrists in primary care settings.[200]
KF5	The Singaporean Government's emphasis and investment in eye care is evidenced by the establishment of **SNEC and SERI**. The SNEC is the designated national public eye centre providing specialist eye care to more than 50% of patients in the public sector.

H.1.1. Eye health expenditure

- **There is no data on eye health expenditure in Singapore**. However, there is evidence of government resource allocation towards eye care services (see Section H.1.2) and emphasis on eye health through research in this area (see Section H.1.4)
- The Singaporean Government has a four-step universal health scheme (which applies to eye health services) in line with their principle of "personal responsibility"[201, 202]:
  - Singaporean citizens and permanent residents can access **government subsidised** health services in public hospitals.
  - **MediSave** is a mandatory monthly saving health scheme that can be withdrawn to fund a prescribed range of hospital treatments such as cataract surgery and anti-VEGF injection. However, it does not cover eye screening, prescription glasses, and most refractive error surgery (with some exceptions).[203]
  - **MediShield Life** is a basic health insurance that subsidises large hospital bills and selected costly outpatient treatments, such as glaucoma surgery and cataract surgery.[204] The Government provides significant subsidies to help keep premiums affordable. Consumers utilise MediSave contributions to pay for MediShield Life insurance premiums. It is also possible for consumer to purchase private health insurance to enhance the MediShield Life coverage.[205]
  - **MediFund** is a government endowment fund that provides a safety net for needy people.[206]
- **Singapore's total health expenditure as a percentage of GDP has recorded steady increases** since 2010 from 3.2% to 4.1% in 2019. This trend contrasts with the relatively steady rate of expenditure (as a proportion of GDP) in the earlier decade (where total healthcare expenditure hovered between 2.8%-3.6% of GDP). In level terms, total healthcare expenditure has increased from S$120 billion (US$ 85 billion) to S$271 billion (US$ 193 billion) between 2010 to 2019. These increases are mainly attributable to an ageing population and a trend towards earlier diagnosis of chronic conditions, close monitoring and follow up in Singapore.[207]

- **In terms of payers, government expenditure constitutes half of total health expenditure**. Government expenditure on healthcare has increased sharply from S$4.1 billion (1.3% of GDP; US$ 2.9 billion) in 2012 to S$11.1 billion (2.2% of GDP; US$ 7.9 billion) in 2019. Between 2009 and 2016, the government's share of health expenditures increased from about 32% to 41% due to increased public subsidies. This has led to a reduction of OOP share of health expenditures from 43% to 31%.[208]
- Despite recent increases in government health expenditure, the proportion of out-of-pocket expenditure (% of current health expenditure) in Singapore remained high at 30% in 2019. As a comparison, the proportion of out-of-pocket expenditure across other OECD countries was 13.9% of total health expenditure in 2019.[209]

H.1.2. Affordability of eye health services

- The government supports access to preventive and curative eye care services mainly through full or partial subsidy. However, the level of subsidy provided varies according to the type of service, the residency status of consumers and the income levels of Singaporean residents. Table H.1Table H.1 summarises the types of preventative and treatment services covered by public funding. The table shows that:
  - **Specific population cohorts** (school students, those aged above 60 and people living with diabetes) have access to complimentary annual eye screening services.[210] However, the general public would need to pay a government subsidised amount (which ranges between S$37 to S$56 or US$26 to US$40) for comprehensive eye check-ups in public hospitals.
  - **Consumers typically bear the full cost of corrective lenses** (e.g., prescription glasses, contact lenses). Other early intervention eye treatments (such as glaucoma medication and prescription eye drops) are not publicly subsidised.
  - **MediSave covers full or partial expenses of selected in-patient eye care services** (between 20-100% based on cost and type of operation), including cataract surgery, glaucoma surgery,[211] and some anti-VEGF injections, with a maximum withdrawal limit applied for each service type as specified by the Singaporean government Central Provident Fund Board.[212]
  - The use of **MediFund to cover remaining payments** is assessed for low-income populations on a case-by-case basis.[206]
- Despite continued government investment in this area, some studies have highlighted scope to improve the affordability of eye health services:
  - The 2020 Singapore Epidemiology of Eye Disease Study of 985 individuals found that nearly two-thirds of Singaporeans with vision impairment reported difficulty affording eyeglasses.[213] Another study estimated that the lifetime cost per capita is S$21,616 (assuming 80 years' duration), and in aggregate, myopia costs Singaporeans a total of S$959 million per year.[214]
  - A 2021Markov model study based on a SNEC hypothetical patient cohort of anti-VEGF treatment found that 26% of people surveyed do not have to pay out-of-pocket costs, while 18% indicated that cost was poorly covered.[215]

Table H.1: Summary of preventative and treatment services covered by public funding

Singapore	
Eye screening services	Comprehensive eye tests are available to the general public at a government subsidised cost in public hospitals. Free eye tests are provided for Singaporeans aged 60 and above, students, and people living with diabetes).
Corrective lenses (glasses and lenses)	Out-of-pocket expenses – consumers bear the full costs.
Medication (including eye drops)	Eye medications (e.g., eye drops and glaucoma medication) are generally not publicly subsidised and are consumer OOP expenses.
Intravitreal injections (e.g., Anti-VEGFs treatments)	Selected anti-VEGF injections are subsidised and MediSave-claimable (e.g, Avastin costs $120 and is fully claimable under MediSave, while Eylea costs $1,250 and only a maximum of $650 is claimable).[216]

Singapore	
Eye surgeries	In-patient eye surgeries are subsidised in public hospitals and claimable through MediSave with a maximum claimable amount applies according to government specified list. The remaining costs are OOP expenses.

KEY: Not publicly funded | Publicly funded for eligible persons | Publicly funded for the whole population

Source: As listed in the table. Note: Private services are available for people who chose to use these services. These services are covered by the consumer.

H.1.3. Eye health workforce

- In Singapore, the eye care workforce is primarily made up of opticians, optometrists, and ophthalmologists, with opticians being the most abundant:[217]
  - There are 3 different categories of **opticians** in Singapore – dispensing only, refraction and dispensing, and contact lens practice. All opticians are equipped with the skills to dispense and fit glasses based on prescriptions from optometrists or ophthalmologists.
  - **Optometrists** are primary eye care providers who specialise in performing eye examinations. Through the tests, they can detect eye infections and common eye diseases such as cataract, glaucoma, diabetic retinopathy, and age-related macular degeneration. They are also qualified to practice opticianry.
  - **Ophthalmologists** are medical doctors who specialise in managing eye problems. They are trained to diagnose and treat eye diseases, including prescribing medications and performing eye surgeries. Ophthalmologists are generally situated in specialist eye hospitals and clinics.
- **Eighty-nine percent of optometrists and opticians work in the private sector**, with 210 in public, 2,345 non-public, and 81 not in active practice.[218] In contrast, more ophthalmologists work in the public sector, with SNEC alone employs roughly 30-50% of the total workforce of ~200.[219] **Optometrists in Singapore represent a skilled underutilised primary eye care provider.** There have been calls for task-shifting from ophthalmologists to optometrists to manage future increases in eye care demand due to the ageing population.[220]
- Government workforce data estimates that there are a total of 2,636 opticians and optometrists in 2019,[218] which is equivalent to a density of 46 per 100,000 persons.
- Table H.2 provides a breakdown of eye health workforce personnel based on literature review and existing government data.

Table H.2: Eye health workforce estimates across Singapore

Category	Estimate	Estimate density (per 100,000)	Source
Ophthalmologists	162-239	2.7-4.2	Resnikoff (2020),[221] John (2014)[222], Zheng (2013)[223], Singapore Society of Ophthalmology membership (2016)[224]
Optometrists	58-220	1-4	John (2014)[222], Singapore Optometric Association membership (2022)[225]
Opticians	2,416-2,578	44-46	Government of Singapore (2019)[226]

Source: As indicated in the table.

- Similar to other advanced nations, Singapore is experiencing a rapidly ageing population. This is likely to lead to an increase in eye diseases and demand for eye care. Against this backdrop, a study on eye workforce requirements found that the required number of ophthalmologists is projected to increase by 117% between 2015 to 2040[227]. However, in recognition that eye care training is typically long and most costly, there have been calls for more tasks to be shifted from ophthalmologists to optometrists.[220]

- **The government has recently taken innovative steps to build a strong pipeline of eye health workers**. Recently, the SNEC has worked in partnership with a pharmaceutical company (Santen Pharmaceutical) to jointly develop and deploy an enhanced educational programme deploying a combined online and offline platform to address the shortage of trained healthcare professionals supply to contribute to development of the eye care ecosystem throughout the region. The first initiative under the partnership is the Ophthalmic Technician training program in Singapore.[228]

H.1.4. Eye care strategy, policy and infrastructure

- The Singaporean Government supports the delivery of eye care services and eye care strategy through the following key initiatives:
  - **The establishment of a national eye centre** which coordinates the provision of specialised ophthalmological services with emphasis on quality education and research (i.e., SNEC). SNEC currently provides specialist eye care to more than 50% of public health patients. SNEC provides a range of specialist eye care services include diagnostic and screening services, treatment for cataracts, and management of sight-threatening eye diseases such as glaucoma, diabetic retinopathy, and AMD. It is also one of the few institutions in the world which records every major operation for teaching and monitoring to ensure high standards and positive outcomes.[219]
  - **The establishment of an eye research institute (i.e., SERI) on ophthalmic and vision research.**[229] To date, SERI has published 3,405 scientific papers, secured external competitive grants worth more than $309 million, and collaborates with global organisations such as Johnson & Johnson to drive research innovation in myopia.[229] SERI's research has generated impact in terms of clinical applications and continuous novel improvements in Singapore's eye care.[230]
  - **The promotion of regular eye screening services**. SingHealth has published guidance that specific population cohorts (e.g., babies, children and teenagers and people with risk factors such as diabetes, high blood pressure or are taking prescription medications which may impact eyes) should undergo regular eye examinations.[231]
- In Singapore, 75% of teenagers in Singapore have myopia or are dependent on glasses. In response to this, the Singaporean Government has implemented different initiatives since 2001 to address the high prevalence of myopia, including:[27]
  - The **National Myopia Prevention Programme** which performs annual vision screening in pre-schools, primary and secondary schools
  - **NurtureSG** which promotes awareness of parents on the importance of preventing early onset myopia
  - **SNEC's Myopia Centre**, established to provide care and early detection for myopia, educate the public on preventive measures, as well as advance clinical research.

H.2. Eye health output findings

Singapore - eye health output key findings	
Number	**Key finding**
KF6	**Eye screening programs are available for specific population cohorts**, including Singaporeans aged 60 and above, students, and people living with diabetes.
KF7	There is scope to increase the take up of comprehensive eye examinations. A 2015 SERI survey of people aged 50-79 found that **only 38% actually attended screening at least once a year**, although 67% of respondents felt that it was important to go for annual eye screening.
KF8	Singapore has a median wait time of 3.1 weeks for eye care surgery.
KF9	In Singapore, **unmet eye needs are evident in the cases of cataract and refractive services**. A 2013 study found that between **4.9%-7.2% of participants living with cataract** did not access cataract surgery, while between **10.7%-12.3% of participants with refractive errors** had not had spectacles or had under corrected spectacles or prescription.[223]

H.2.1. Availability and utilisation of eye screening services

- **Eye screening services are available to the Singaporean population** through one of three complimentary programs for certain population groups, or paid services at public and private eye clinics:

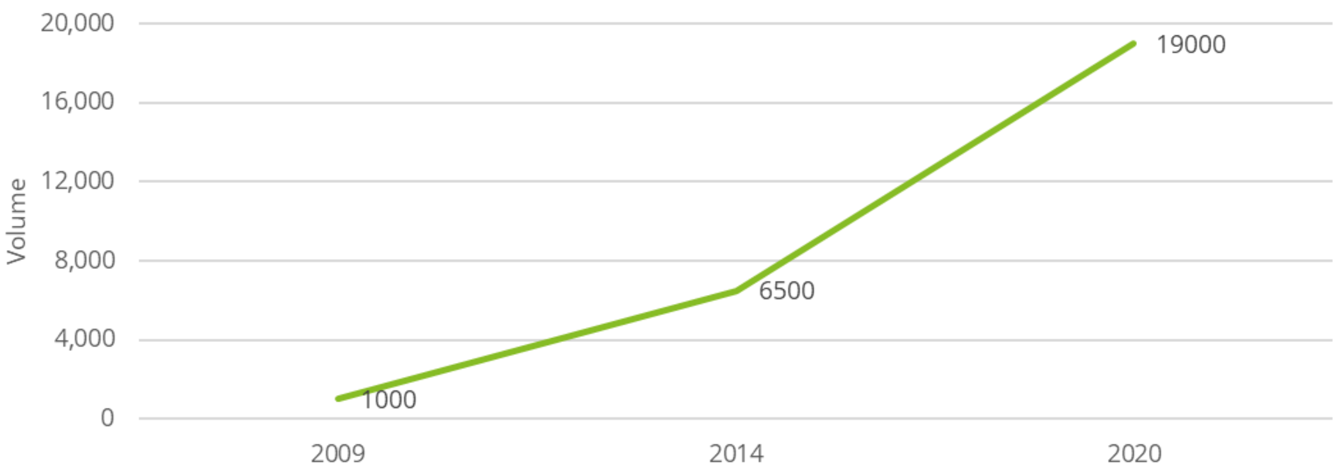
- **Project Silver Screen** for Singaporeans aged 60 and above[232]
- **Annual eye tests** for students in preschools, primary and secondary schools[233]
- **Singapore Integrated Diabetic Retinopathy Programme** for people living with diabetes.[234]

- A population-based study in 2011 which surveyed over 9,000 Singaporeans has identified scope for higher uptake of regular eye screening. Based on the American Academy of Ophthalmology Preferred Practice Pattern Guidelines, individuals with specific risk factors[235] are encouraged to undertake annual eye screening services. However, the study revealed that between 22% to 40% of these individuals do not have access to annual (or more frequent) eye examination services. The study attributed this level of unmet need to workforce shortages – specifically the lack of ophthalmologists and the fact that opticians do not currently deliver regular annual eye examination services.

H.2.2. Availability and utilisation of eye treatment services

- Eye health service utilisation is proxied through the following data indicators: cataract surgery, and refractive correction.
- **Unlike other OECD countries, Singapore does not publish recommended maximum waiting times for cataract surgeries.** Maximum waiting times for cataract surgeries can vary extensively across countries, which in part reflects different constraints on funding and resourcing. As of 2015, Singapore's eye care surgeries recorded a median waiting times **of 3.1 weeks.**[236]
- SNEC is a key service provider of eye health treatments. Approximately 17,000 cataract surgeries are performed at SNEC annually.[237] More than 40,000 glaucoma cases are managed annually (2,000 from other countries) at the SNEC, and more than 600 glaucoma surgeries are performed.
- **The proportion of Singaporeans with refractive errors that utilise spectacles or other corrective treatment ranges between 42.7% to 65.5%.**[223] A 2020 study found that in the multi-ethnic Singaporean population with vision impairment, almost one-third had low eyecare utilisation.
- **The utilisation of anti-VEGF injections increased significantly** from 1,000 units in 2009 to 6,500 in 2014, and to 19,000 in 2020 at the SNEC alone (Chart H.1).[237]

Chart H.1: Anti-VEGF injection utilisation in Singapore (2009, 2014, 2020)



Source: SNEC (2017).[237]

- **There is anecdotal evidence that some Singaporeans do not have access to eye treatments.** A study which surveyed 925 Singaporean residents (n=925) found that 68.8% of people with visually significant cataract were unaware of their cataract status.[238]
- **Specific population cohorts were assessed to have unmet eye care needs.** A population based study (n=9,000) found that an estimated 4.9%-7.2% of Singaporeans who live with cataract had not accessed cataract surgery,[223] while around 10.7%-12.3% of Singaporeans who have refractive errors in one or both eyes had not had prescription glasses (or had under corrected glasses).[223] There are also ethnic variations in needs for eye care services in Singapore (Singaporeans is

made up of three major ethnic groups – Chinese, Malay and Indian) due mostly to genetic predisposition and lifestyle changes.

H.3. Eye health outcome findings

Singapore - Eye health outcome key findings	
Number	**Key finding**
KF10	**The quality of eye health services and procedures is high**, as proxied by the **high success rates** of cataract surgery (99%), corneal transplant (93%), and refractive corrective surgery (99%) at the SNEC.
KF11	As of 2020, 3.43% (or approximately 195,000) of the Singaporean population had mild vision impairment, 2.72% (or approximately 155,000) had moderate to severe vision impairment and 0.22% (or approximately 12,500) were blind.
KF12	**Singapore has one of the highest prevalence of myopia in the world**. It is estimated that approximately 20% of Singaporean children (age 7 or under) have myopia, with the proportion increasing to 80% among college students.

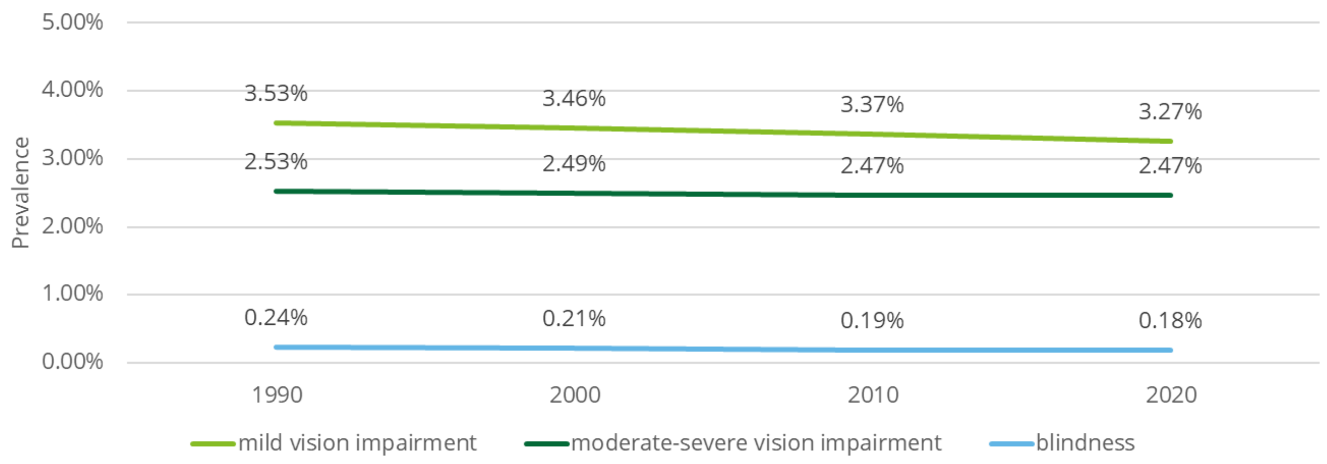
H.3.1. Quality of eye health services

- **Eye health service quality in Singapore is high,** as proxied through the high success rates of cataract surgery, corneal transplant, and refractive corrective surgery:
  - **From 2010 to 2014, 98%-99% of cataract surgeries performed at SNEC had a visual success rate classified as "good" (PVA 6/12 or better).**[237] The average incidence rate of infection (i.e., endophthalmitis) was very low at 0.0208% based on clinical criteria.
  - Eighty percent of all corneal transplants are performed at the SNEC. The three main types of corneal transplant procedures - penetrating keratoplasty, endothelial keratoplasty, and anterior lamellar keratoplasty – have a visual success rate between 82.9-92.9%.[237]
  - Over the past 10 years, nearly 100% of people at the SNEC undergoing laser refractive surgery procedures achieved a good outcome (PVA 6/12 or better).[237]

H.3.2. Prevalence of vision impairment and blindness

- Based on estimates derived from the Global Burden of Disease study (2020),[112] the age-standardised prevalence of Singaporeans having **mild vision impairment is 3.27%** (driven by the high prevalence of myopia); while the proportion of Singaporeans having moderate or severe vision impairment is 2.47%. The proportion of Singaporeans with blindness is 0.18%.
- The **age-standardised prevalence of vision impairment decreased steadily** from 1990 to 2020,[112] especially for mild condition (Chart H.2).

Chart H.2: Vision impairment prevalence in Singapore (1990-2020)



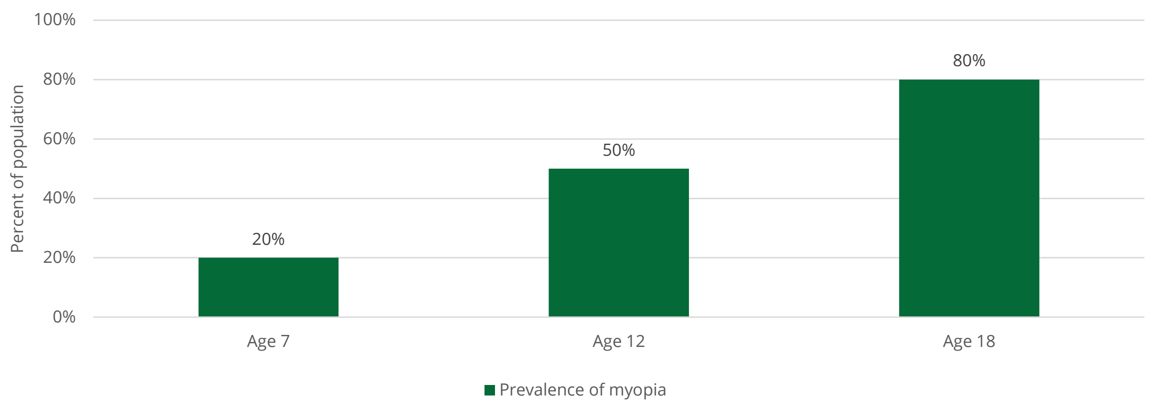
Source: GBD (2020).[20]

- In Singapore, under-corrected refractive error is the most common cause of vision, accounting for 58.6% of all sight loss. This is followed by cataract (23.2%), AMD (1.4%), and diabetic retinopathy (1.4%).[239]

H.3.3. Prevalence of specific eye diseases

- Eye diseases and conditions that are most prevalent in Singapore are uncorrected refractive errors (**22% of total population**)[240], cataract (**9.7%; 2013**),[241] glaucoma (**3.2%; 2015**),[242] AMD (**5.6%; 2014**),[243] and diabetic retinopathy (**1.4%, or 28.2% among diabetic population; 2018**).
- Myopia is prevalent in Singapore across various age groups (Chart H.3). Approximately 20% of Singapore children (age 7 and under),[244] 50% of adolescents,[28] and 80% of college students are estimated to live with myopia.[28]
- Among adults aged over 40 years, the prevalence of myopia, high myopia, hyperopia, and astigmatism in was 38.9%, 8.4%, 31.5%, and 58.8%.[245]

Chart H.3: Prevalence of myopia among Singaporean children and adolescents.



Sources: Deloitte using Seet (2001)[28], SNEC (2020).[29]

- In Singapore, **the percentage of elderly people affected by cataracts is about 78.6%.**[246] The number of people affected by cataracts also increases as they get older. It affects 63.6% of people between 60 and 64 years, and 94.6% of people 75 years and older.

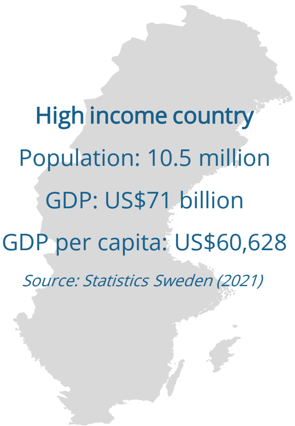
Appendix I: Country data report: Sweden

Sweden – Country Fast Facts

Data availability: **Good**

Data quality: **Good**

National profile



High income country

Population: 10.5 million

GDP: US$71 billion

GDP per capita: US$60,628

Source: Statistics Sweden (2021)

Population age profile

Prevalence of vision loss

5% of the Swedish population have vision loss or blindness

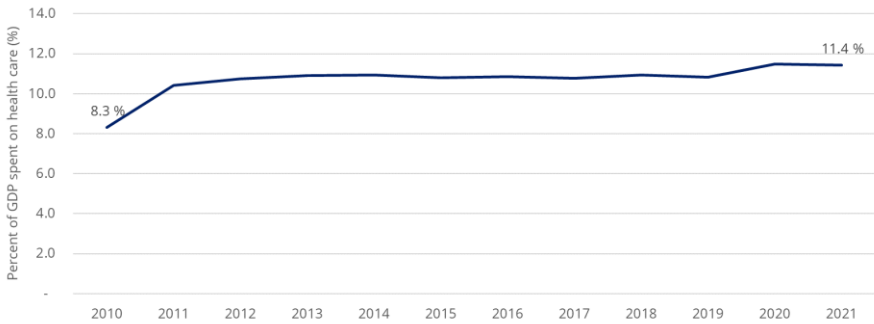
The total number in persons:

490k

Source: Global Burden of Disease (2020). Reported as age-standardised prevalence estimates.

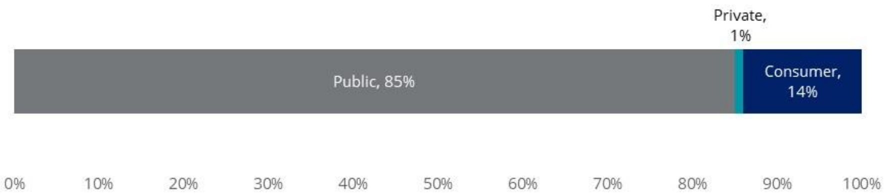
Health system at a glance

- Parts of the Swedish health system adopt a reimbursement financing system. Under this system, the costs of medications and primary health care services for the remainder of the calendar year is covered by the Swedish Government once a resident reaches the co-payment threshold of US$138 for primary health care services and US$276 for medications per year (for any condition). Hospital care is not included in the above co-payment schemes, and some exceptions apply - some out-of-pocket costs may apply in certain situations.
- No targeted eye screening programs are available for the general population, however such programs exist for children (aged 3 months to 7 years) and for people with diabetes.
- Total health expenditure has recently **increased** from an average of ~8% of GDP between 2010 to **approximately ~11% in 2021.**



Source: OECD (2021).

- Health expenditure in Sweden is largely funded by the public sector (85%). The remaining health expenditure is funded by consumers (i.e., out-of-pocket costs; 14%) and private sources (1%).



Source: European Observatory on Health Systems and Policies (2021).

It is estimated that there are 97,000 people living with late-stage age macular degeneration (AMD) in Sweden. From 2012 to 2040, the number of people living with late-stage AMD is expected to increase by 75%.

Source: Linekleiv et al (2013).

KEY FINDINGS

For Sweden

1	Between 1990 and 2020, the total prevalence of mild vision impairment and blindness decreased by 0.36%. As of 2020, **3.3% and 2.9% of the total Swedish population have mild vision impairment and blindness, respectively**. However, during the same period, the prevalence of MSVI has **remained unchanged at 1.5%.**
2	Eye heath expenditure was only available for Sweden in inpatient hospital settings. In 2011, diseases of the eye and adnexa for inpatient hospital was estimated to cost Kr 293 billion (US$34 billion), which is **approximately 0.4% of total inpatient hospital expenditure.**
3	Parts of the Swedish healthcare system have a reimbursement financing model. Under this model, once a person **reaches the co-payment (i.e., OOP cost) threshold of 1,200 Kr (US$138) for primary healthcare expenses and separately 2,400 Kr (US$276) for medication expenses** for any condition cause, the **healthcare and medication expenses** for the remainder of the calendar year are covered by the Swedish Government.
4	The **eye care workforce density has remained relatively unchanged in Sweden over the last 5 years**. However, an ageing population will likely lead to an expected increase in age-related conditions such as AMD, glaucoma and cataract in the future. With this context in mind, workforce shortages may be a barrier to the timely access to eye care in the future.
5	There is no national eye screening program for the general population. **Eye screening programs are available for children from the ages of 3 months to 7 years.** To ensure equity of access to eye care for those from financially disadvantaged backgrounds, the government provides corrective lense subsidies for children and adolescents aged 8-19 years.

I.1. Eye health investment findings

Sweden - Eye health investment key findings	
Number	**Key finding**
KF1	Healthcare expenditure as a proportion of GDP has steadily increased over the last decade. In 2021 (the most completed annual data available), Sweden **spent 11.4% of GDP (Kr 616 billion; US$71 billion) on healthcare expenditure.**[32] Only eye health expenditure data for inpatient hospital settings was available for Sweden. In 2011, diseases of the eye and adnexa for inpatient hospital settings was estimated to cost **Kr 293 million (US$34 million)**, which made up approximately **0.4% of total inpatient hospital expenditure.**[32]
KF2	Eye health services are assessed to be affordable in Sweden due to the high proportion of public subsidy. Once a resident passes the co-payment threshold of **Swedish krona (Kr) 2,400 (US$276) for medications** and separately **Kr 1,200 (US$138) for primary healthcare services** (regardless of the cause of illness) per year, the cost of medications and healthcare services are **covered by the Swedish Government** for the remainder of the calendar year.[247] However, hospital care is not included in the above co-payment schemes, and some exceptions apply with some out-of-pocket costs may apply in certain situations. Further, the cost of corrective lenses is not covered by this reimbursement financing model.
KF3	There are approximately **26 opticians per 100,000 persons** and **15 ophthalmologists per 100,000 persons** in Sweden in 2019 and 2018, respectively.[248]
KF4	**Sweden does not have a specific national eye health plan.** However, the National Board of Health and Welfare, a government agency, develops **national healthcare guidelines** and recommendations for the **prevention, diagnosis and treatment of diseases impacting the Swedish population.**[249] This includes national guidelines on the treatment and management of eye conditions.
KF5	The Swedish Government's emphasis and investment in eye care is evidence by the establishment of **St. Erik Eye Hospital, the only hospital in Sweden that specialises in a single organ – the eye.** The Hospital offers planned and emergency care, produces high-quality research and delivers a broad variety of education and training in the field of eye and eyesight.

I.1.1. Eye health expenditure

- From 2010 to 2021, the overall health expenditure as a percentage of Sweden's GDP has increased from 8.3% (Kr 297 billion; US$34 billion) to 11.4% (US$71 billion); due in part to population growth and the ageing population.[250]
- Only inpatient hospital cost attributed to disease of the eye and adnexa was publicly available for Sweden. **In 2011, Kr 293 million (US$34 million) was spent on diseases of the eye and adnexa, which is approximately 0.4% of the total inpatient hospital expenditure (Kr 72.2 billion; US$ 8.3 billion) in Sweden.**[32]
  - The costliest diagnostic categories in the inpatient hospital setting were diseases of the circulatory system (Kr 12.8 billion [US$1.5 billion], 18% of total inpatient hospital expenditure), injury, poisoning and other consequences of external causes (Kr 8.4 billion [US$1.0 billion], 12% of total inpatient hospital expenditure) and neoplasm (Kr 7.9 billion [US$0.9 billion], 11% of total inpatient hospital expenditure).
- **In terms of payers, government expenditure constitutes the majority of Sweden's total healthcare expenditure.** In 2021 (the latest available data), 85% of healthcare was government-financed (through general taxation). The remaining expenditure is financed by consumers' out-of-pocket expenditure (14% of total healthcare expenditure) and private health insurance (1% of total healthcare expenditure).[251]
  - The high coverage of health expenditure by the government can be explained by Sweden's health reimbursement financed model. Once Swedish residents pass the co-payment threshold for **medications (Kr 2,400; US$276)** and separately **primary healthcare services (Kr 1,200; US$138)** per year, the cost of medications and healthcare services for the remainder of the co-payment calendar year are covered by the Swedish Government.[247] Hospital care is not included in the above co-payment schemes, and some exceptions apply with some out-of-pocket costs may apply in certain situations.
  - The cost of corrective lenses (such as glasses and contact lenses) is not covered by this reimbursement financing model. However, a subsidy is provided for all children and adolescents aged 8-19 years which is discussed further in Section I.1.2).

I.1.2. Affordability of eye health services

- As described in Section I.1, Sweden's existing health reimbursement model has meant that Swedish residents face limited financial barriers in accessing eye health services.
- A summary of the eye services that are covered by the public sector is shown in Table I.1. The table shows that:
  - Eye screening service, intravitreal injections and eye surgeries are paid by the consumer until they meet the Kr 1,200 (US$138) co-payment threshold as stipulated in the existing health reimbursement model. Beyond this point, all healthcare costs are covered by the government (publicly funded through taxation) for the remainder of the calendar year.
  - Medications (including eye drops) are paid by the consumer until the Kr 2,400 (US$276) co-payment threshold for medications has been passed. Beyond this point, all healthcare costs are covered by the government (publicly funded through taxation) for the remainder of the calendar year.
  - The cost of corrective lenses (i.e., glasses and contact lenses) is not covered under Sweden's reimbursement financing model. However, in March 2016, the Swedish Government implemented a national reform to provide a subsidy for spectacles for children and adolescents aged 8-19 years each year.[252] This was specifically implemented to address equity, with the Swedish Government stating that more disadvantaged children and adolescents have equal access to spectacles. The subsidy expenditure is approximately Kr 800 (US$92).[253]

Table I.1: Summary of preventative and treatment services covered by public funding

	Sweden
Eye screening services	If a person's OOP healthcare expense **more than 1,200 Kr**, this service is covered by the government.
Corrective lenses (glasses and lenses)	OOP expense for all Swedish residents. Children and adolescents aged 8-19 years can receive a subsidy of Kr 800 (US$92) per year.
Medication (including eye drops)	If a person's OOP medication expense is **less than 2,400** Kr, this service is covered by the consumer (i.e., OOP).
Intravitreal injections (e.g., Anti-VEGFs treatments)	If a person's OOP healthcare expense is **less than 1,200 Kr**, this service is covered by the consumer (i.e., OOP).
Eye surgeries	If a person's OOP healthcare expense is **less than 1,200 Kr**, this service is covered by the consumer (i.e., OOP).

KEY: Not publicly funded | Publicly funded for eligible persons | Publicly funded for the whole population

Source: As listed in the table. Note: Private services are available for people who chose to use these services. These services are covered by the consumer.

I.1.3. Eye health workforce

- The eye health workforce in Sweden is predominately made up of opticians/optometrists (these professions are combined in Sweden) and ophthalmologists. The size of Sweden's eye health workforce is summarised in Table I.2. This data is sourced from the National Board of Health and Welfare, which routinely publishes health care personnel and workforce statistics.

Table I.2: Eye health workforce estimates in Sweden

Category	Estimate	Estimate density (per 100,000)	Source
Opticians/optometrists	2,659	26	National Board of Health and Welfare (2018 estimates)[248]
Ophthalmologists	1,512	15	National Board of Health and Welfare (2019)[248]

Source: As indicated in the table.

- From 2017 to 2019, the number of ophthalmologists per 100,000 persons has slightly increased. This is in comparison to the number of opticians/optometrists per 100,000 persons, which has remained stable from 2015 to 2018 (Chart I.1).

Chart I.1: Eye care workforce per 100,000 persons, Sweden, 2015 to 2019

Source: National Board of Health and Welfare (2021).

I.1.4. Eye care strategy, policy and infrastructure

- Sweden **does not have a specific national eye health plan.** However, the Swedish government plays a vital role in ensuring the quality of eye care meets specific standards. The National Board of Health and Welfare (a government agency) develops and publishes national guidelines and recommendations for the prevention, diagnosis and treatment of diseases impacting the Swedish population.[249] This includes guidelines on the diagnosis, treatment and management of eye conditions such as cataract, glaucoma and AMD.
- Research and policy advocacy for eye care are driven by peak body organisations such as the Swedish Ophthalmological Association and Swedish Optical Society and the Swedish Government.
- The Swedish Government's emphasis and investment in eye care is evidenced by the establishment of **St. Erik Eye Hospital, one of the leading eye hospitals in Europe and the most comprehensive ophthalmic and vision research institutions in Sweden.** Annually, St. Erik Eye Hospital performs approximately 8,500 operations and 11,000 fundus photographs, delivers 24,000 intravitreal injections and provides care to about 150,000 people from Stockholm County, Sweden and aboard.[254]
  - During the 1980's, the concept of gathering all surgical eye care under one roof was operationalised to consolidate resources and expertise under one facility. The St. Erik Eye Hospital was established in February 1990.
  - The hospital now employs over 400 professionals across four departments and six support departments. There are over 10 services, an emergency department and consulting services for inpatients at other hospitals.
  - Together with Karolinska Institute, St. Erik Eye Hospital is the most comprehensive ophthalmic and vision research institution in Sweden. Annually, approximately 35-40 scientific articles are published by approximately 35 employees across their research groups. The hospital generates high-quality research that is closely linked to clinical practice.[255]

I.2. Eye health output findings

Sweden - Eye health output key findings	
Number	**Key finding**
KF6	**Sweden does not have a nation eye screening program for its general population.**[256] However, **children aged 3-7** and **people with diabetes** have access to eye screening programs which may be covered by the government if the healthcare service co-payment threshold is reached.[257, 258]

Sweden - Eye health output key findings	
Number	**Key finding**
KF7	Approximately 116,000 cataract procedures were performed in Sweden in 2020. **The average wait time for cataract surgery was 2.09 months.**[259]
KF8	There are now four anti-VEGF treatments that are available to treat wet-AMD. The use of **anti-VEGF injections has increased over the last 10 years for wet-AMD, with over 92,000 treatments provided in Sweden in 2020.**[51]

I.2.1. Availability and utilisation of eye screening services

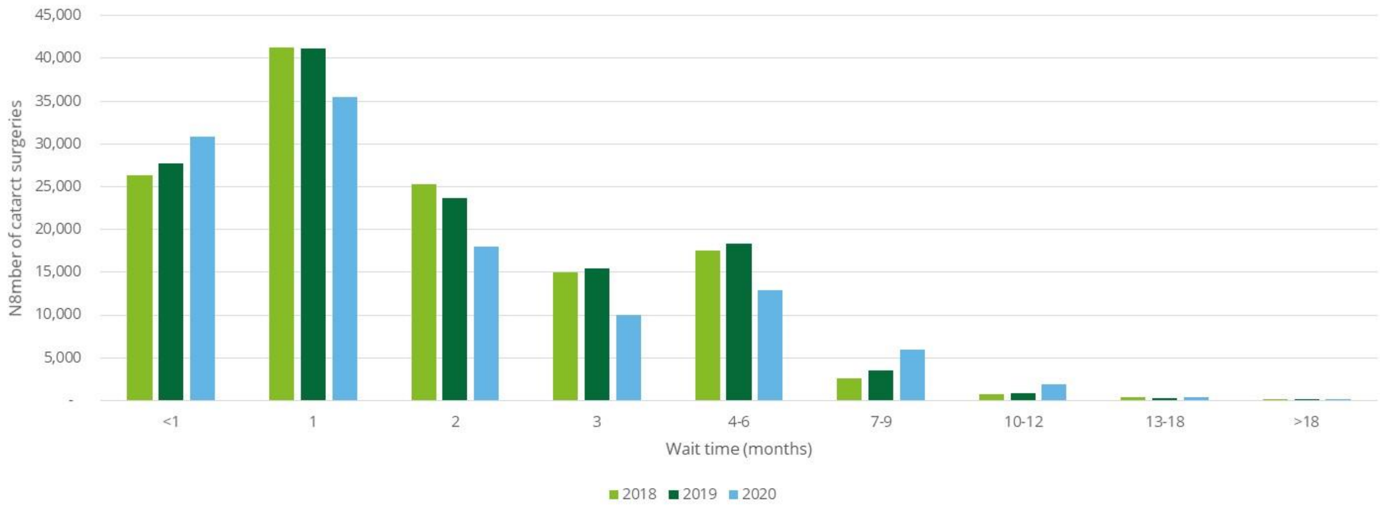
- Sweden does not have a national eye screening program for the general population. However, residents have access to eye screening services if they choose to get their eyes tested.[256]
- In Sweden, pre-school vision screening is offered for all children from preterm to 7 years. Vision screening for children can be conducted by an ophthalmologist, paediatrician, general practitioner or specialist nurse in either a school, hospital or child healthcare centre.[257]Testing interaocular pressure is usually undertaken by opticians and eye screening can be undertaken at a private eye clinic paid by the consumer.
- Sweden has a national diabetic screening program which is linked to the Swedish Diabetic Database. People with type 2 diabetes and those with type 1 diabetes who are on insulin treatment are included in the database. In 2008, of the 251,386 people living with diabetes registered in the database, 3,515 people (1.4%) were diagnosed with diabetic retinopathy.[258] The database, however, does not collect information about patient retinopathy outcomes or service utilisation such as eye screening visits.

I.2.2. Availability and utilisation of eye treatment services

Eye health service utilisation is proxied through the following data indicators: cataract surgery and the uptake anti-VEGF treatment(s). The insights from these sources are described in more detail below.

- In 2020, there were 115,746 cataract surgert operations registered in the National Cataract Registry (a national registry which records data on the number of cataract surgeries). The number of operations per month varies between 5,000 to 14,000.[259]
- Compared to 2019, there were approximately 15,000 cataract surgeries that were missed in 2020. This is likely due to the cancellation of non-elective surgeries in response to the COVID-19 pandemic. This drop in cataract surgery volume is the largest recorded in the register's history.[259]
- The reduced cataract surgery volumes resulted in a slight increase in cataract wait time. In 2020, the average cataract wait time in 2020 was 2.09 months, compared to 2.0 months and 1.96 months in 2019 and 2018 respectively.[259 260, 261]
- The number of cataract surgeries performed by wait time (in months) for 2018-20 is shown in Chart I.2. In 2020, 8,395 people were waiting more than 7 months for cataract surgery, which is greater than the volume of people waiting more than 7 months for cataract surgery in 2018 (3,838 people) and 2019 (4,759 people).[259, 260, 261]
- Swedish law stipulates people should wait no more than 90 days to undergo surgery or see a specialist. However, according to the National Cataract Registry data, 18% of people waited more than 90 days for their cataract surgery in 2020. This may suggest that a proportion of people do not receive timely access to eye care in Sweden.

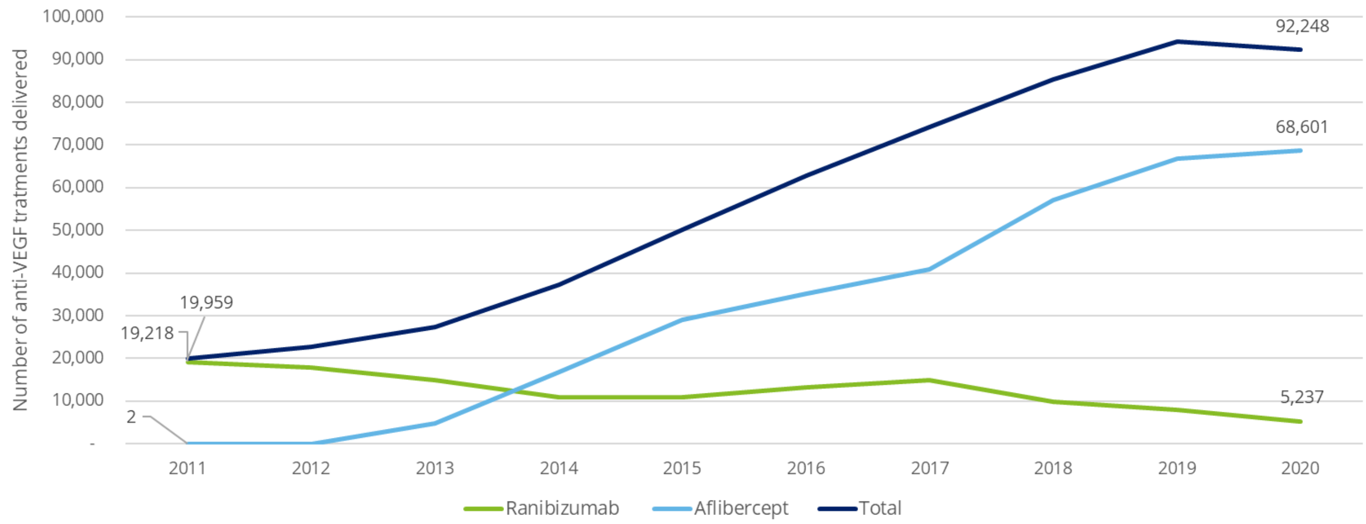
Chart I.2: Number of cataract surgeries performed by wait time (in months), Sweden, 2018-20



Source: Swedish Cataract Surgery (2018, 2019 and 2020).[259, 260, 261]

- The most common treatment for wet AMD in Sweden is intravitreal injections with anti-VEGF treatment. There are four anti-VEGF treatments that are available in Sweden, which include aflibercept, ranibizumab and brolucizumab. Brolucizumab is the latest anti-VEGF treatment to be approved (in 2020).
- The demand for anti-VEGF treatment has and will continue to grow in Sweden as most treated conditions, particularly AMD, are highly age-dependent.[262] With an ageing population, the number of individuals at risk of these conditions and who may require anti-VEGF treatment will likely increase in the future.
- Trend data from 2011 to 2019 indicated that the total number of anti-VEGF treatments has increased by 96% over this period (Chart I.3).[51] However, their use decreased in 2020 compared to 2019, which is likely to be caused by the impact of the COVID-19 pandemic (outpatient services declined due to the diversion of staffing resources to respond to the COVID-19 pandemic).[263]

Chart I.3: Number of anti-VEGF treatments delivered, by treatment-type, Sweden, 2011-21

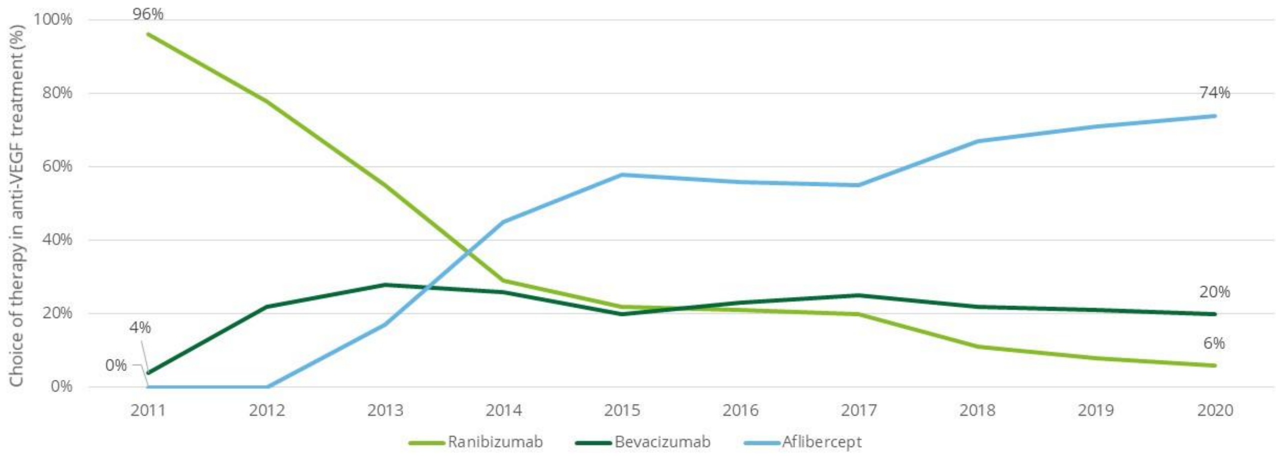


Source: Sweden Macular Registry (2020). Note that Brolucizumab is not included in the chart as no trend data exists for this treatment.

- The National Board of Health and Welfare actively monitors the cost effectiveness of anti-VEGF treatments. This has contributed to changes in the administration behaviour of anti-VEGF drugs for people with AMD (Chart I.4).[51,264]

- In 2012, aflibercept was approved for treatment of wet AMD. Since its approval, there has been an increase in the number of registered treatments in favour of aflibercept (see Chart I.4). Economic evaluation analysis in Sweden has found that aflibercept is less costly than ranibizumab, whilst demonstrating similar efficiency. It has therefore been considered more cost-effective and the dominant anti-VEGF treatment since 2014.[265]

Chart I.4: Choice of therapy in treatment with anti-VEGF injections, Sweden, 2011-20



Source: Sweden Macular Registry (2020).

I.3. Eye health outcome findings

Sweden - Eye health outcome key findings	
Number	Key finding
KF9	**The quality of eye health services for cataract surgery is high**, as indicated by the **low endophthalmitis (infection inside the eye) rates** (0.01% of cataract operations were affected), low capsular complication rates (0.59% of women and 0.70% in men) and high rates of people who achieved a postoperative VA required to drive (>95% of cataract operations).[51]
KF10	**Approximately 4.8% (489,400 people) of Swedish population have vision impairment or blindness.** The majority of these people live with mild vision impairment (235,700 people), followed by moderate-severe sight loss (226,900 people) and blindness (26,800 people).[112]
KF11	Approximately 187,000 persons aged $\geq$65 years in Scandinavia have late-stage AMD, **of which 97,000 (52%) people live in Sweden.** With an ageing population, it is projected that between 2012 to 2040, the number of people with **late-stage AMD (the most severe form of AMD causing permanent sight loss) will increase by 75% in the Scandinavian population.**[266]

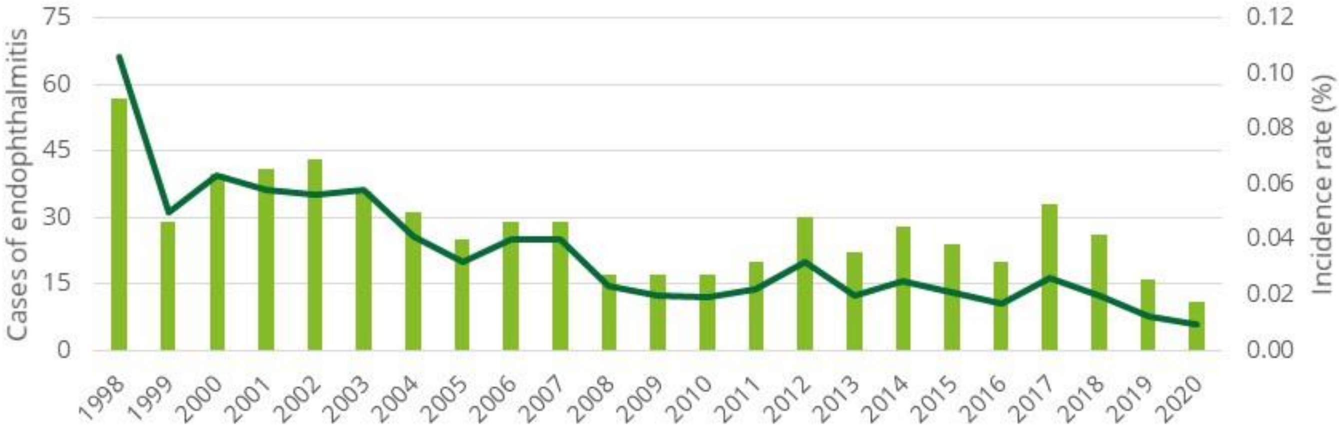
I.3.1. Quality of eye health services

- The quality of Sweden's eye health services is proxied through the following data indicators: cataract postoperative surgical outcomes and inflection/complication rates.
  - Three outcome parameters are used to track the quality of cataract surgeries performed – (1) the postoperative VA, (2) the rate of posterior capsule rupture (PCR) and (3) the endophthalmitis infection rate (infection inside the eye). Although endophthalmitis is uncommon in cataract surgeries, more than half of those affected experience significant visual impairment.
- Based on the latest Sweden Cataract Surgery Registry Annual (March 2020), the quality of cataract surgery outcomes has been notably high:
  - At the 4-month follow-up timepoint post-surgery, the VA required to drive in the operated eye was achieved in 95.8% of cataract surgeries.
  - The PCR rate occurred in only 0.59% of women and 0.70% of men.

- The incidence of endophthalmitis was 0.0095% (n=11) in 2020.

- Over the last 2 decades, the incidence of endophthalmitis has decreased. This was driven by the intraocular administration of antibiotics during cataract surgery. The incidence of endophthalmitis has remained steady at 0.02% from 2008-20 (Chart I.5).

Chart I.5: Endophthalmitis registration related to cataract surgeries, Sweden, 1998-2020

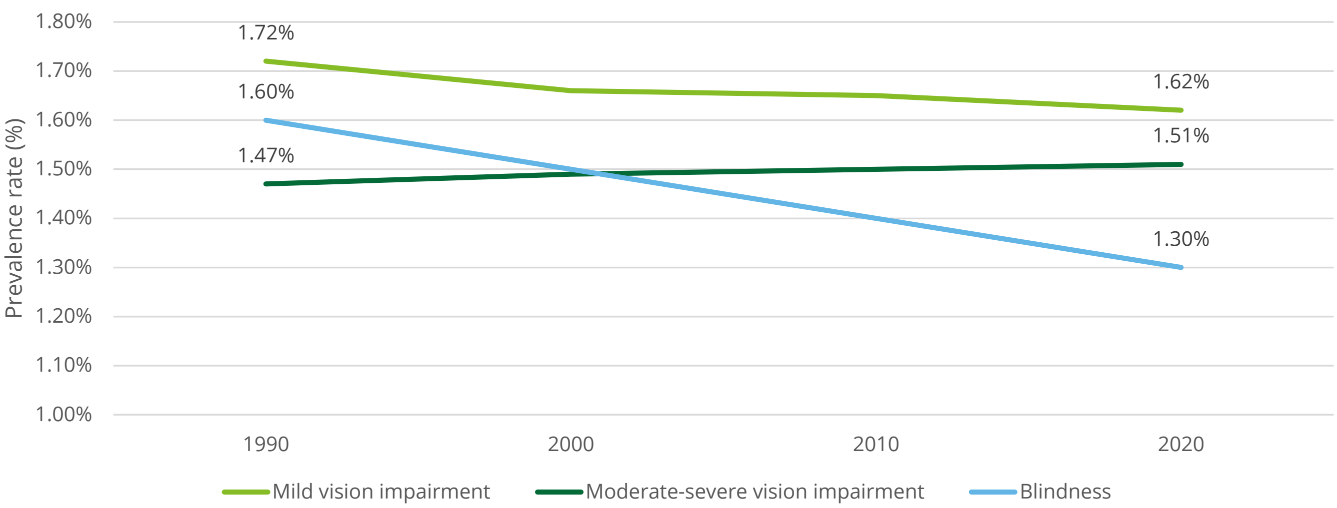


Source: Sweden Cataract Registry (2020).

I.3.2. Prevalence of vision impairment and blindness

- Based on age-standardised prevalence estimates from the Global Burden of Disease Study, approximately 4.8% of the Swedish population (489,400 people) had vision impairment or blindness in 2020. The majority of these people live with mild vision impairment (VA between <6/12 and $\geq$6/18; 1.62% of the population; 235,700 people), followed by moderate-severe sight loss (VA between <6/18 to $\geq$3/60; 1.51% of the population; 226,900 people) and blindness (VA <3/60; 1.30% of the population; 26,800 people).[112]
- The prevalence rate of mild, moderate-severe and blindness in Swedish from 1990 to 2020 is shown in Chart I.6. From 1990 to 2020, the prevalence of mild vision impairment and blindness has decreased, from 1.72% (19,000 people) to 1.62% (235,700 people) and 1.60% (22,800 people) to 1.30% (26,800 people) respectively.[112] This is likely due to recent eye care innovations and the increased provision of services for many chronic eye conditions over the last decades.[112]
- Conversely, the prevalence of MSVI in Sweden has remained unchanged at 1.5% (115,800 to 169,000 people) between 1990 and 2000.[112]
- No prevalence estimates from primary sources were available for Sweden.

Chart I.6: Prevalence of mild, MSVI and blindness, Sweden, 1990, 2000, 2010 and 2020



Source: GBD (2020).[20]

I.3.3. Prevalence of specific eye diseases

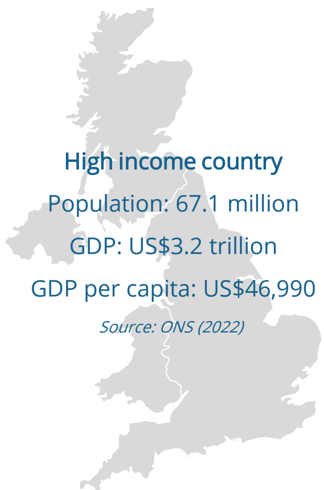
- The prevalence of age-dependent eye conditions is on the rise in Scandinavia (which is made up of Denmark, Norway and Sweden), driven by ageing population. Of the 187,000 persons aged $\geq$ 65 years in Scandinavia who have late-stage AMD, 52% (97,000 people) live in Sweden in 2012.[112]
- From 2012 to 2040, the number of people aged $\geq$ 65 years in Scandinavia will increase from 3.6 million to 5.4 million people (51% increase), with the largest increase observed in those aged $\geq$ 80 years. The significant increase in older population will inevitably contribute to an increasing prevalence of age-related eye diseases. For the Scandinavian region, the number of people with late-stage AMD is projected to increase to 328,000 in 2040 (75% increased from 2012 estimates). Assuming the same distribution of the Scandinavian population in 2012, it is estimated that approximately 171,000 people will have late-stage AMD in Sweden in 2040.

Appendix J: Country data report: United Kingdom

United Kingdom (UK) – Country Fast Facts

Data availability: **Good** | Data quality: **Good**

National profile



High income country

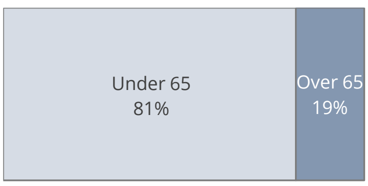
Population: 67.1 million

GDP: US$3.2 trillion

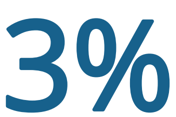
GDP per capita: US$46,990

Source: ONS (2022)

Population age profile



Prevalence of vision loss



of the UK population have vision loss or blindness

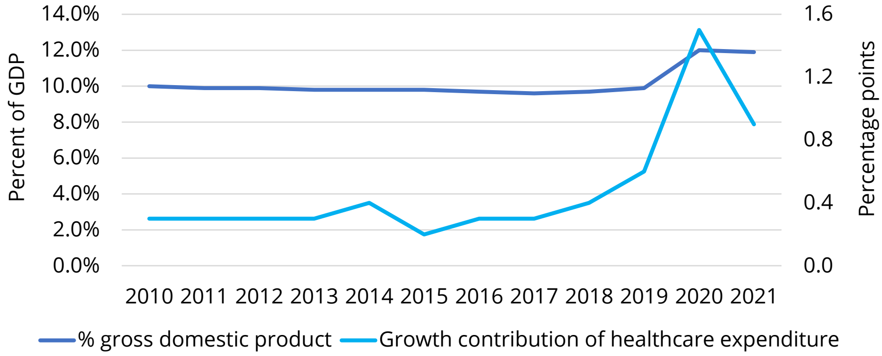
The total number in persons:

2.2m

Source: RNIB (2021).

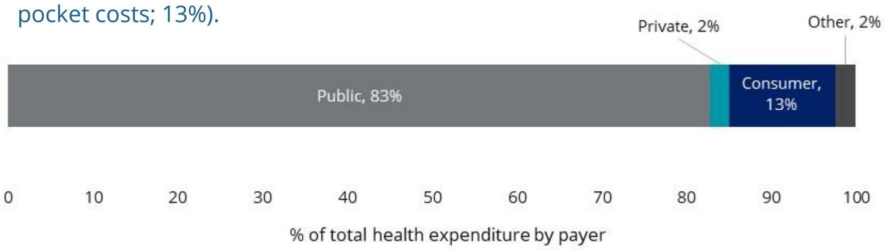
Health system at a glance

- The UK is made up of four nations including England, Scotland, Wales and Northern Ireland. All nations have predominately publicly funded healthcare systems. The four healthcare systems include the National Health Service (NHS) England, NHS Scotland and NHS Wales and Health and Social Care (in Northern Ireland).
- Targeted eye screening programs are available throughout the UK. However, only Scotland provides free routine eye screening for the whole population.
- Total health expenditure has recently **increased** from an average of ~10% of GDP between 2010-19 to **about ~12% in 2021.**



Source: ONS (2022).

- Health expenditure in the UK is largely funded publicly (83%). The second largest contributor to health expenditure are consumers costs (i.e., out-of-pocket costs; 13%).



Source: ONS (2022).Note: other payers include non-profit institutions serving households and Enterprise financing schemes

It is estimated that there are 708,000 people living with glaucoma in the UK. From 2015 to 2035, the number of people living with glaucoma is expected to increase by 44%.

Source: Glaucoma UK (2022).

KEY FINDINGS

For the United Kingdom

1	Between 2013 and 2021, the prevalence of vision impairment and blindness has **remained relatively stable**, **accounting for approximately 3% of the total UK population.** It is projected that the prevalence of vision impairment and blindness in the UK will **increase to approximately 4% of the total UK population**, driven by the rise in the ageing population.
2	Eye health expenditure data was only available for Wales. In Wales, eye health expenditure has **decreased slightly from £183.1m (US$264.3m; 2.7% of total health expenditure) to £182.0m (US$262.7m; 2.2% of total health expenditure)** from 2018-19 to 2020-21, respectively.
3	Aside from Scotland, preventative services (such as eye screening) are not fully subsidised by the public sector for the entire population. The cost of corrective lenses (glasses and lenses) is generally fully borne by consumers. In contrast, the cost of available eye health treatments and procedures (e.g., cataract surgery, anti-VEFG treatments) is fully paid by the public healthcare system.
4	The demand for **anti-VEGF treatments (identified as one of the costliest vision-saving medication solutions) has and will continue to grow** in the UK as most treated conditions, are highly age dependent. With an ageing population, the number of individuals at risk of these conditions and who may require anti-VEGF treatment is likely to increase over time.
5	The UK is experiencing a **shortage of optometrists and ophthalmologists**. This, together with the impacts of the COVID-19 pandemic, has impacted timely access to services (as reflected in the growing backlog of people waiting to undergo treatment).

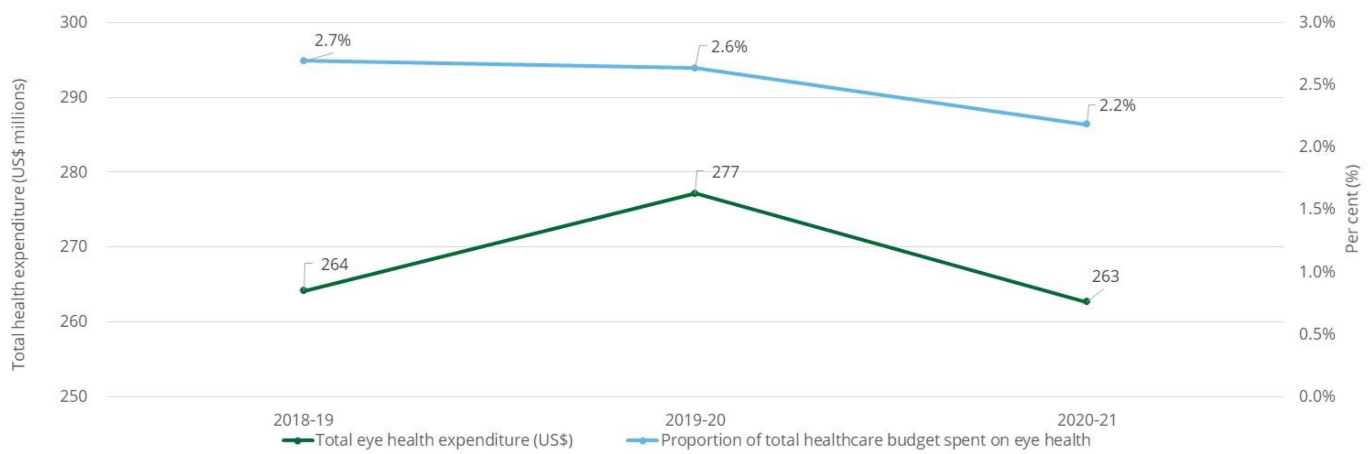
J.1. Eye health investment findings

UK - Eye health investment key findings	
Number	**Key finding**
KF1	Healthcare expenditure as a proportion of GDP has steadily increased over the last decade. In 2021 (the most completed annual data available), the **UK spent 11.9% of GDP (British pound £277b; US$400b) on healthcare expenditure.**[267] Eye health expenditure data was only available for Wales. In Wales, eye health expenditure has **decreased slightly from £183.1m (US$264.3m; 2.7% of total health expenditure) to £182.0m (US$262.7m; 2.2% of total health expenditure)** from 2018-19 to 2020-21, respectively.[268]
KF2	**The types of eye care services covered by the public health system vary by country.** In England, Wales and Northern Ireland, eye screening services are free for people under the age of 16, over the age of 65, and for those who meet certain eligibility criteria. In Scotland, eye screening services are free for the whole population.
KF3	There are approximately **20.9 optometrists per 100,000 persons** and **2.2 ophthalmologists per 100,000 persons** in the UK in 2019.[269,270]
KF4	The UK **does not have a specific national eye health plan.** However, the National Institute for Health and Care Excellence (NICE), the executive public body which provides national advice to improve health and social care, publishes **national guidance for the diagnosis, management and treatment of eye conditions.** While NICE officially operates in England only, some products and services are provided to Wales, Scotland and Northern Ireland. During the COVID-19 pandemic, eye care services such as **primary care optometry was considered an essential service** and continued to provide emergency care for people with complex eye needs.

J.1.1. Eye health expenditure

- From 1997 to 2021, the overall health expenditure as a percentage of the UK's GDP has increased from 6.8% to 11.9%; due in part to population growth and the ageing population.[267] In nominal dollars (current prices), the healthcare expenditure in the UK is higher at £276.6b (US$399.2b) in 2021 compared to £165.5b (US$238.9b) in 2011 (unadjusted for inflation).
- **Wales was the only country which had complete eye health expenditure data. The proportion of total healthcare budget spent on eye health has decreased in the most recent three years**, from 2.69% (£183.1m; US$264.3m), 2.63% (£191.7m; US$276.7m) and 2.18% (£182.0m; US$259.8m) for 2018-19, 2019-20 and 2020-21 respectively (Chart J.1). In 2021, the health disciplines with the highest reported expenditure in Wales included mental health (£936m; US$1.4b; 11% of healthcare budget) followed by trauma and injuries (£667m; US$962.8m; 8.0% of healthcare budget).
- For Scotland, the only eye health expenditure data available was for patient care provided by orthoptists (allied health care professionals who specialise in diagnosing and treating defects in eye movement and problems with how the eyes work together) and hospital opticians in hospitals and ophthalmic medical practitioners in family health services.[271] Between April 2019 – March 2020, Scotland's total expenditure on ophthalmic services provided by orthoptists and hospital opticians amounted to £311.4m (US$449.5m), which is equivalent to 3.2% of the total health expenditure.[272]
- **In terms of payers, government expenditure constitutes the majority of UK's total healthcare expenditure (£257.6b; US$371.8b).** In 2020 (the latest available data), 82.8% (£213.4b; US$308.0b) of healthcare was government-financed, 12.5% (£32.3b; US$46.6b) was paid by the consumer (i.e., OOP, 2.2% (£5.8b; US$8.4b) is voluntary health insurance schemes, 2.1% (£5.5b; US$7.9b) is non-profit institutions serving households (e.g., charitable organisations, trade unions, religious organisations, politics parties, universities) and 0.3% (£648m; US$935.3m) for enterprise financing schemes.[273]
- **The proportion of OOP expenditure on health services is relatively similar with other OECD countries, particularly those with matured healthcare systems (i.e., Australia and Canada).**[274] In the UK, OOP expenditure is the second largest contributor to healthcare expenditure (12.5%), which is equivalent to £32.3b (US$46.6b).[273]

Chart J.1: Eye health expenditure, Wales, 2018-21



Source: StatsWales (2022).[268]

J.1.2. Affordability of eye health services

- The level of publicly subsided eye health services varies by country. For that some countries, such as Scotland, eye screening services are covered for the whole population, whereas in England, Wales and Northern Ireland, people need to meet certain criteria to be eligible for free eye examinations.
- A summary of eye services that are covered by the public sector is shown in Table J.1. The table shows that:
  - Eye screening services are fully subsidised for the general population in Scotland. Across England, Wales and Northern Ireland, selected population cohorts (e.g., those aged above below 18 and above 65) have access to free eye screening services
  - Corrective lenses (glasses and lenses) are predominately paid by the consumer (i.e., OOP cost). However, NHS vouchers are available for those who meet eligibility.
  - The costs of eye surgeries and intravitreal injections are fully subsidised by the public sector.

Table J.1: Summary of preventative and treatment services covered by public funding

	England	Wales	Northern Ireland	Scotland
Eye screening services	Publicly subsidised nationally for those who are eligible. Otherwise, it is an OOP expense.	Publicly subsidised nationally for those who are eligible. Otherwise, it is an OOP expense.	Publicly subsidised nationally for those who are eligible. Otherwise, it is an OOP expense.	Publicly subsidised nationally.
Corrective lenses (glasses and lenses)	Generally out-of-pocket expense. NHS vouchers available for those who meet eligibility.			
Medication (including eye drops)	Publicly subsidised nationally for those who are eligible. Otherwise, it is an OOP expense.	Publicly subsidised nationally.	Publicly subsidised nationally.	Publicly subsidised nationally.
Intravitreal injections (e.g., Anti-VEGFs treatments)	Publicly subsidised nationally.	Publicly subsidised nationally.	Publicly subsidised nationally.	Publicly subsidised nationally.
Eye surgeries	Publicly subsidised nationally.	Publicly subsidised nationally.	Publicly subsidised nationally.	Publicly subsidised nationally.

KEY: Not publicly funded; Publicly funded for eligible persons; Publicly funded for the whole population

Source: As listed in the table. Note: Private services are available for people who chose to use these services. These services are covered by the consumer.

J.1.3. Eye health workforce

- The eye care workforce in the UK is made up of a multidisciplinary team of health professionals, including technicians, nurses, opticians, optometrists and ophthalmologists. The majority of the eye health workforce is made up of optometrists and ophthalmologists. Optometrists are primarily situated in high-street (primary care/community) optometry services, and ophthalmologists are situated in eye care led services (including hospital eye services).
- As there is no complete national data source, the estimation of UK's eye health workforce is drawn from literature review, existing government data and information from peak body professional groups (Table J.2).

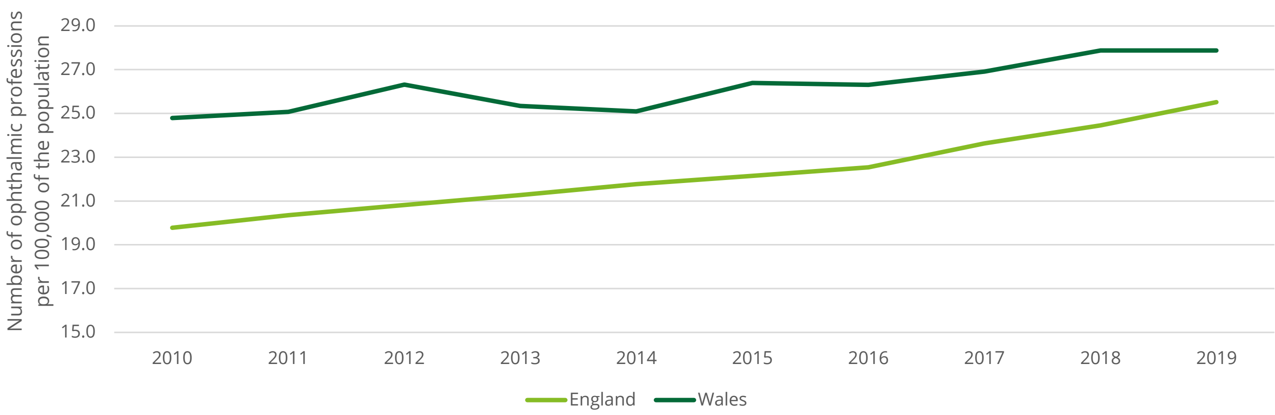
Table J.2: Eye health workforce estimates across the UK

Category	Estimate	Estimate density (per 100,000)	Jurisdiction	Source
Optometrists	>14,000	20.9	UK	Association of Optometrists (2019 estimates for the UK)[275]
Ophthalmologists	1,500	2.2	UK	Royal College of Ophthalmology (2019 estimates for the UK)[270]

Source: As indicated in the table.

- From 2010 to 2019, for both England and Wales, the number of ophthalmic practitioners (i.e., optometrists and ophthalmic medical practitioners) per 100,000 of the population has increased (Chart J.2).
- Despite this, the UK is experiencing a shortage of optometrists and ophthalmologists. This will strain current and future eye service delivery capacity, given the UK's ageing population and increased prevalence of diabetes and hypertension in the country.[276] This is particularly troubling for the UK as there has been a predicted 44% increase in demand for eyecare services over the next 20 years, and around a quarter of the current eye care workforce is nearing retirement.[270]

Chart J.2: Ophthalmic practitioners in England and Wales, 2010 to 2019



Source: NHS (2021).

J.1.4. Eye care strategy, policy and infrastructure

- The UK **does not have a specific national eye health plan.** However, the UK government plays a vital role in ensuring the quality of eye care meets specific standards. NICE – an executive public body sponsored by the Department of Health and Social Care – publishes guidance, advice and quality standard for all health conditions, supported by best available evidence to inform decisions in health, public health and social care.[277] This includes guidelines on the diagnosis, treatment and management of eye conditions. These guideline should be consistently applied throughout England and may be adopted in Wales, Scotland and Northern Ireland.[278]

- The government has also recognised that more needs to be done to prevent avoidable sight loss given the rise of the ageing population.[279] The importance of preserving sight was particularly emphasised during the COVID-19 pandemic, where eye care services such as primary care optometry was identified by the government as an essential service and continued to provide emergency care for people with complex eye needs.
- Advocacy for timely and accessible eye care services across the UK is primarily driven by charity and peak health professional groups including (but not limited to) RNIB (UK charity group), the Royal College of Optometrists and the Royal College of Ophthalmologists. These advocacy groups work to keep eye health and sight loss on medical and social care agendas and respond to national and local issues facing people with sight loss or blindness across the UK.
- The rise in the ageing population will lead to increased demand for eye care services. To address this demand, there has been greater emphasis by professional eye health peak bodies such as the College of Optometrists and College of Ophthalmologists to permanently expand the role of optometrists in eye care pathway in the UK. This would:
  - place optometrists at the heart of patient-centred care in the UK,
  - make full use of their skills,
  - provide opportunities to optometrists to develop new skills, and
  - play a central role in leading and delivering new models of care to improve patient outcomes.[280]
- In August 2022, a new National Clinical Director for Eye Care has now been appointed in England for the first time. This new role could help transform eye care services for people living with macular disease and other sight conditions. The newly appointed role emphasises the the importance to draw all of the parts of eye care together and ensure people with eye conditions receive coherent and standarised care from initial diagnosis through to management of eye conditions.[281]
- England is currently experiencing a shift in care delivery from the NHS to Integrated care systems (ICSs). ICSs bring together NHS organisations, local authorities and other providers to take collective responsibility for planning services, improving health and reducing inequalities across geographical areas within England.[282]

J.2. Eye health output findings

UK - Eye health output key findings	
Number	**Key finding**
KF5	**Targeted eye screening programs are available throughout the UK. However, only Scotland provides free eye screening for the whole population.** Specific population cohorts (children, youths and people with diabetes) have access to publicly funded eye screening programs.
KF6	**The wait time for eye care services is long and will continue to grow with the rise in the ageing population.** There were approximately 440,000 people on waiting lists for eye care services in 2019. The NHS did not meet the recommended 18-week referral to treatment times for approximately 15% of people.
KF7	There are now four anti-VEGF treatments that are licensed to treat a number of eye conditions including AMD, diabetic macular edema and diabetic retinopathy. The use of **anti-VEGF injections has increased over the last few years, with over 580,000 treatments** provided in England in 2021.

J.2.1. Availability and utilisation of eye screening services

- Across the UK, eye screening services are available for the whole population.
  - In England and Northern Ireland, residents are eligible for publicly subsidised sight tests if they are aged over 60; are aged over 40 with a close family member diagnosed with glaucoma; or are considered at risk of glaucoma by an ophthalmologist.[283]
  - In Scotland, routine eye tests are fully funded for all of the population.[284]
  - In Wales, routine eye tests are fully funded by Eye Health Examination Wales and are eligible to people who meet certain criteria such as being diagnosed with diabetes or glaucoma, or they have been advised by an ophthalmologist that they are at risk of glaucoma.[285]
- Across the UK, pre-school vision screening is offered to all children aged 4-5. The child can be tested at their nursery, a community clinic or a hospital eye clinic.[286]
- Across the UK, diabetic screening services are available for anyone with diabetes who is 12 years old or over.
  - In England and Northern Ireland and Wales, free diabetic eye screening is offered annually.[26,287]

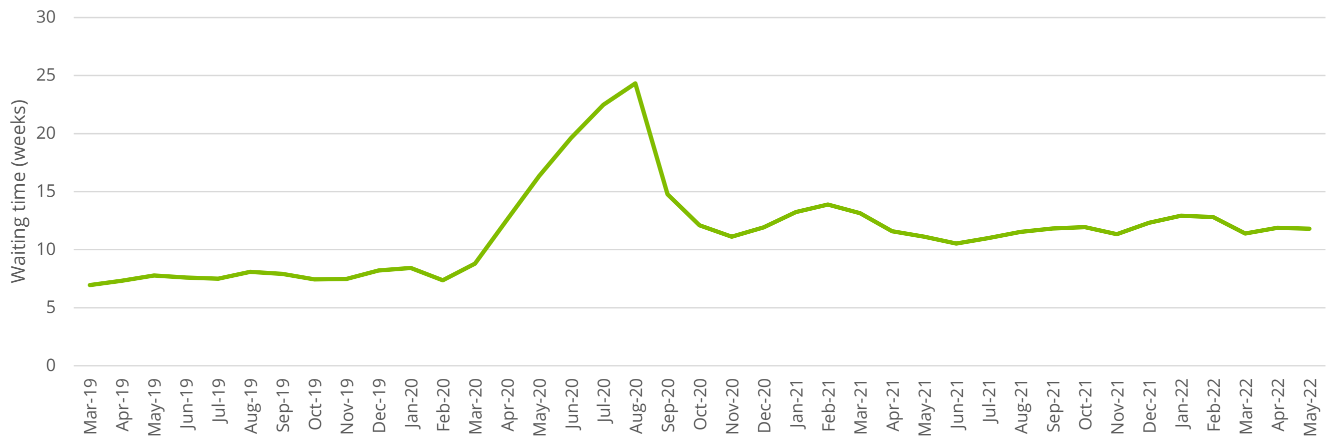
  - In Scotland, free diabetic eye screening is offered on a bi-annual basis for those with low risk of sight loss.[288]
- The NHS recommends that everyone from the age of three undergoes an eye test at least every two years to address uncorrected refractive error and detect any possible eye health conditions.[289]
- However, there is anecdotal evidence of scope to increase the take up of these eye tests. Based on an online survey of over approximately 11,000 adults (representative of all UK adults aged 18 and over) in 2017, 27% of people in the UK had not had an eye test within the last two years.[290] This highlights the importance of educating the population on the importance of timely access to eye services.

J.2.2. Availability and utilisation of eye treatment services

Eye health service utilisation is proxied through the following data indicators: cataract surgery, and anti-VEGF treatment uptake. The insights from these sources are described in more detail below.

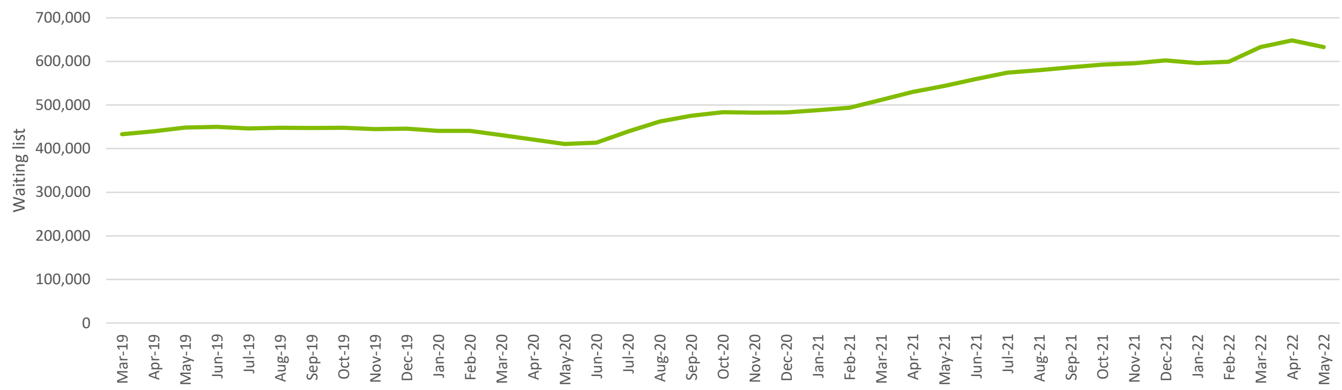
- Prior to the COVID-19 pandemic, there existed a large backlog of people waiting for treatment. This was driven by an increasing ageing population, funding constraints and low levels of support for training that have resulted in a shortage of trained ophthalmologists in the country.[291] This impacted the rate at which people with eye conditions can be seen, diagnosed and appropriately managed, which would have adverse health consequences (e.g. potential sight loss) as people wait for their surgery.
- The backlog of people waiting for eye treatment worsened between 2020-22. Prior to the pandemic, the NHS was unable to meet 18-week referral to treatment times (benchmark set by the NHS) for approximately 15% of people. In the first five months of 2022, only 64% of eye care patients have been seen within an 18-week timeframe.
- Chart J.3 shows the median waiting time in the first half of 2020 was 12.2 weeks, which is 4.4 weeks higher than the median waiting times in 2019. The increase in median waiting times means that the overall waiting list for eye care continues to grow. As of May 2022, the waiting list for eye care has grown to 633,000 people, representing an increase of 44% since February 2020 (see Chart J.4).
- In 2017-18, around 452,000 cataract surgery procedures were undertaken in England and 20,000 in Wales.[292] This is equivalent to 799 cataract surgeries per 100,000 persons in England and 631 cataract surgeries per 100,000 persons in Wales.

Chart J.3: Consultant-led referral to treatment median waiting times, eye care, 2019-22



Source: NHS (2022).[293]

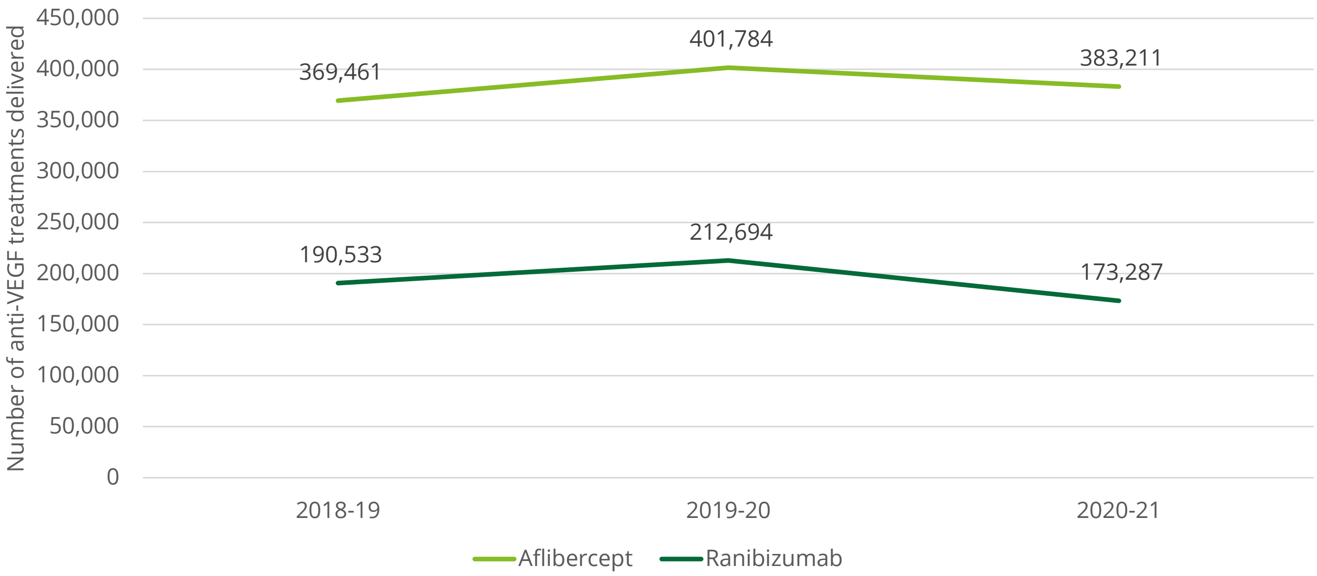
Chart J.4: Waiting list for eye care, 2019-22



Source: NHS (2022).[293]

- There are four anti-VEGF treatments that are licensed in the UK which include aflibercept, ranibizumab, brolucizumab and faricimab.[294] In addition, some centres have used bevacizumab, which is not licensed for intra-ocular use, for the treatment of eye disease.
- The total cost of four anti-VEGF treatments (excluding faricimab) in England in 2020-21 was £334.4m (US$482.7m).[295]
- The demand for treatment has and will continue to grow in the UK as most treated conditions, particularly AMD, are highly age-dependent.[262] With an ageing population, the number of individuals at risk of these conditions and who may require anti-VEGF treatment is likely to increase over time. Furthermore, within each condition, there is an increasing spectrum of indications. For example, neovascular AMD is being treated at an earlier stage in people with better VA than in the past and clinical trial data has shown proliferative diabetic retinopathy may be successfully delayed with anti-VEGF treatment.[53] For these reasons, the demand for sight-saving treatment will continue to rise in the UK.
- Trend data from the last 5 years indicated that prior to the COVID-19 pandemic, the number of anti-VEGF treatments (particularly for aflibercept and ranibizumab) was increasing (Chart J.5).[296] However, their use decreased in 2020-21, which is likely to be caused by the impact of the pandemic, which saw outpatient services (the setting where anti-VEGF treatments are delivered) fall across the UK.

Chart J.5: Number of anti-VEGF treatments delivered, by treatment-type, England, 2018-21



Source: NHS England (2021). Note that Brolucizumab and faricimab are not included in the chart as no trend data exists for these treatments.

J.3. Eye health outcome findings

UK - Eye health outcome key findings	
Number	**Key finding**
KF8	**The quality of eye health services for cataract surgery is high**, as indicated by the **low complication rates** (1.1% of cataract operations were affected by PCR) and **low rates of VA loss** (0.9% of cataract operations).[292]
KF9	**Approximately 3% (2.2 million people) of the UK population have vision impairment or blindness.** The majority of these people live with mild vision impairment (1.4 million people), followed by moderate vision impairment (490,000 people) and severe vision impairment (blindness; 292,000 people).[297]
KF10	The **leading cause of vision impairment is cataract**, with **over 713,000 people** living with this condition in the UK. The second highest prevent eye condition is glaucoma (708,000 people) followed by late-stage AMD (640,000 people).

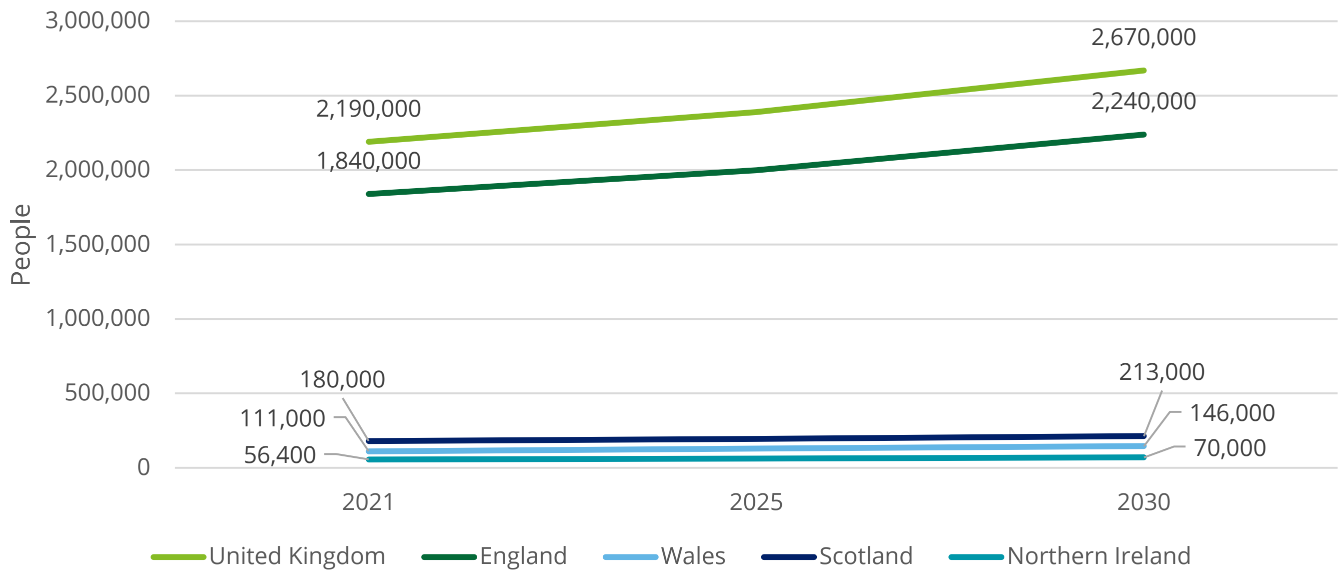
J.3.1. Quality of eye health services

- The quality of the UK's eye health services is proxied through cataract postoperative surgical outcomes.
  - There are two primary outcome indicators for cataract surgical quality are audited in the UK. The first outcome indicator is the rate of posterior capsule rupture (PCR). In an adverse operative event, PCR is relevant because it results in a significantly higher risk of harm to the eye and may impact recovery of vision. The second outcome indicator is VA loss related to the surgery.
- Based on the latest National Ophthalmology Data Audit Report (which collects annual data on the quality of cataract surgery performed in England and Wales with the aim to improve the care provided to people), [298] 91.0% of eyes which underwent cataract surgery recorded a 'good' postoperative VA (required VA to drive).
  - The overall consultant surgeon VA loss rate was 0.9% of all eyes which underwent cataract surgery.
  - The overall consultant surgeon PCR rate was 1.1% of all eyes which underwent cataract surgery.
- The VA loss rate and PCR rate between 2017 to 2021 has remained constant (0.9% and 1.1% respectively). This indicates that consistently good practices have been adopted by consultant surgeons since the inception of the National Ophthalmology Database Audit.

J.3.2. Prevalence of vision impairment and blindness

- Between 2013-21, the prevalence of vision impairment and blindness has remained relatively stable, accounting for approximately 3% of the total UK population.[299] Based on estimates derived from the RNIB (the UK's lead charity serving those with vision impairment), 1.93 million people had vision impairment (VA of $\geq$3/60) and blindness (VA < 3/60) in 2013, compared to 2.2 million people in 2021. Of the people with vision impairment or blindness in 2021, 1.4 million people (64%) have mild vision impairment, 490,000 people (22%) have moderate vision impairment and 292,000 people (14%) have severe vision impairment/blindness.[300]
- From 2021 to 2030, it is estimated that total number of people with vision impairment of blindness in the UK will increase to 2.7 million (accounting for 3.9% of the UK population), of which, 2.2 million people are in England, 312,000 people are in Scotland, 146,000 people are in Wales and 70,000 are in Northern Ireland (Chart J.6).[300]
- The increase in prevalence is likely to be driven by the UK's ageing population who are more likely to experience vision impairment.[300] Further, vision impairment is strongly linked to certain chronic conditions such as diabetes and lifestyle factors including obesity, the rates of which are both increasing in the UK.

Chart J.6: Projected estimates of vision impairment and blindness in the UK, disaggregated by nation, 2021, 2025, 2030



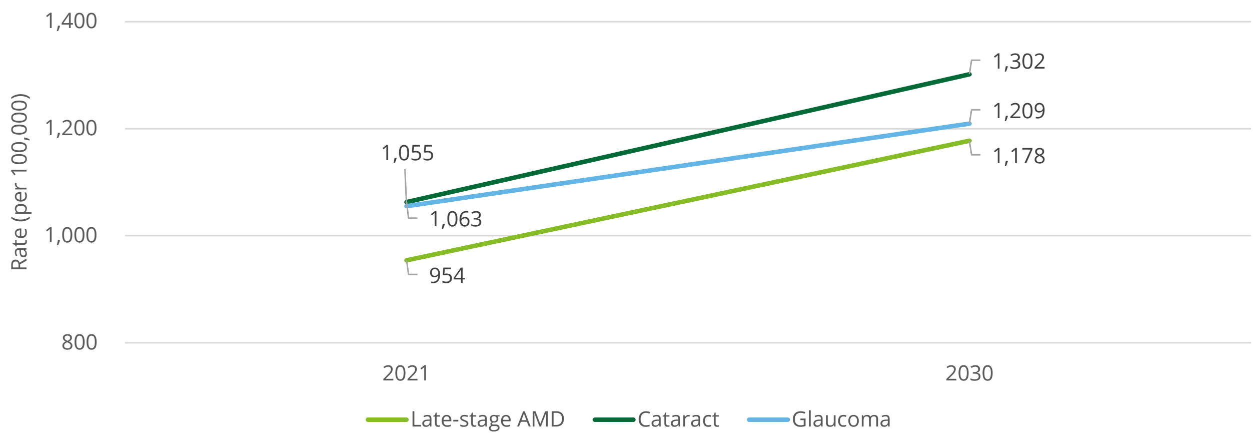
Source: RNIB Data tool (2021).[300]

- In comparison to age-standardised prevalence estimates derived from the Global Burden of Disease Study, the prevalence of vision impairment (VA $\geq$3/60) and blindness (VA <3/60) is 2.9% (12.0 million people) in 2020.[112] Of the people with vision impairment or blindness in 2020, 6.7 million people (56%) have moderate to severe vision impairment (VA between <6/18 to $\geq$3/60), 4.6 million people (39%) have mild vision impairment (VA between <6/12 and $\geq$6/18) loss and 644,000 people (5%) have blindness (VA <3/60).[112]

J.3.3. Prevalence of specific eye diseases

- The projected prevalence rate (per 100,000 persons) of late-stage AMD, cataract and glaucoma is expected to increase across the UK as shown in Chart J.7.[112]

Chart J.7: Projected prevalence rate (per 100,000) persons of late-stage AMD, cataract and glaucoma in the UK, 2021 to 2030



Source: RNIB Data Tool (2021).[300]

Appendix K: Country data report: United States

United States (US) – Country Fast Facts

Data availability: **Good**

Data quality: **Good**

National profile

High income country

Population: 331.9 million

GDP: US$23.0 trillion

GDP per capita: US$69,269

Source: US Census Bureau (2022); EA (2022)

Population age profile

Prevalence of vision loss

3% of the US population have vision loss or blindness

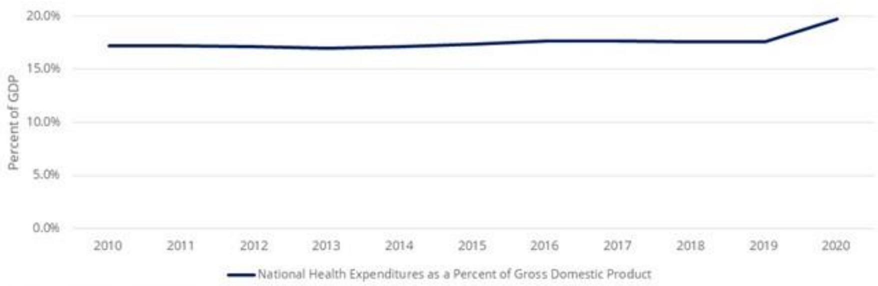
The total number in persons:

12.0m

Source: Global Burden of Disease (2020). Reported as age-standardised prevalence estimates.

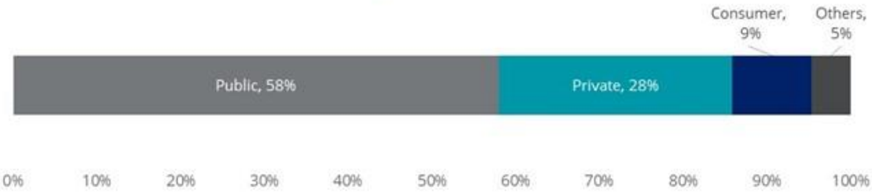
Health system at a glance

- The US healthcare system is a mix of public and private healthcare providers. The federal government provides funding for the national Medicare (a medical insurance program for people over 65 and certain people with disabilities under the age of 65) and Medicaid (an assistance program for low-income patients' medical expenses) programs.
- The Affordable Care Act includes coverage for paediatric vision care as one of the essential health benefits. For children under the age of 19, vision coverage is included in individual health insurance plans, which partially covers the cost of vision screening (basic testing to identify problems with vision), eye exams (testing for specific eye diseases) and glasses to correct vision problems.
- Total health expenditure has recently **increased** from an average of ~17% of GDP between 2010 to **about ~20% in 2020.**



Source: Centers for Medicare & Medicaid Services (2022).

- Health expenditure in the US is largely publicly funded through national programs such as Medicare and Medicaid (58%). Private funding (mainly private health insurance) is the second largest contributor to health expenditure (28%).



Source: Centers for Medicare & Medicaid Services (2022).. Note: Public includes Medicare, Medicaid and other government-funded health insurance programs; other payers includes investment costs into infrastructure and research.

It is projected that during the next three decades, the population of adults with vision impairment and age-related eye diseases will double because of the rapidly ageing US population, alongside with the epidemic of diabetes and other chronic conditions.

Source: Centers for Disease Control and prevention (2020)

KEY FINDINGS

For the United States

1	Between 1990 and 2020, the prevalence of vision impairment and blindness has **remained relatively stable**, **accounting for approximately 2.9% of the total US population.** However, it is projected that the population of adults with vision impairment and age-related diseases will **double** over the **next three decades** due to the rapidly ageing population, with the **leading cause of vision impairment being cataract**.
2	In 2017, eye health expenditure was estimated at **US$53.5 billion** in the US, accounting for **1.6% of the total healthcare expenditure** in that year. The majority of eye health expenditure (58%; $30.8 billion) is directed to those aged 65 and over.
3	For people with **health insurance coverage** (91.4% of the US population), the **type** and **comprehensiveness** of the health insurance determines the **availability** and **cost of eye care services**. For the remaining 8.6% of the US population that do not have health insurance, **eye care services are paid OOP**, although subsidies are available for those who have specific eye conditions or are part of low-income households.
4	The *National Eye Institute Strategic Plan: Vision for the Future* is the nation's plan which outlines the opportunities for stakeholders to drive innovative research, inspire and train the ophthalmic workforce and translate clinical practice to improve patient outcomes and quality of life and eliminate sight loss.
5	The US is experiencing a **shortage of ophthalmologists**, which will impact the timely access to ophthalmological care across the country. There is scope to empower the optometry and ophthalmic medical technician workforce to take on additional responsibilities of ophthalmic care.

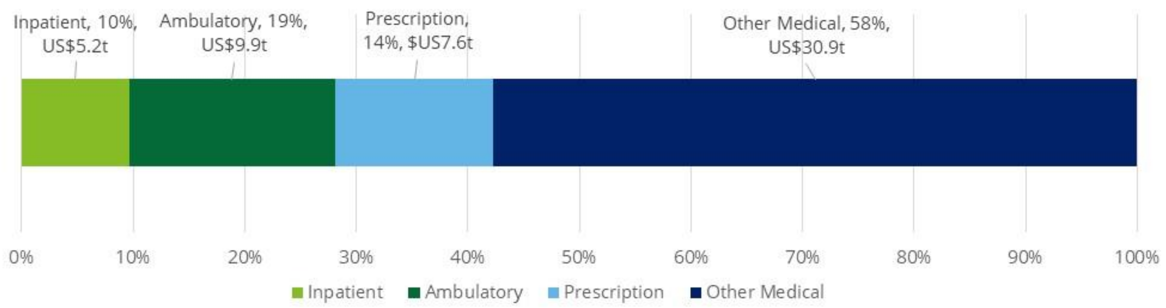
K.1. Eye health investment findings

US - Eye health investment key findings	
Number	**Key finding**
KF1	In the past decade, healthcare expenditure as a proportion of GDP has increased from **17.2% (US$2.6 trillion) in 2010 to 19.4% ($US4.1 trillion) in 2020.**[301] In 2017, eye health expenditure in the US was estimated to total **US$53.5 billion,** which is equivalent to **1.6% of the total healthcare expenditure** in that year.[302]
KF2	Eye health expenditure is **mainly concentrated in older people**, with **58% (US$30.9 billion)** of total eye health expenditure being directed to those **aged 65 and above.** This is consistent across all eye health components, including inpatient, ambulatory, prescription, and other medical costs.
KF3	For people with **health insurance coverage (91.4% of the US population),** the **type and comprehensiveness** of the **health insurance** determines the **availability and cost of eye care services.**[303] Eye care services are included in Medicare and Medicaid – programs that the US government funds for those aged 65 and older, certain people with disabilities under the age of 65, and low income households.[304] For the remaining 8.6% of the US population that do not have health insurance, eye care services are **paid OOP,** although, some subsidies are available for those from disadvantaged populations.
KF4	There are approximately **3 ophthalmologists, 12 optometrists and 20 ophthalmic medical technicians per 100,000 persons** in the US in 2021.[305, 306, 307]
KF5	The National Eye Institute, an agency of the US Department of Health and Human Services, is dedicated to prolong and protrct the vision of the American people. In 2021, the National Eye Institute released the ***National Eye Institute Strategic Plan: Vision for the Future,*** which highlights opportunities to **drive innovative research, inspire and train the ophthalmic workforce and translate clinical practice to improve patient outcomes.**[308]

K.1.1. Eye health expenditure

- From 2010 to 2020, the overall health expenditure as a percentage of the US' GDP has increased from 17.2% (US$2.6 trillion) to 19.4% ($US4.1 trillion); due in part to population growth, the growth in the size of the US's ageing population and more recently, in response to the COVID-19 pandemic.[301]
- Based on 2017 data (the latest analysis undertaken by the Centers for Medicare and Medicare Services), the US spent US$53.5 billion on eye health, accounting for approximately 1.6% of the total health expenditure in that year.[301]
  - Of the US$53.5 billion spend on eye health, the majority of the costs (58%; US$30.8 billion) was spent on medical costs which includes medical equipment such as eyeglasses, contact lenses, and other ophthalmic products, medical care provided in the home, ambulance services and dental care. The next largest cost were for ambulatory care (19%; US$9.9 billion) which includes outpatient care, specialist care and optometry care, followed by prescription (14%; US$7.6 billion) and inpatient costs (10%; US$5.2 billion; Chart K.1).

Chart K.1: Eye health expenditure, US, 2017, by cost categories



Source: Centers for Disease Control and Prevention (CDC) (2017).[302]

- Of the US$53.5 billion spent on eye health, the largest proportion of costs were directed to those aged 65+ (58%; US$30.9 billion), followed by those aged 19-64 (40%; $21.2 billion) and ages 0-18 (3%; US$1.4 billion). Those aged 65+ and above also incurred the highest level of expenditure across all four cost categories – medical care, ambulatory care, prescription and inpatient care (Chart K.2).

Chart K.2: Eye health expenditure, US, 2017, by cost category and age group

Source: CDC (2017).[302]

- The US healthcare system is a **mixed system**, where publicly financed programs such as Medicare (for adults aged 65 and older and certain people with disabilities under the age of 65) and Medicaid (for low-income adults, children, pregnant women, elderly adults and people with disabilities) coexists with privately financed (private health insurance plans) market coverage.[309] There are four parts of Medicare which cover a varying number of services:
  - Part A provides inpatient/hospital coverage. Eye care services are not covered by Medicare in this part.
  - Part B provides outpatient/medical coverage, such as eye procedures including cataract surgery.
  - Part C provides an alternative way to receive Medicare benefits through a Medicare Advantage Plan, which entitles a person to receive Medicare coverage from a private health plan that contracts with the federal government.
  - Part D provides prescription drug coverage including ophthalmic drugs.[310]

- In terms of payers, health insurance constitutes the majority of the US' total health expenditure (US$4.1 trillion). In 2020 (the latest available data), 68% (US$2.8 trillion) was financed through health insurance (which includes government funded insurance through Medicare and Medicaid, private health insurance and other health insurance programs), 18% (US$733 million) is financed through other third-party payer programs and public health activity, 9% (US$389 million) is financed through consumers (i.e., OOP expense) and 5% (US$193 million) is dedicated to investments (i.e., structures, equipment, or research).[311] The coverage, both in the availability and affordability of eye care services in the US is heavily reliant on an individual's health insurance plan.

K.1.2. Affordability of eye health services

- Eye health services are funded through a variety of sources, as outlined in Section K.1. For people with some form of health insurance coverage (91.4% of the US population; 303.4 million people), the type and comprehensiveness of the health insurance determines the availability and cost of eye care services.[303]
- For people with public health insurance coverage through Medicare (18.4% of the US population; 59.8 million people), the following services are and are not covered:
  - Routine eye exams and the cost of corrective lenses (glasses or contact lenses) are not covered
  - Medicare holders enrolled in Part A and Part B are eligible for an annual glaucoma screening for people with diabetes, with a family history of glaucoma, who are African American over age 50, and who are Hispanics aged 65 and older; eye procedures such as cataract surgery involving implantation of an intraocular lens.[312]

  - Medicare holders enrolled in Part D (drug coverage) may have all or some of their ophthalmic drugs covered by their insurance plan.
- Medicaid is a welfare program for certain low-income residents who meet the eligibility criteria set by the federal and state government. For people with public health insurance coverage through Medicaid and Children's Health Insurance Programs (CHIP; 17.8% of the US population; 57.9 million people)[313], the following services are and are not covered:
  - Under the Early and Periodic Screening, Diagnostic, and Treatment Program of Medicaid, eye exams and corrective lenses (glasses and contact lenses) are covered for children under 21 years. States determine how frequently these services may be accessed and the level of Medicare benefits received.
  - Some states cover the cost of eye services for the adult population such as glaucoma screening, and a proportion of the cost of cataract surgery, doctor care and the hospital stay.
- For people with public health insurance coverage through Veterans Affairs or Civilian Health and Medical Program of the Department of Veterans Affairs (0.9% of the US population; 3.0 million people), some benefits include partial coverage of the cost of eyeglasses and procedures such as LASIK.[314]
- The majority of the US population have private health insurance (66.5% of the US population; 216.5 million people). For people with a private health insurance plan, the type and comprehensiveness of the health insurance determines the affordability of eye care services.
- For the remaining 8.6% of the US population (28.0 million people) who do not have health insurance, eye care services are paid out-of-pocket (OOP). In the absence of support, some US residents in this category would not access eye health services in a timely manner. This is particularly concerning in the context of vision, given that once sight is lost, such as through glaucoma, it cannot be restored.

Table K.1: Summary of preventative and treatment services covered by public funding

	Private/public health plan	Uninsured
Eye screening services	Partial or fully subsided if the service is included as a benefit in a person's private/public health plan.	This is an OOP cost. However, some subsides may be available for those from low-income backgrounds or who have specific eye conditions.
Corrective lenses (glasses and lenses)	Partial or fully subsided if the service is included as a benefit in a person's private/public health plan.	This is an OOP cost. However, some subsides may be available for those from low-income backgrounds or who have specific eye conditions.
Medication (including eye drops)	Partial or fully subsided if the service is included as a benefit in a person's private/public health plan.	This is an OOP cost. However, some subsides may be available for those from low-income backgrounds or who have specific eye conditions.
Intravitreal injections (e.g., Anti-VEGFs treatments)	Partial or fully subsided if the service is included as a benefit in a person's private/public health plan.	This is an OOP cost. However, some subsides may be available for those from low-income backgrounds or who have specific eye conditions.
Eye surgeries	Partial or fully subsided if the service is included as a benefit in a person's private/public health plan.	This is an OOP cost. However, some subsides may be available for those from low-income backgrounds or who have specific eye conditions.

KEY: Not publicly funded | Publicly funded for eligible persons | Publicly funded for the whole population

Source: Medicare Government (2022).[301]

K.1.3. Eye health workforce

- The eye care workforce in the US is made up of a multidisciplinary team of health professionals, including ophthalmologists, optometrists and ophthalmic medical technicians (assist ophthalmologists by performing ophthalmic clinical functions such as performing eye exams, administer eye medications, and instruct the patient in care and use of corrective lenses), opticians, and nurses who have undergone additional training in eye care such as ophthalmic nurses.
- Table K.2 provides a summary of the workforce size for ophthalmologists, optometrists and ophthalmic medical technicians in 2021 (the latest available data).

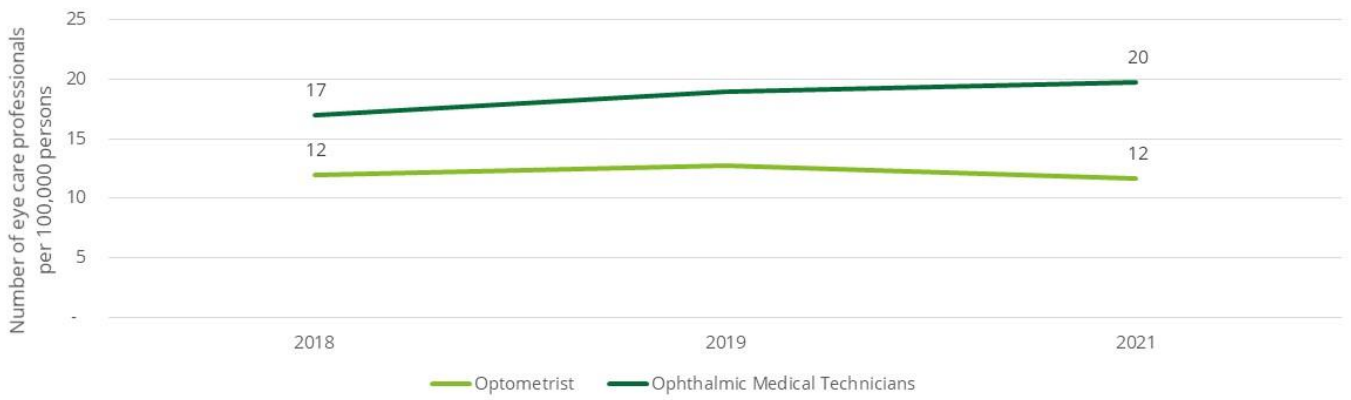
Table K.2: Eye health workforce estimates across the US, 2021

Category	Estimate	Estimate density (per 100,000)	Source
Optometrists	38,720	12	U.S Bureau of Labour Statistics (2021 estimates)[315]
Ophthalmologists	11,610	3	U.S Bureau of Labour Statistics (2021 estimates)[316]
Ophthalmic Medical Technicians	65,700	20	U.S Bureau of Labour Statistics (2021 estimates)[317]

Source: As indicated in the table.

- From 2018 to 2021, the number of optometrists per 100,000 persons has remained relatively stable (approximately 12-13 optometrists per 100,000 persons).[318] However, the number of ophthalmic medical technicians has increased from 17 to 20 per 100,000 persons during the same period (Chart K.3).
- The American Association of Medical Colleges (AAMC) has reported shortages in the supply of ophthalmologists across the US. The Association predicted that eye care will have the largest workforce shortage among all surgical specialises by 2025.[319] This is not a new issue in the US asthe number of ophthalmologists have been decreasing in the past two decades. The situation is exacerbated by the fact that many ophthalmologists are approaching retirement age over the next decade.[320] To address this issue, the US can consider empowering the optometrist and ophthalmic medical technician workforce to take on more ophthalmic care responsibilities, and to better complement potential shortages of ophthalmologists.

Chart K.3: Eye workforce in the US, 2018, 2019, 2021



Source: US Bureau of Labor Statistics (2018, 2019, 2021). Note: Prior to 2021, all physicians including ophthalmologists were grouped into one category and therefore the number of ophthalmologists were not able to be disaggregated from this summed figure.

K.1.4. Eye care strategy, policy and infrastructure

- The National Eye Institute (NEI) - an agency of the US Department of Health and Human Services and one of the institutes and centres of the US National Institutes of Health (NIH) - is the nation's leader in driving vision research, with a focus to eliminate s loss and improve quality of life for Americans.[321] Vision research is supported by the NEI through research grants and training awards made to scientists.[322]
- In 2021, the NEI released the ***National Eye Institute Strategic Plan: Vision for the Future***, which identifies emerging opportunities for internal and external stakeholders to work together to drive innovative research, inspire and train the ophthalmic workforce and translate clinical practice to improve patient outcomes.[323] The NEI's strategic plan includes 7 areas of emphasis that represent challenges impacting multiple facets of vision science in the US. These include genes, disease mechanisms, biology and neuroscience of vision, immune system and eye health, regenerative medicine, data science, individual quality of life and public health and disparities research.

- The NEI also has its own dedicated Eye Clinic, which hosts clinical research studies and trials to find new ways to prevent, diagnose and treat eye disease and sight loss.[324] This is in addition to the other 9 eye institutes/hospitals which specialise in the diagnosis, treatment and management of blindness and vision impairment across the US.
- In the Federal FY22 budget, $863.9 million in funding was allocated to the NEI, highlighting the federal government's commitment through the NEI to prevent blindness and improve the quality of life for those living with vision impairment. The budget funding towards the NEI over the last several financial years is shown in Table K.3. NEI has consistently allocated 2% of its budget to the NEI in the last 4 financial years.[325]

Table K.3: Federal funding allocation for NEI, FY2019-22

	FY2019	FY2020	FY2021	FY2022
NIH budget ($ million)	39,080.0	41,680.0	42,930.0	44,960.0
NEI funding ($ million)	796.5	824.1	835.7	863.9
NEI funding as a proportion of NIH budget (%)	2.0%	2.1%	2.1%	2.2%

Source: National Alliance for Eye and Vision Research (NAEVR/AEVR) (2022).[325]

K.2. Eye health output findings

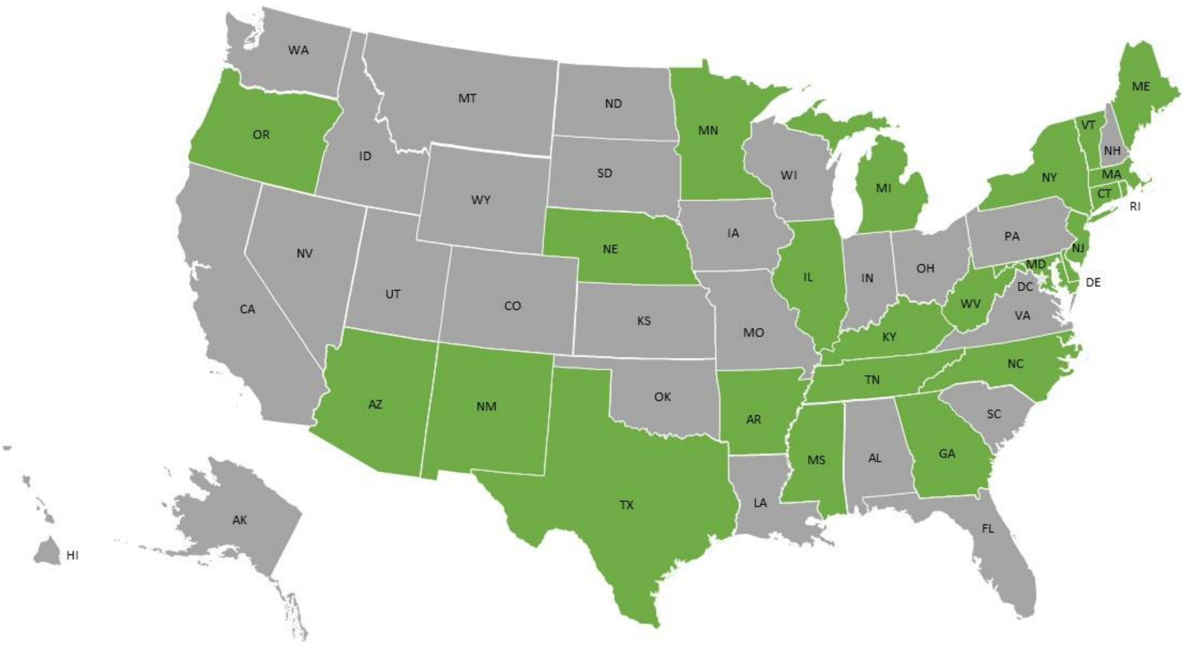
US - Eye health output key findings	
Number	**Key finding**
KF6	**Routine eye screening services are widely available to the US population.**[326] However, the type and comprehensiveness of the health insurance determines the availability and cost of eye services. There are state-based and national programs (run by non-for-profit and charity organisations) that **offer free or low-cost eye exams and glasses for disadvantaged subpopulations.**[327]
KF7	**The Affordable Care Act (ACA) includes coverage for paediatric vision care as one of the essential health benefits.** Approximately 11% (35 million people) of the US population are enrolled in coverage related to the ACA. For children under the age of 19, vision coverage is included in individual health insurance plans, which partially covers the **cost for eye exams, vision screening and glasses to correct vision problems.**[326]
KF8	The Centre for Medicare and Medicaid Services captures anti-VEGF utilisation data which is not publicly available data. However, an analysis of **Medicare Part B Beneficiaries** across the US found that over **2.5 million intravitreal injections were performed in the outpatient setting** in the 2015 calendar year.[328]

K.2.1. Availability and utilisation of eye screening services

- Across the US, routine eye screening services are available to the population. However, the type and comprehensiveness of a person's health insurances determines the availability and cost of eye exams. Unlike paediatric vision care which is considered an essential health benefit under the ACA, the ACA does not require insurers to provide routine eye exams for adults.[326]
  - It is well documented in the literature that the lack of health insurance is associated with lower health care utilisation in general and with lower ocular health care utilisation in particularly.[329,330] Analysis of the National Health Interview Survey (n=289,442) found that insured adults compared to those who were partially insured or not insured had lower eye care utilisation rates (39.4%, 27.4% and 11.3%) within a 12-month period.[331]
- There are national programs available across the US which offer free or low-cost eye care, although there is limited information on the size and uptake of these programs.[332] These programs have specific requirements such as having low income or a higher risk of certain eye diseases as outlined below:
  - **VSP Eyes of Hope** provides children and adults with no-cost eye care and eyeglasses. This program is for people with limited income who don't have health insurance
  - **Mission Cataract USA** offers free cataract surgery to people of all ages who can't afford the procedure.

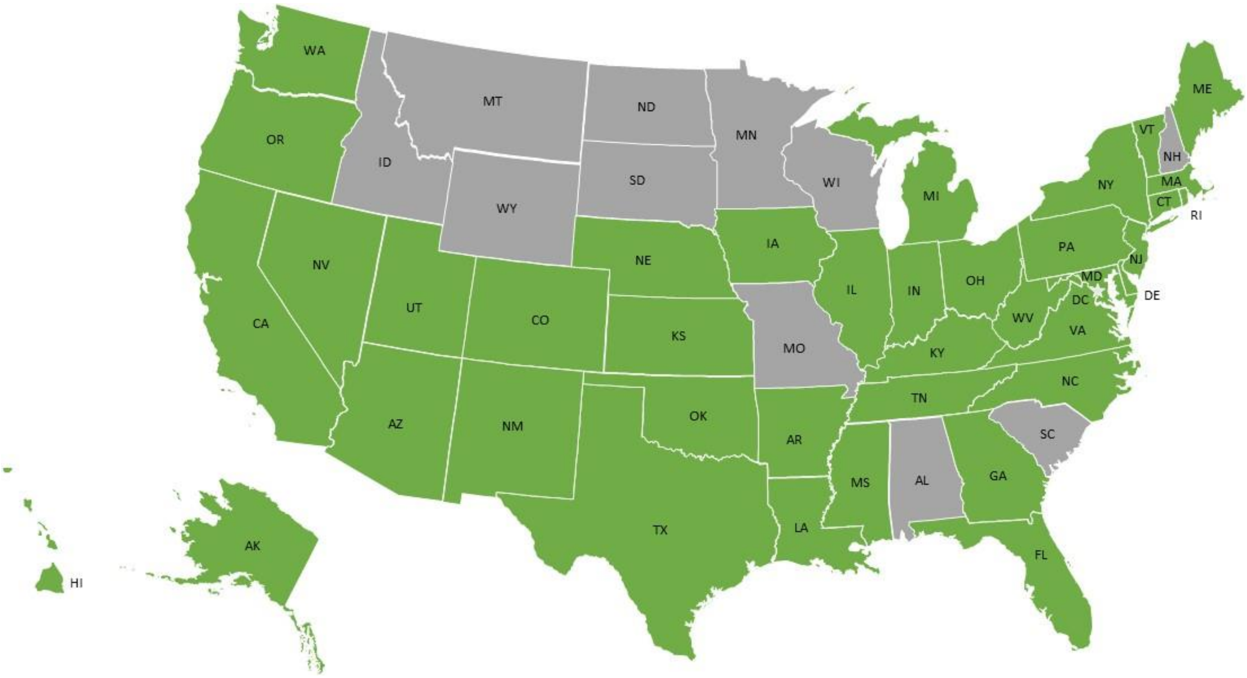
  - The **American Glaucoma Society** (AGS) helps people with low incomes or no insurance get glaucoma surgery through their AGS Cares program.
- For children under the age of 19, vision coverage is included in individual health insurance plans, which partially covers the **cost for eye exams, vision screening and glasses to correct vision problems.**[326] The specific paediatric vision services that must be covered by health insurance plans depends on the benchmark plan each state uses. In most states, the benchmark plan's paediatric vision coverage includes one annual eye exam and one pair of glasses per year.
  - Analysis from the 2016-17 National Health Interview Survey that children aged 3-5 with private health insurance (66.7%) were more likely than both children with public coverage (61.2%) and uninsured children (43.3%) to have ever had a vision test. Eye care utilisation rates may be enhanced if progress is made towards increasing the number of children with health insurance, or a greater proportion of costs of services are subsidised for children and their families.
- Across the US, 54% of states mandate vision screening for preschool-aged children (Chart K.1) and 78% of states require vision screening for school-aged children (Chart K.2).[333] Note that pre-school/school-age vision screening is only required if a public or charter school (publicly funded but operate as independent groups) offers that program, in which the child will be screened upon entry. Some states allocate/provide funding for vision screening.

Figure K.1: States requiring vision screening for **pre-school** children, US



Source: Prevent Blindness (2020). Note: Green = legislation, rule, code or requirement for vision screening or an eye exam.

Figure K.2: States requiring vision screening for **school-aged** children, US



Source: Prevent Blindness (2020). Note: Green = legislation, rule, code or requirement for vision screening or an eye exam.

- There is no national diabetes eye check programme across the US. However, the Centres of Disease Control and Prevention (CDC) acknowledges the importance of promoting eye health services for people with diabetes. People who have diabetic retinopathy and have Medicare Part B benefits included in their health insurance plan only pay 20% of their annual eye exam costs.[334]
- The American Optometry Association recommends that adults aged 18 to 64 years who are asymptomatic or at low risk of sight loss to get their eyes tested biannually. For at-risk adults, it is recommended they get their eyes tested annually, or as recommended by their treating physician. For those 65 years and older, it is recommended they receive annual eye tests or as recommended by their treating physician.[335] Despite this guidance, there is evidence that greater education and awareness is required to increase the uptake of timely screening services.
  - In 2018, a survey (n =1,000) conducted by the American Optometry Association found that 55% of Americans had not received a comprehensive eye exam in the past 2 years.[336] The proportion of Americans who did not receive a comprehensive eye exam in the past 2 years increased to 58% in 2020.[337]

K.2.2. Availability and utilisation of eye treatment services

Eye health service utilisation is proxied through the following data indicators: cataract surgery, and anti-VEGF treatment uptake. National data on the number of cataract surgeries and utilisation rates of anti-VEGF treatment is not publicly available. However, findings from large-cohort studies can be used to derive insights on these proxied indicators.

- In 2014, the rates of routine cataract surgery among Medicare Beneficiaries were estimated at 769 per 10,000 beneficiaries aged 65 years or older. Trends among Medicare beneficiaries are likely to reflect national trends, given that the majority of cataract surgeries (>80%) are covered by Medicare.[338]
- There are four anti-VEGF treatments that are licensed in the US which include aflibercept, ranibizumab, brolucizumab and faricimab. Faricimab is the latest treatment to be approved by the U.S. Food and Drug Administration. Some centres have also used bevacizumab, which is not licensed for intra-ocular use, for the treatment of eye disease.
  - The Centre for Medicare and Medicaid Services captures anti-VEGF utilisation data which is not publicly available data. However, an analysis of **Medicare Part B Beneficiaries** across the US found that over **2.5 million intravitreal**

injections were performed in outpatient settings in 2015.[328] Of this, 34% were for aflibercept, 27% were for ranibizumab and 45% were for bevacizumab.

- North America is the biggest consumer of anti-VEGF treatments globally. The increase in disease prevalence, rising consumer awareness, proactive government measures, technological advancements and improvements o the healthcare infrastructure drive the regional market.[339]

K.3. Eye health outcome findings

US - Eye health outcome key findings	
Number	Key finding
KF9	**Approximately 3% (12.0 million people) of the US population have sight loss or blindness.** The majority of these people live with moderate-severe vision impairment (6.7 million people), followed by mild vision impairment (4.6 million people) and severe sight loss (blindness; 644,000 people).[112]
KF10	By 2050, projection modelling estimates that **cataract will be the leading cause of vision impairment** in the US, affecting **11,730 per 100,000 persons,** followed by diabetic retinopathy (3,392 per 100,000 persons), glaucoma (1,421 per 100,000 persons) and age-related macular degeneration (1,138 per 100,000 persons).

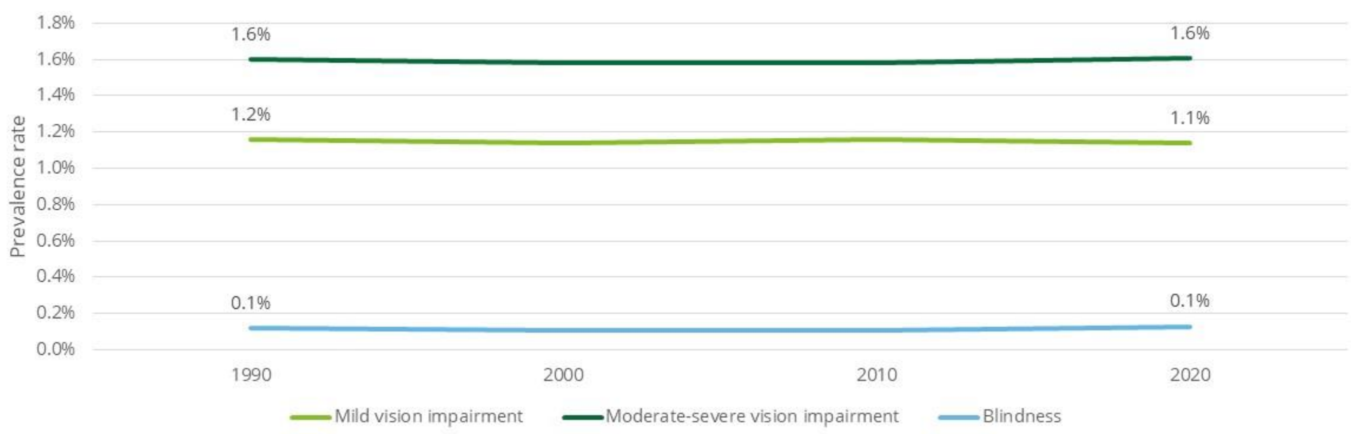
K.3.1. Quality of eye health services

- No data was available for the quality of eye health services.

K.3.2. Prevalence of vision impairment and blindness

- Based on the age-standardised prevalence estimates derived from the Global Burden of Disease Study, approximately 2.9% of the US population (12.0 million people) had vision impairment or blindness in 2020. The majority of these people live with MSVI (VA between <6/18 to >3/60; 1.6% of the population; 6.7 million people), followed by mild vision impairment (VA between <6/12 and >6/18; 1.1% of the population; 4.6 million people) and blindness (VA <3/60; 0.1% of the population; 644,000 people).[112]
- The age-standardised prevalence rates of mild, moderate-severe and blindness in the US from 1990 to 2020 is shown in Chart K.4. Over the last four decades, the prevalence rate for mild, MSVI and blindness have remained relatively stable.
- The prevalence of vision impairment (VA <20/40 but better than 20/200) and blindness (VA 20/200 or worse) for adults aged 40 years and above in the US has been estimated in a study using 6 large US-based population studies.[340] In 2015, the overall estimated prevalence of vision impairment and blindness was 2.14% (3.22 million people) and 0.68% (1.02 million people) respectively, for persons aged 40 years and older in the US.
- No prevalence estimates from primary sources were available for the US.

Chart K.4: Age-standardised prevalence rate of mild, MSVI and blindness in the US, 1990, 2000, 2010, 2020

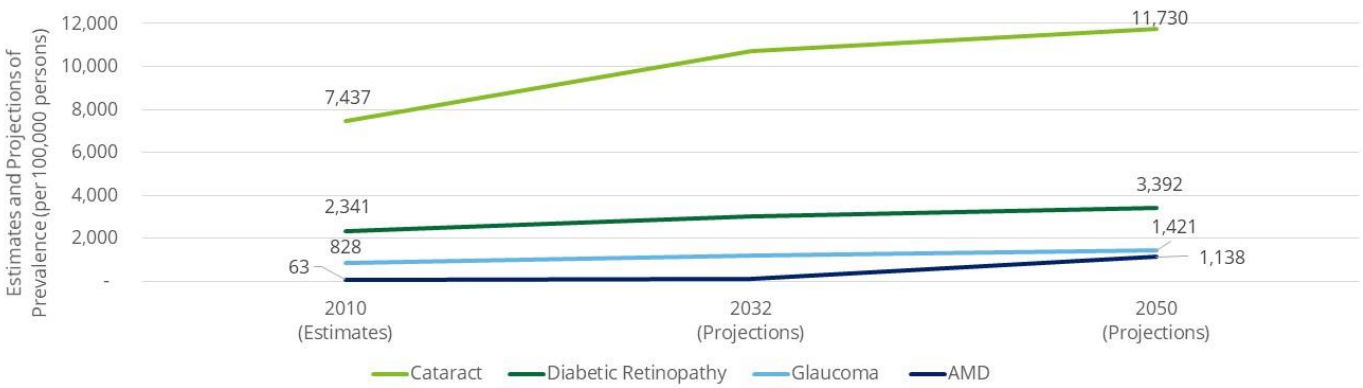


Source: IAPB (2020).[112]

K.3.3. Prevalence of specific eye diseases

- The CDC's Vision Health Initiative (VHI) was established to coordinate national efforts around preventing sight loss through eye diseases and to understand who is at highest risk for sight loss.[341]
  - In 2010, the top four most common eye disease in the US were cataract (24.4 million people; 7.4% of the population), diabetic retinopathy (7.7 million people; 2.3% of the population), glaucoma (2.7 million people; 0.8% of the population) and AMD (0.2 million people; 0.1% of the population) respectively.
  - The VHI has estimated that during the next three decades, the number of adults with vision impairment and age-related eye diseases will double because of the rapidly ageing US population. Further, the epidemic of diabetes and other chronic conditions will contribute to an increasing number of residents experiencing sight loss.
  - The VHI has projected that by 2050, cataract will be the leading cause of vision impairment in the US, affecting 11,730 per 100,000 persons (affecting a total of 45.6 million people). This is followed by diabetic retinopathy (3,392 per 100,000 persons; 13.2 million people), glaucoma (1,421 per 100,000 persons; 5.5 million people) and age-related macular degeneration (1,138 per 100,000 persons; 3.1 million people).[342]
- The estimated and projected prevalence rate (per 100,000 persons) for glaucoma, and age-related macular degeneration, diabetic retinopathy and cataract in the US is shown in Chart K.5.[342]

Chart K.5: Projected prevalence rate (per 100,000) persons of age-related macular degeneration, diabetic retinopathy, cataract and glaucoma in the US, 2032, 2050



Source: CDC (2020). Note: projections have been estimated from 2010 prevalence figures.

Appendix L: Country case study report: Nepal

Acknowledgment

Deloitte would like to acknowledge the sources of data received from stakeholders from the IAPB and the Nepal Netra Jyoti Sangh (NNJS). In particular, we acknowledge the expert advice and input from Dr. Saileh Mishra and Mr. Yuddha Sapkota.

Context

Nepal has a population of approximately 30 million people.[343] With a national annual GDP per capita of just over US$1,200, Nepal is a lower middle-income country according to the World Bank classification system.[343] Over the last decade, Nepal's total health expenditure as a share of GDP has been increasing consistently from 3.13% in 2000 to 4.45% in 2019,[344] reflecting increased investment into the nation's healthcare.

Nepal's eye health system has experienced significant improvements in the past four decades. In the 1970s, its eye health system was in rudimentary stages and there was limited data collection to highlight the prevalence of vision impairment and blindness across the country. The establishment of the NNJS as a non-government social welfare organisation was a turning point for the nation. In 1981, a large population-based survey of 39,887 Nepalese revealed the severity and prevalence of blindness in the country, which estimated that 0.84% (approximately 126,000 people) of its population were self-reported to be affected by blindness and vision impairment.[345] Findings from this study have led to the initiation of the Public Private Partnership model by the Nepalese government, creating appropriate settings for significant mobilisation of resources and support from the NGOs to address the needs of the Nepalese population living with vision impairment and blindness, as described in the following sections.[345]

Eye health service delivery

Prior to 1981, there was only one eye hospital, four eye departments in general hospitals, and seven ophthalmologists in the entire country.[345] As a result of limited resources and competing public health priorities, the government delegated responsibilities of eye care service delivery and coordination to NNJS (an NGO established in 1978 as the National Society for Comprehensive Eye Care).[345]

NNJS is the central body responsible for the coordination and provision of eye health service delivery across Nepal through various roles as shown in Table L.1. The continual efforts, focus and investments into eye health by NNJS and the Nepalese government has led to an increase in the number of eye health facilities and resources to diagnose, treatment and manage vision impairment and blindness in the community. By 2010, there were 20 dedicated eye hospitals, 19 eye departments, 63 primary eye care centres, and a total number of 147 ophthalmologists in Nepal. In 1999, Nepal signed the global initiative **Vision 2020: The Right to Sight**, a joint programme of the WHO and the International Agency for the Prevention of Blindness (IAPB) with the aim to eliminate avoidable blindness.

Table L.1: The role of NNJS in the provision of eye care service delivery in Nepal

Category	NNJS' roles	NNJS' programs
Infrastructure	Enable better communications and connection through a network of eye hospitals and eye care centres	-
Workforce	Manage and coordinate the eye care workforce by providing training	Ophthalmic Assistant Training Program
Resources	Mobilise internal and external resources	-

Category	NNJS' roles	NNJS' programs
Partnerships	Collaborate with the Government of Nepal and both national and international non-governmental organizations	Nepal Government-supported programs, including Free Cataract Surgery Camp Program, Presbyopic Glass Distribution Program, and Community School Eye Checkup Program.
Service availability / accessibility	Oversee and coordinate national eye health programs	National Eye Sight Program, national Trachoma Program, National Low Vision Program, National Program For Control Of Childhood Blindness In Nepal, Nepal REACH Program
Service affordability	Promote eye health facilities' self-sustainability; utilise cross-subsidisation of services	
Service quality	Evaluate and monitoring of the existing programs; quality control of eye services	Research and Monitoring Program
Health promotion	Involve active community participation	Eye Health Education Program

Source: NNJS (2022).[346]

Eye health outcomes

The population-based surveys conducted in the past three decades have identified significant improvements in eye health outcomes in Nepal. The prevalence of blindness had reduced from 0.84% in 1981 (n=117,600) to 0.35% in 2010 (n=93,400), representing a reduction of 58% during this period.[345] The decline in the prevalence of blindness has continued in the most recent decade. This is evidenced by a 2019 survey publication which estimated that the prevalence of blindness has decreased to 0.28% of the population.[347]

While the prevalence of blindness has decreased over time, the rate of vision impairment has increased during this period from 16% in 1981 to 20% in 2019. This is likely driven by the suite of policies, programs and investments which have focused on addressing blindness instead of mild to severe vision impairment. Future areas of focus should continue to address the needs of those living with mild to severe vision impairment, to ensure vision does not deteriorate and progress advanced stages of vision impairment or blindness. Data showed that blindness disproportionately affects more female and rural residents. Nepal should also dedicate efforts to better ensure there is equitable access to eye care for all Nepalese people.

Cataract is the largest cause of blindness in Nepal, accounting for 62.2% (n=~58,000) of the nation's blindness. This is followed by posterior segment eye disease (i.e., diseases of the retina, choroid and optic nerve; 16.5%), glaucoma (5.9%), corneal scar (5.2%), and uncorrected aphakia (3.4%).[345] However, Nepal's cataract surgical coverage rate has improved over time. The proportion of blind Nepal residents who have received cataract surgery has increased from 35% in 1981 to 85% in 2019.[345]

Compared to 1981, the prevalence of blindness caused by cataract and trachoma has decreased in 2010 by 76% (from 0.56% to 0.19%) and 75% (from 2.4% to 0.6%) respectively. This may be partly attributable to the NNJS-related eye programs including the National Eye Sight Program, National Trachoma Program, and National Low Vision Program. The number of cataract surgeries conducted has increased from 1,000 in 1981 to over 200,000 in 2010.

Enablers of eye health improvements

The combined learnings from eye health delivery and outcomes in Nepal have identified six enablers to improve eye health in the population. These include:

1. **Eye workforce development.** Nepal trains and utilises ophthalmic assistants (OA) as mid-level ophthalmic professional that requires a shorter training period (3 years) and can perform primary eye care services including eye examination, diagnosis of most eye diseases, and prescribing glasses. The training of 400 OAs have significantly enhanced efficiency and coverage of eye care services across Nepal including rural areas, leading to them being regarded as "the backbone of eye care services in Nepal".[348]
2. **Promotion of eye health awareness.** Nepal delivers a comprehensive eye health education and awareness program (Eye Health Education Program) to increase community awareness of eye disease prevention, early intervention and existing

eye care services. The program is conducted through various mediums including radio broadcast, text messaging, telefilms, banners, and brochures.

3. **Centres of Excellence.** NNJS is in the process of establishing a Centre of Excellence in each province. These Centres are envisaged to have the capabilities to deliver comprehensive eye care services as well as training, research, intraocular lens manufacturing, and eye bank and community program delivery. The Centres would also help support the delivery of subspecialist training.
4. **Novel service delivery models.** Nepal has implementeed novel methods to serve populations that have low eye care service accessibility. A prominent example is the surgical camps set up by NNJS in remote areas. Under this model, OAs provide eye screening and referral for people with cataract to hospitals to receive surgeries.
5. **Health insurance scheme.** The Nepalese Government recently rolled out a national health insurance policy to all Nepal provinces. Under this new policy, health insurance holders are able to receive free eye treatment surgeries at hospitals, free spectacles, and low-cost eye screening services. While the health insurance has a coverage of 80% in Nepal, the remaining low-income population (an estimated ~5.7 million people or 20% of the population) face cost barriers in accessing health insurance. If left unaddressed, they would have to continue bearing the full cost of eye health services.[349]
6. **Affordable and accessible cataract surgery**. Cataract surgery in Nepal is more affordable and accessible compared to other developing economies due the current cross-subsidisation approach (i.e., those who can afford surgery cross subsidise poorer residents), streamlined cataract surgery processes (resulting in short wait time of approximately 60-minutes), high productivity and the large talent pool of ophthalmologists and ophthalmic assistants.

Current challenges and barriers

While Nepal has achieved significant improvements in eye care delivery and outcomes over the last several decades, there remains scope to reduce barriers to eye care access and improve patient outcomes. This includes:

- Eye care services is at present not integrated into government health system, resulting in efficiency losses (due to the potential duplication of eye services). The current model is also not sustainable in the long term due to a potential over-reliance on foreign aid. This indicates the need to transition to greater integration with other government health services.
- Nepal is a mountainous country which creates a barrier for people to travel to other regions in order to access eye care services. Despite recent observed improvements in the rate of performed cataract surgeries in the country, the rate varies considerably among different geographic areas (e.g., 37% in Narayani to 94% in Bagmati). This variation is consistent with the average income levels of these provinces.
- Despite the implementation of educational programs such as the Eye Health Education Program, there remains to be low awareness of NNJS and its services that contribute to low uptake of available NNJS eye health services (informed by stakeholder interview).
- A low proportion of the population access eye creening services. This has resulted in low awareness and treatment of common eye conditions such as refractive error. If left untreated for a prolonged period, this may lead to an increased risk of more severe eye conditions in the future.
- While there have been improvements to the cataract surgical coverage rates, Nepal's cataract post-operative outcomes are lower than other advanced countries. 64% of completed cataract surgeries achieved VA 6/18 (classified as 'moderate', less than mild vision impairment). This is a lower proportion compared to the UK, where 91% of eyes which underwent cataract surgery recorded a 'good' postoperative VA of 6/12.

Lessons learnt

This case study on Nepal's approach to eye health and care has highlighted several key lessons to improve eye outcomes. These include:

1. **The importance of data collection**. The 1981 population-based survey is a significant driver for the actions, investments, and resource mobilisation in eye health. Nepal has also subsequently undertaken addition population-based surveys in 2010 and 2022 to track progress. In the absence of data, countries may not be able to direct their resources to the best efficient use.
2. **Workforce expansion.** The introduction of OAs as mid-level ophthalmic professionals has helped to improve the accessibility and availability of eye services across Nepal.

3. **Partnership with NGOs**. For low to middle income countries with limited resources, public-private-NGO partnerships can play a vital role in addressing gaps in eye care services and enabling the provision of capability building supports to the eye health workforce.
4. **Inclusion of eye care services in national insurance.** The inclusion of eye health in the universal healthcare policy means that financial constraint / affordability is not a barrier for 80% of Nepalese residents who have health insurance.[350] This improves the accessibility of eye care services.
5. **Novel service delivery models**. In countries with large rural/remote areas or natural geographic barriers, eye health service accessibility is an issue for a section of the population. Novel service delivery models such as surgical camps allow tailored solutions for population cohorts who live in disadvantaged areas.

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Limitation of our work

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